“Where Ignorance is Bliss, ’tis Folly to be Wise”: Transparency in Contests*

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Abstract

Increasingly, lobbying groups are subject to transparency requirements, obliging them to provide detailed information about their business. We study the effect this transparency policy has on the nature of lobbying competition. Under mild conditions, mandated transparency leads to an increase in wastefulness of lobbying competition and a decline in expected allocative efficiency. Hence we identify a negative side-effect of transparency policy, which also has implications for various other fields such as political campaigning or firm competition.

Keywords: Transparency Policy, Rent-seeking Contests, Information Disclosure, Value of Ignorance

JEL-Classification: D72, D82, L12

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1 Introduction

On March 20, 2009, U.S. president Barack Obama released a presidential memorandum on the subject of ensuring responsible spending of Recovery Act funds. In this he promises to disclose all lobbying contacts on the distribution of Recovery Act funds within three business days to the public. In reaction to this, on April 7, 2009 the Sunlight Foundation, a nonprofit, non-partisan organization promoting government openness and transparency, presented its own proposal for real-time lobbying disclosure on their blog.[1] After meeting with a lobbyist, the government agency immediately submits a summary of the meeting details through a standardized platform, and the results are accessible to the general public on the internet. Instead of learning about them every quarter year, journalists as well as the public will have an immediate basis to evaluate the decisions of policymakers and the influence they were facing. But this is not the only effect of increased transparency. Real-time disclosure also directly informs the competing lobbyists about their opponent's interests and doings. In this paper we show how this can have bad consequences. Lobbying competition can become more fierce and less efficient.

This paper addresses the following questions. What information policy is optimal, if a competitor in a contest can decide and commit to acquire relevant information about his rival or disclose his own private information to the rival? Do the competitors agree on information transmission? What is the effect of mandatory disclosure policy on the outcome of competition? Our main results are:

- Strong transparency policy in a competitive environment can have detrimental side effects for society. We identify conditions where it leads to increased competition and less efficient outcomes.

- Decentralizing information disclosure instead is often beneficial. We identify conditions where the competing groups will agree to transparency decisions, benefiting both the competitors and society at large.

- When outcomes are very sensitive to (lobbying) expenditures (e.g. luck and outside factors become less important), decentralized agreement becomes unlikely. In these circumstances, neither mandatory disclosure nor a laissez-faire transparency rule are optimal.

Our main results may be illustrated through the following simple example: Two competitors are vying for some prize. One of them (the incumbent) has a known valuation for the prize while the valuation of the other (the newcomer) is (potentially) unknown, and may be either high or low. The key intuition underlying all of the results stems from the following observation: Competition is fiercest when the two rivals have similar valuations and milder when valuations

[1] http://sunlightfoundation.com/blog/2009/04/07/a-vision-of-real-time-lobbying-disclosure/.

diverge. Consider first the decision to acquire information. While better information helps the incumbent to choose an optimal effort level, if the decision to acquire information is revealed, then the newcomer will also respond. When the incumbent has a relatively high valuation, he is better off not acquiring information since, if this information reveals that his opponent has a high valuation, competition is sharpened while if the opponent is revealed to have a low valuation, then the incumbent can no longer credibly commit to deter his opponent through overinvestment. Thus, information acquisition is unambiguously bad. On the other hand, when the incumbent has a relatively low valuation, acquiring information is beneficial as it reduces the efforts of the opponent regardless of valuation—in the case of high valuation, it stems from the revealed divergence of values while in the case of low valuation, it stems from discouragement.

Now, consider the decision of the newcomer to disclose information. If the newcomer faces an incumbent with a relatively high valuation, competition will be fierce if he discloses a high valuation and mild when his value is revealed to be low. Since not disclosing leads to an intermediate level of competition, low valuation newcomers prefer to reveal while high valuation ones do not. The reverse is true when the newcomer faces a relatively weak incumbent: high valuation newcomers prefer disclosure while low valued ones prefer opacity. How does this translate into a newcomer's *ex ante* disclosure policy? His expected payoffs are dominated by how he fares when he has a high valuation since this raises both the benefits and chances of winning the contest. As a result, the optimal policy is to disclose when the incumbent has a relatively high value and to remain opaque when the incumbent has a relatively low value.

This means that the competing parties agree on disclosure when the value of the incumbent is relatively high, and on non-disclosure otherwise. Thus, a central insight to emerge from this analysis is that, despite the fact that the two sides have opposing interests in that both want to win, they agree that less "effort", *ceteris paribus*, is good. Since information sharing affects the degree of competition, there is scope for agreement. Furthermore information sharing not only influences the degree of competition but also the efficiency in allocating the prize to the party who values winning most. Agreement on reduced competition often also leads to greater efficiency in allocating the prize. When information sharing is optimal, it results in greater separation in the efforts of the two parties and, as a result, the prize is awarded to the higher valued party more often. Likewise, when information sharing is not optimal, it again results in greater separation of efforts. Thus, endogenous information sharing leads to *ex ante* Pareto gains. In this circumstance, mandatory disclosure policies can increase wasteful competition and distort prize allocations.

Consider some other examples of competitive environments in which transparency policy is relevant. In the U.S., transparency in political campaigning is regulated by the Federal Election Campaign Act (FECA). It requires candidates to disclose sources of campaign contributions and campaign expenditure quarterly. Not only is the public opinion affected by disclosure of this information but also the campaign decisions of competing candidates and hence competition. Disclosure of campaign contributions and expenditures conveys information about the depth of financial support of a candidate and this in turn influences the decisions of the opposing candidates and hence the election outcome. This paper suggests mandating transparency can make candidates compete more fiercely and thus competition more wasteful. Or consider competition between firms. In the U.S., the Securities and Exchange Commission (SEC) as well as the Federal Accounting Standards Board (FASB) regulate firms' disclosure of financial information. This information is not only accessible by stakeholders of a firm but also by its competitors, which has implications for competition between firms if private information is revealed. Our results shed light on how mandatory disclosure influences competition in winner-take-all markets, or more generally markets where competition can be represented by a contest. This is for example the case in advertising intensive markets, like the market for soft drinks.

The paper is organized as follows. Next we survey the related literature. Section 2 introduces the model. Section 3 studies information acquisition, Section 4 studies disclosure incentives. Section 5 puts the two decisions together. Section 6 considers a more general contest success function and Section 7 discusses the effect of mandatory disclosure policy. Section 8 studies the robustness of our findings with respect to the discriminatoriness of the competition. Section 9 concludes.

Literature Review

The nearest antecedent to our paper is Kovenock, Morath, and Münster (2010), who study information disclosure between firms when the contest outcome is very sensitive to contest expenditures. Our concerns are with both information disclosure and acquisition and how they relate to the sensitivity of the contest outcome to expenditures. Baik and Shogren (1995) study the effects of spying and information acquisition in contest games. To gain tractability, they abstract away from strategic considerations in the expenditures themselves – essentially, the contest game is decision-theoretic. Our analysis, however, highlights the importance of the strategic interaction between acquisition/disclosure and contest expenditures. Indeed, our main result is driven by the fact that acquisition changes the behavior not just of the party gaining new information but also the party whose information was disclosed.

Information acquisition and/or disclosure decisions have been studied in three different but complementary settings to ours: Cournot and Bertrand competition, auctions and agency theory. Vives (1984), Li (1985), Shapiro (1986) and Darrough (1993) amongst others study information transmission in the context of Cournot and Bertrand competition. With contests we add a third possible form of competition between firms. Other papers, e.g. Persico (2000) or Eso and Szentes (2007) have analyzed the incentives to acquire or disclose information either about one's private value or about a common value in auction settings. With our analysis of an all-pay auction we complement this literature, while adding a different dimension with the analysis of non-fully discriminating contests. One of our main results is to show that it can be optimal for a lobbying group or firm to remain ignorant about the valuation its rival places on "winning" the contest. The strategic value of ignorance has also been shown in the context of agency theory. A principal may benefit from ignorance as it alters the agent's incentives to exert effort. The agent may benefit as well, as ignorance may make it harder for the principal to extract rents. Papers highlighting these effects are for example Dewatripont and Maskin (1995), Barros (1997) and Kessler (1998). While this literature focusses on vertical relationships between two distinct parties, in our model the focus is on competing parties in a horizontal relationship.

Information transmission from lobbies to the policy maker through lobbying has been studied for example by Potters and van Winden (1992), Lagerlöf (2007) and Grossman and Helpman (2001). The focus of this literature is on the welfare implications of lobbying when lobbyists have private information which is relevant to the policy maker and the policy maker attempts to learn by observing lobbying expenditures. In contrast we focus on information transmission between lobbyists and its implications for welfare and efficiency, and highlight consequences for disclosure policy.

Information disclosure has also been studied in the context of goods markets, e.g. Jovanovic (1982), Milgrom (2008) and Daughety and Reinganum (2008), where the focus is on whether markets lead to optimal incentives for firms to disclose information about the quality of their goods. This literature revolves around the trade-off that disclosure is beneficial for the consumer but costly to the seller. In contrast, we show that mandatory disclosure can be harmful even without direct monetary costs, purely through its strategic effect.

Finally, our paper is of course also related to the literature on asymmetric information in contests (e.g. Hurley and Shogren (1998), Katsenos (2009), Moldovanu and Sela (2001) or Hernandez-Lagos and Tadelis (2011)), and the role of commitment in contests (e.g. Dixit (1987), Baik and Shogren (1992), Morgan (2003), Morgan and Várdy (2007), Yildirim (2005) and Fu (2006)) though the form of commitment typically consists of committing to a sequence of moves. In contrast we study contests where players are able to commit to certain informational regimes.

2 The Model

While we couch the model in the context of lobbying, it is easily translated into other competitive situations.[2] Consider two lobbying groups $i = A, B$ who vie for favorable legislation to be passed.

[2] We can easily reframe our model in terms of another introductory example – political campaigns. Two politicians $i = A, B$ are campaigning for a political office. The political office yields i a value v_i while failure yields a value normalized to zero. To affect the chances of success, each politician chooses some amount of campaign expenditures x_i. The chance that i is successful depends on the contest success function (CSF) defined in equation 2. The talent of the incumbent politician is more or less common knowledge and hence his value for office v_A is known. For the newcomer we assume the value is low with probability q and high else.

Success yields lobby i a value v_i while failure yields zero. To affect the chances of success, each group chooses lobbying effort x_i. The chance that i is successful depends on the contest success function (CSF):

$$p_i(x_i, x_j) = \frac{x_i}{x_i + x_j}. \tag{1}$$

If both groups choose zero lobbying effort ($x_i = 0$) a coin toss determines success. Lobbyists are risk-neutral with a constant marginal cost of effort normalized to one. While each lobbying group knows its own valuation for success, information about the other party differs. In particular, the valuation of group A is commonly known while group B has private information about its value. One can think of this situation arising when group A is an "incumbent" who has engaged in many past fights over related issues while group B is a newcomer or, alternatively, where publicly available information makes it easy to estimate A's value while B's value, perhaps being more subjective, is harder for outsiders to estimate. For simplicity, we assume that B's value is binary—it is either low, $v_B = v_L$, with probability q or high, $v_B = v_H$, with the complementary probability. In Appendix F, we show that qualitatively similar results are obtained when B's distribution of values occurs on a continuum. The payoff functions are equal to

$$\begin{aligned}
\pi_B &= \frac{x_B}{x_B + x_A} v_B - x_B \\
\pi_A &= \left(q \frac{x_A}{x_{BL} + x_A} + (1-q) \frac{x_A}{x_{BH} + x_A} \right) v_A - x_A.
\end{aligned}$$

We focus on the case where there is uncertainty as to which lobbying group has the higher valuation, i.e., when $v_A \in [v_L, v_H]$. Furthermore we assume that the policy is valuable enough for all lobbying groups to choose strictly positive lobbying effort.

3 Information Acquisition

In this section we consider the incentives to acquire information about one's opponent before the contest. In terms of our model, suppose that it were costless for group A to acquire a credible report as to B's valuation before the start of the contest and this decision is common knowledge. Afterwards the contest described in Section 2 takes place. One might be tempted to draw an analogy with a bargaining situation. In effect, A and B are negotiating (through their efforts) on who will receive the valuable legislative prize. The usual advice in such situations is to "know thy enemy". That is, group A should gather as much information as possible about group B, including its valuation. This information will enable it to make the best possible decision regarding its negotiation strategy, which can now be type-specific. Since information gathering is costless, it seems obvious that the optimal strategy is complete information gathering.

Where the analogy breaks down is in the form of the "negotiation" between the two parties. Here, success will be determined by performance in an imperfectly discriminating contest; thus, there is an integrative as well as distributive aspect to the "negotiation." In particular, both lobbying groups benefit if lobbying efforts are more muted and, since only relative lobbying efforts determine the outcome, equilibrium success probabilities would be unaffected if both sides could agree to scale down their efforts.

But how can ignorance enable the lobbying groups to scale down effort? Consider a lobbying group A which has a valuation above the average of lobbying group B. If it knew for sure it faces a strong group B, competition between the similarly strong groups would be very intense. But the chance to encounter a much weaker group B diminishes A's investment incentive, and hence also the strong group B's reaction because from its view investments are strategic complements. On the other hand, A overinvests against a weak group B to increase its chances in case its opponent turns out to be strong. The weak group B will react to this discouragement by lowering its investment because its investments are strategic substitutes. By optimally choosing to remain ignorant about lobbying group B's valuation, A can on the one hand discourage a weaker rival and on the other hand appease a stronger rival, thereby softening the competition between the two lobbies. Thus, unlike a decision-theoretic or negotiation context, rent-seeking competition between the two parties creates a value to ignorance.

A sharp illustration of this intuition may be seen for the case where group A has diffuse priors (i.e. $q = 1/2$). Here we show that, when group A is strong compared to B, it prefers to remain ignorant while when it is weak, it seeks information to mitigate this disadvantage. Formally,

Proposition 1. *If lobbying group A is relatively strong compared to group B ($v_A > \sqrt{v_L v_H}$) it strictly prefers not to acquire any information about B's value while a relatively weak lobbying group A ($v_A < \sqrt{v_L v_H}$) always acquires costless information about group B.*

Proof. See appendix. □

Figure 1 illustrates the intuition behind the value to ignorance graphically. It shows the best response functions of both groups when A knows the valuation of group B. Optimal lobbying expenditures under complete information are given where the best response functions intersect. If group A's value is relatively high, its lobbying effort under ignorance (vertical line) is higher than under complete information in case it faces the low value opponent (left panel), while the opposite is true against the high value opponent (right panel). We can directly see that this benefits A by decreasing both its opponents' lobbying efforts.[3]

[3]Technically speaking, our results are due to the non-monotonicity of reaction functions. This implies that efforts are strategic complements for the favorite while they are strategic substitutes for the underdog, where in our set-up the favorite is the group with the higher valuation. See Dixit (1987) for a discussion.

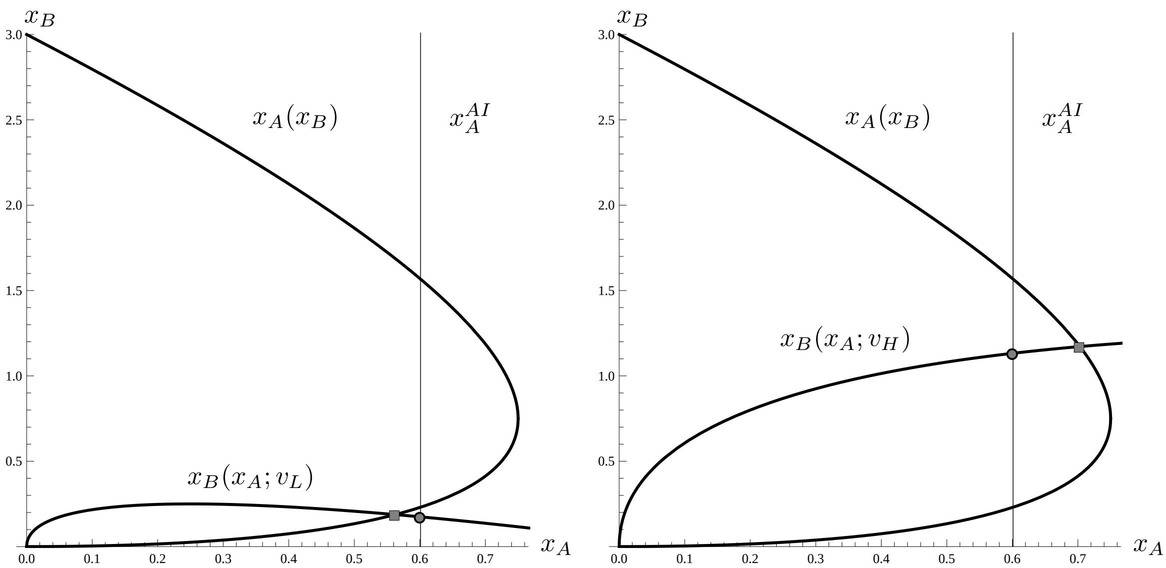


Figure 1: The left panel shows the full-information best response functions when lobbying group A faces a weak opponent, the right panel when it faces a strong opponent. x_A^{AI} denotes the lobbying effort of A under ignorance. Under ignorance (dot) both types of B expend less than under full information (square).

Softening competition through ignorance does not always work. If group A's valuation is below the geometric mean of v_B, ignorance increases competition. A weak group A invests little when facing a much stronger group B while it fights hard against the just slightly weaker group B, where competition is more equal. By staying ignorant A finds itself overinvesting in case it faces the stronger group B, which reacts to this threat with an increase in investment. At the same time it underinvests in case it faces the weak group B, which also reacts with an increase in investment, sensing a good opportunity. Hence a weak lobbying group A always acquires costless information.

Note that if group A's decision to acquire information were not observable to group B, A would always choose to acquire information about B's value. Deviating from ignorance to information acquisition enables A to play a best response while B does not change its behavior as the deviation is unobservable. In equilibrium this is anticipated by group B and the contest always takes place under complete information. In this sense observability is a form of commitment opportunity that enables A to commit to a beneficial action which would otherwise not be feasible, as it is not in its complete-information best response. In fact, commitment to ignorance can have a similar effect as pre-commitment of effort. If group A had the opportunity to be a Stackelberg leader, meaning it could pre-commit its contest effort in a way observable to B, it would choose to overinvest relative to simultaneous moves against a lower-valued rival while it would choose to underinvest against a higher-valued rival. Both rivals react to this precommitment with a decrease in investment (Dixit (1987)).

4 Information Disclosure

Lobbying group A's decision to stay ignorant could well be obsolete if group B can credibly disclose its value to A. In fact, it is not clear what happens if A and B disagree about whether B's value should be revealed. In this section we explore the other side of the information transmission decision and focus on group B's incentives to disclose its valuation to A. There are many possibilities how disclosure could work. As a first step we assume that lobbying group B has the opportunity to commit ex-ante, before learning its value, to a disclosure policy. In case it chooses to disclose, it discloses its value truthfully and without cost to A after learning it and before the start of the contest. In this sense we give B a commitment opportunity to maximize its ex-ante welfare. At the end of this section we discuss this assumption and analyze an alternative model where B can only use a costly signal to signal its value to A.

Even though disclosure enables the opponent to make a more informed decision, this does not necessarily mean that the disclosing group is hurt by this. For example if the opponent learns that the group has a much higher valuation it will optimally react by lowering its expenditures, as its chances of success are so slim, and this is beneficial for both groups. On the other hand, if the opponent learns the lobbying group has a very low valuation, it might also find it beneficial to lower its expenditures, as not much is needed for success. Disclosing a similar valuation on the other hand makes competition fiercer.

If the disclosure decision is made ex-ante, we find that information is only disclosed when B faces a relatively weak group A. Formally,

Proposition 2. *Assume lobbying group B does not know its value yet but is given the opportunity to commit ex-ante to a disclosure policy. If lobbying group B expects to be relatively weak compared to lobbying group A ($\sqrt{v_L v_H} < v_A$) it strictly prefers to commit to non-disclosure. On the other hand, a lobbying group B with a high expected valuation ($\sqrt{v_L v_H} > v_A$) always commits to disclose its value.*

Proof. See appendix. □

To make the intuition behind Proposition 2 clearer let us first look at the incentives of a high- and a low-value lobbying group B separately. A high-value lobbying group B will prefer disclosure if it can discourage lobbying group A from expending lobbying effort. This is the case whenever it is relatively strong, or $v_A < \sqrt{v_L v_H}$. For $v_A \geq \sqrt{v_L v_H}$ disclosing makes A more aggressive, as it learns that its opponent is of similar strength. The opposite is true for a weak lobbying group B. When facing a strong group A it prefers to disclose its valuation, as A will react with lower lobbying effort. If A is weak on the other hand, revealing its valuation makes competition stronger, as A learns that it is facing a similarly strong opponent. The weak and the strong lobbying group B's incentives are never aligned. If disclosing is beneficial for one, it is harmful to the other. From an ex-ante point of view, before learning its valuation, the strong lobbying groups' interests always dominate though. The reason is that an increase in success probability in case the value is high is worth more than in case the value turns out to be low.

Notice that the conditions for information disclosure/withholding in Proposition 2 are identical to those in Proposition 1 when group A is determining whether to pursue this information. That is, despite competing with one another, both groups agree on information revelation. We formalize this observation in Corollary 1 in Section 5.

Ex-ante commitment to a disclosure policy is an interesting benchmark but might not always be feasible. Also costless and truthful revelation can be an unrealistic assumption in some settings. To test the robustness of our results, we consider an alternative model. Let us assume that disclosure of the lobbying group's value is costly and not verifiable. Instead, a lobbying group has the option of sending a costly signal in order to try to inform A of its value. We assume that costs of the signal s_i are linear, $c(s_i) = s_i$, $i = H, L$, and signaling takes place before the start of the contest. Then we find:

Proposition 3. *After lobbying group B learns its valuation and given the chance to send a costly signal before the contest to group A, only a high-value lobbying group credibly reveals its valuation. This is only profitable in a situation where group A is relatively weak ($\sqrt{v_L v_H} > v_A$). Otherwise no information is disclosed.*

Proof. See appendix. ☐

The intuition for this proposition carries over from the one for Proposition 2. A lobbying group with a high valuation stands to gain more from a decrease in A's lobbying effort. This means that it is willing to expend more signaling effort than a low-value group. If it is in its interest, it will always be able to imitate a low-value group's signal so that no information is disclosed. Hence against a strong group A information will never be disclosed because it is detrimental to the high-value group, while against a weak group A the high-value group is willing to credibly disclose its valuation through the costly signal. Our results are in line with the results in Katsenos (2009) who analyzes costly signaling in a lottery contest with two-sided asymmetric information and two possible types of valuations, v_H and v_L for both parties. He finds that separating equilibria only exist, when the probability to face a strong opponent is sufficiently low. Our result complements this finding in a one-sided asymmetric information setting where v_A can be different from v_H and v_L.

5 Information Transmission

So far we have analyzed the lobbying groups' disclosure and acquisition decisions separately. Now we combine these analyses to find out, how lobbying groups exchange information voluntarily.

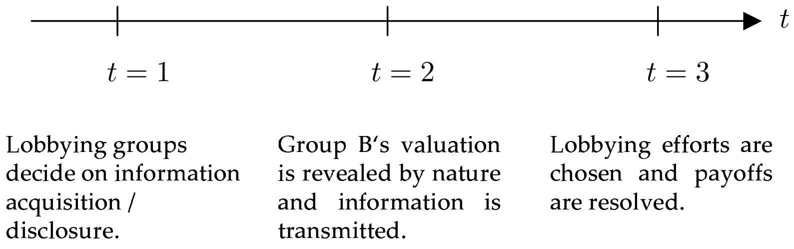


Figure 2: Sequence of moves

In Section 7 we then compare our findings to lobbying under mandatory disclosure policy.

The game proceeds as follows: Prior to the start of lobbying, each lobbying group engages in information disclosure/acquisition decisions; that is, group A decides whether to pursue credible information about B's valuation while group B simultaneously decides on its disclosure policy. Following information acquisition/disclosure, both lobbying groups simultaneously choose lobbying efforts and payoffs are resolved. Figure 2 illustrates the flow of the game.

We assume that lobbying group B has not learned its valuation when deciding on information disclosure. In Proposition 3 we showed that our results extend to an alternative set-up where B has learned its valuation and has the possibility to send a costly signal to group A. Then if both lobbying groups agree that information should be exchanged (B prefers disclosure and A acquisition) A will learn the value of group B. If on the other hand both lobbying groups agree not to disclose (B prefers non-disclosure and A ignorance), no information is transmitted. What is not so clear is what happens if A and B do not agree. For example A might want to acquire information about B's value, but B might not be willing to disclose it. Or B might want to disclose its value while A does not want to acquire it. The payoff in these situations which we denote by π_i^D, could be equal to π_i^{CI}, or π_i^{AI} or anything in between depending on how exactly information transmission works. For our results in this section we do not need to make any assumption as to what exactly will happen in these cases as long as $\pi_i^D \leq \max\left\{\pi_i^{CI}, \pi_i^{AI}\right\}$.

Consider again the case with group A having diffuse priors (i.e. $q = 1/2$). Then the lobbying groups always agree on information transmission between them. Formally,

Corollary 1. *If lobbying group B expects to be relatively weak compared to lobbying group A ($\sqrt{v_L v_H} < v_A$) both lobbying groups agree not to transfer any information while if lobbying group B expects to have a high valuation compared to A ($\sqrt{v_L v_H} > v_A$) both agree on disclosure.*

Proof. This follows from the proof of Propositions 1 and 2. There we found that $\pi_i^{CI} > \pi_i^{AI}$ for $v_A < \sqrt{v_H v_L}$ and $\pi_i^{CI} < \pi_i^{AI}$ for $v_A > \sqrt{v_H v_L}$, $i = A, B$. For $v_A = \sqrt{v_H v_L}$ both groups are indifferent. We have the following payoff matrix.

	B discloses	B doesn't disclose
A acquires	π_A^{CI}, π_B^{CI}	π_A^D, π_B^D
A doesn't acquire	π_A^D, π_B^D	π_A^{AI}, π_B^{AI}

Depending on π_i^D, multiple Nash equilibria are possible. For example even though $\pi_i^{CI} > \pi_i^{AI}$, $i = A, B$ in case $v_A < \sqrt{v_H v_L}$, staying ignorant and not disclosing is a Nash equilibrium when information is only transferred if both parties agree $\left(\pi_i^D = \pi_i^{AI}\right)$. This equilibrium though is Pareto dominated by the one where A acquires information and B discloses. In this sense the lobbying parties, given a chance to coordinate, would always *agree* on the Pareto superior equilibrium. This is also the only trembling hand perfect equilibrium. Note that this is also the unique equilibrium when parties can decide sequentially on information transmission. $\square$

We find the lobbying groups' incentives to be always aligned.The reason for this is that there exist gains from coordination in the form of reduced competition. By coordinating, both parties can save on lobbying expenditures.

This finding can also be related to the literature on sequential moves and pre-commitment of effort in contests. Corollary 1 is in a sense analogous to the findings in Baik and Shogren (1992) and Leininger (1993), who analyze the choice of the order of moves in sequential rent-seeking contests. They find that it is in the interest of both lobbying groups to choose the sequence of moves where the least efforts are expended. This means that both groups always prefer the weak group to go first and pre-commit contest effort. It chooses a low lobbying effort and the strong group reacts with lower lobbying effort as well. Even though the weak group ends up winning less often, it is compensated by lower lobbying costs. When choosing whether to disclose a similar logic applies. Staying ignorant can have a similar effect as moving first, if it enables A to move closer to its Stackelberg point. As we have shown, this is the case for a relatively strong lobbying group A. By staying ignorant it can credibly reduce its investment against the high-valuation lobbying group B who will react by reducing its expenditures as well. Interestingly in this set-up the strategic complementarities from facing a high-valued rival always dominate, and hence agreement is possible, even though efforts are strategic substitutes for the low-valued lobbying group B.

Our results require very little structure in determining how exactly information transmission works. The only essential prerequisite is some form of commitment opportunity. In reality, this could take many forms. For example, one purpose of trade associations is to facilitate information exchange (e.g. Kirby (1988) or Vives (1990)). Members commit themselves to share their private information with the help of the trade association, while for non-members it will be much harder to reveal and receive credible information. Another example of institutionalized information exchange are strategic marriages. A strategic marriage policy was pursued by many houses of European rulers during the Renaissance and thereafter. The probably best known example is the House of Habsburg's strategic marriage to Spain and Italy. Among other things these strategic marriages can serve as commitments to disclose credible information to and acquire credible information about other empires. Another nice historical example about the voluntary exchange of credible information can be found in Schelling (1960), "*[t]he ancients exchanged hostages, drank wine from the same glass to demonstrate the absence of poison, met in public places to inhibit the massacre of one by the other, and even deliberately exchanged spies to facilitate transmittal of authentic information*". Our analysis provides a rationale for this: exchanging authentic information can decrease the fierceness of conflict, something that is good for both parties.

6 More General Contest Success Function

So far we have assumed that the lobbying process can be represented by a simple lottery contest. In order to show the robustness of our results, in this section we assume the political process can be represented by a more general CSF of the following form:

$$p_i(x_i, x_j) = \frac{f(x_i)}{f(x_i) + f(x_j)} \tag{2}$$

where $f' > 0$ and $f'' \leq 0$.[4]

As we have seen in the previous section, whether ignorance is bliss for the lobbying groups is determined by whether or not group A's value is above the average of group B's valuations. Proposition 1 shows though, that it is not the arithmetic average; rather the decision to acquire or disclose information turns on the geometric mean of B's value. Next we show that such a critical value of lobbying group A's valuation, let us denote it by $\widehat{v}_A$, exists more generally.

Lemma 1. *For every q, there exists a value $\widehat{v}_A \in [v_L, v_H]$ such that, if $v_A = \widehat{v}_A$, lobbying group A is indifferent between acquiring information or not, and lobbying group B is indifferent between disclosing information or not.*

Proof. See appendix. □

To illustrate the intuition for the proof of this lemma, assume A knows its opponent. When A faces a weak opponent B, a relatively small lobbying effort will basically guarantee success for A. With an increase in B's value, A increases its optimal lobbying effort until both groups have an equal value. Here competition is at its fiercest. Now an increase in B's value will start to discourage A from investing, until at one point B becomes so strong that A invests barely

[4] This is a standard contest success function, see Skaperdas (1996) for an axiomatization.

anything. This logic implies that there will always be two possible values of group B, one larger than A's, one smaller, such that A expends exactly the same lobbying effort. If group B has exactly these values, v_L and v_H, A's behavior will be unchanged whether it knows B's value or not.

It is tempting to reason from Lemma 1 that Propositions 1 and 2 hold for more general prior probabilities of B's values v_L and v_H and more general lobbying technologies. Indeed, we can generalize Propositions 1 and 2 as well as Corollary 1 locally around the critical value $\widehat{v}_A$.

Proposition 4. *In a neighborhood of $\widehat{v}_A$, if lobbying group B expects to be relatively weak compared to lobbying group A ($\widehat{v}_A < v_A$) both lobbying groups agree not to transfer any information while if lobbying group B expects to have a high valuation compared to A ($\widehat{v}_A > v_A$) both agree on disclosure.*

Proof. See appendix. □

Is there a reason why Proposition 4 might not always hold globally, as does Corollary 1? It can be shown that under certain circumstances there can be disagreement between the lobbying groups. The reason is that the critical value $\widehat{v}_A$ for Lemma 1 is not always the only critical value for group A. To illustrate, take a very strong lobbying group A with a value close to v_H and assume that the probability of facing a strong group B is small. Then group A's lobbying effort under ignorance is similar to the lobbying effort knowing it is facing a weak group B. But if B happens to be strong and A were ignorant, it would underinvest by a large amount. Even though this leads the strong group to reduce its effort, this is not optimal for group A. In fact, there is an optimal degree of underinvestment against a stronger opponent. If A had the opportunity to precommit lobbying effort, this would be the effort level it would optimally choose, the so-called Stackelberg point. Ignorance can enable lobbying group A to move closer to this optimal effort in certain situations. In other situations A will surpass the Stackelberg point under ignorance, as in the example above. If A surpasses the Stackelberg point by too much, acquiring information is the optimal strategy. Consequently, there exist situations like the one described above where the two lobbying groups will not agree on information transmission.

7 Mandatory Disclosure Policy

Transparency policy is a topic of high relevance in many political debates around the world. For example in the U.S., transparency laws have been passed regulating lobbying, political campaigning or financial accounting of firms. A large part of the U.S. economy is hence affected through transparency laws. Thus it is important to understand all possible consequences of mandatory disclosure policy. In competitive environments like the ones mentioned above, transparency policy can affect the nature and outcome of competition. Here we take a closer look at exactly this effect. In the previous section we saw that typically the competitors agree on whether to disclose information between themselves. In many cases they agree not to disclose any information to their mutual benefit. Transparency policy, on the other hand, forces the competing parties to disclose certain information to the public, and hence also to their competitors.

We focus our analysis on two outcome variables: expected aggregate lobbying efforts and expected allocative efficiency. It is typically in the interest of a society to keep lobbying efforts low, since lobbying activities are not directly productive but serve only to influence policy. In our model this is captured by the fact that by scaling down efforts proportionally both groups still win the contest with identical probability. This decrease in lobbying investment can be used for directly productive activities. Of course, in a frictionless world one could argue that markets would always allocate these funds efficiently. In reality, this is certainly not always the case. Furthermore there is also a misallocation of non-monetary resources, as for example human capital, and hence reducing lobbying efforts seems a reasonably aim. It is also in the interest of a society to have the probability that a law or bill which has a relatively high social value be passed as large as possible. This social value is represented in our analysis by the lobbying groups' valuations. We implicitly assume that all individuals affected by the policy are part of one of the two lobbying groups, for example a "pro" and a "contra" group. Inside each group there are no transaction costs and no externalities, and thus the groups' valuations for the policy perfectly reflect societal preferences. This can be seen as an approximation for a situation where both groups face similar free-rider problems.[5] Consequently it is in society's interest that a higher valued lobbying group has the best chances to succeed. We will refer to this as expected allocative efficiency henceforth.

Mandatory disclosure policy can take many different forms, ranging from disclosure of information about *actions* (e.g. expenditures or efforts) to disclosure of *characteristics* (e.g. valuations, costs or productivity), or any mix thereof. Depending on its form, mandatory disclosure will impact competition to different degrees. In this paper we consider disclosure policy about the competitors' characteristics. Transparency about actions can reveal something about characteristics, but does not necessarily have to (in technical terms there can be pooling or separating equilibria). Thus our analysis also applies to disclosure about actions, whenever information about characteristics is revealed.

Let us resume the example of lobbying introduced in Section 2 and first assume that we are interested in keeping the expected wastefulness of the lobbying competition low and it is irrelevant for society which lobbying group is successful. This could for example be the case in rent-seeking contests. We then get the following result.

Proposition 5. *Expected aggregate effort is lower under*

[5] Free-rider problems in group contests with public goods prizes are discussed for example in Esteban and Ray (2001) or Kolmar and Rommeswinkel (2010).

- *information disclosure if lobbying group A is relatively weak ($v_A \leq \sqrt{v_H v_L}$),*
- *asymmetric information if lobbying group A is relatively strong ($v_A > \sqrt{v_H v_L}$).*

Proof. See appendix. □

As foreshadowed in Section 5 we find that if the uninformed lobbying group is relatively strong, mandatory information disclosure makes the lobbying process more wasteful in expectation. In addition, we have shown in Corollary 1 and Proposition 4 that in many situations the lobbying groups voluntarily agree not to transfer any information. In these cases a "laissez-faire" policy leads to less wasteful competition. If we assume that information can only be transferred when it is in lobbying group B's interest to disclose its information, we can conclude the following.

Corollary 2. *If society is interested in keeping lobbying expenditures low a "laissez-faire" policy is preferable to a policy of mandatory disclosure.*

Next we consider expected allocative efficiency. We define expected allocative efficiency as the probability that the lobbying group with the highest valuation wins the lobbying contest. Then we can show

Proposition 6. *Expected allocative efficiency is greater under*

- *information disclosure if lobbying group A is relatively weak ($v_A \leq \sqrt{v_H v_L}$),*
- *asymmetric information if lobbying group A is relatively strong ($v_A > \sqrt{v_H v_L}$).*

Proof. See appendix. □

This finding also relates to the literature on sequential contests. As we discussed in Section 3, asymmetric information enables the uninformed lobbying group to act similar to a Stackelberg leader when it is sufficiently strong relative to the informed lobbying group. Morgan (2003) finds that sequential rent-seeking contests dominate simultaneous ones in terms of efficiency. Hence if asymmetric information enables A to get closer to its Stackelberg point, which is true for $v_A > \sqrt{v_H v_L}$, it also improves efficiency. Together with the results in Corollary 1 and Proposition 5 we find the following.

Corollary 3. *Assume that society is interested in increasing expected allocative efficiency and keeping expected wastefulness of the lobbying competition low. Then a "laissez-faire" policy is always weakly superior, independent of the relative weights the policy maker places on the two goals.*

With a completely altruistic policy maker, transparency is clearly beneficial for efficiency. Only if it is known which policy is the best, can it be chosen by the policy maker. If the policy maker follows his self-interests and bases his decision on lobbying efforts, transparency will have a differential effect on the lobbying groups, sometimes favoring the "weaker", sometimes the "stronger" one. As we have shown, this can lead to another undesirable side-effect of transparency policy, a decrease in expected allocative efficiency. At the same time, our result has the potential to explain the emergence of mandatory disclosure policies, even though shown to be inefficient. A policy maker interested in maximizing his rent-seeking revenues always weakly prefers mandatory disclosure to voluntary disclosure.

Furthermore, note that disclosure policy which does not affect current lobbying competition, in other words disclosure with a sufficient time lag or with "soft" disclosure requirements which do not reveal anything about the competitors' characteristics, does not have these detrimental effects. At the same time it can still afford possible benefits through increased accountability and better informed voters. In this respect our findings help evaluate calls for an increase in transparency, as for example by the Sunlight Foundation in the U.S.. Coming back to our introductory example, the demand for real-time lobbying disclosure, our findings imply that even apart from the direct costs of increased transparency such as bureaucratic expenses, this policy is likely to have indirect costs in terms of an increase in expected wastefulness and a decrease in expected allocative efficiency of lobbying competition, which have to be traded off against the additional benefits.[6]

8 Noisiness of the Contest and the Scope for Agreement

So far we have implicitly assumed that lobbying expenditures do not perfectly determine the outcome of the competition. By spending more in the contest a lobbying group can increase its chances to succeed, but there always remains some uncertainty. Put differently, the lobbying group with the lower expenditures still has a non-zero chance of success – the lobbying process is at least somewhat noisy. There are different reasons this might be true. For example, policy makers may have preferences over political outcomes unknown to the lobbying groups, or face imperfectly observable constraints. Another reason for a noisy lobbying process from the lob-

[6]There may be another negative effect of transparency, not captured in our model. Higher transparency makes direct transfers of funds from lobbying groups to policy makers less likely, because this would be considered bribery or corruption, which is typically illegal. Of course, this does not mean that lobbying groups stop exerting pressure. Rather they (partially) substitute away from transfers to legal sources of effort, which are usually labor intensive. But this has direct negative consequences for efficiency and wastefulness of the competition. While bribing is purely distributive and therefore funds are not "wasted", labor intensive lobbying directly wastes resources and hence is an allocative problem. Therefore, it can be argued from a wastefulness perspective that bribery has an advantage over lobbying, what is in line with for example Lambsdorff (2002). Consequently, transparency may not only increase lobbying effort, but is likely to influence the composition of lobbying effort in a socially undesirable way.

bying groups' perspective is that lobbying efforts are only imperfectly observable by the policy maker. This could be due to the complexity of the subject so that it is difficult for lobbyists to communicate their concerns properly, or because it is not clear ex-ante what the best strategy to approach a political decision maker is and which consequences of the favored bill to highlight.

We have captured this uncertainty by using a non-deterministic CSF of the ratio form, as defined in equation (2). We now consider a CSF which can be interpreted as the limiting case when noise vanishes completely, the all-pay auction. It represents a situation where the political process is very sensitive to lobbying effort and where the lobbying group with the highest expenditure wins with certainty.[7] This higher sensitivity implies higher marginal returns to lobbying effort and therefore increases the fierceness of the competition. It is interesting to consider this situation as an extreme case, because it is implicitly assumed that policy makers do not have any private preferences about the political outcomes, do not face any constraints and the process of communication between the lobbying groups and the policy maker is free of misunderstandings and noise. In short, the policy maker bases his decision solely on lobbying expenditures. The next proposition shows how an absence of noisiness influences the incentives to coordinate on information transmission.

Proposition 7. *When the political process takes the form of an all-pay auction*

1. *disclosing information is weakly dominated for lobbying group B,*
2. *staying ignorant is weakly dominated for lobbying group A,*
3. *the lobbying groups' incentives are never aligned and therefore they will never agree on transferring information voluntarily.*

Proof. See appendix.[8] □

This result reveals that the contest's degree of sensitivity to rent-seeking efforts influences when the lobbying groups agree on information transmission. In contrast to ratio form contests, in a fully discriminating contest the lobbying groups' incentives are never aligned. The informed group never discloses its information while the uninformed group always takes an opportunity to acquire information. Because of the fierceness of competition there is no scope for agreement.

Consider the lobbying groups' incentives separately. Why does lobbying group B never benefit from disclosing its valuation? Under a noisy political process, by disclosing its value, a strong group B discourages a weak group A from investing. This does not work when the political process is fully discriminating. By disclosing information, a strong lobbying group will

[7] The standard references analyzing all-pay auctions are Hillman and Riley (1989), Baye, Kovenock, and de Vries (1993, 1996), and Krishna and Morgan (1997).

[8] A proof for part 2 of the Proposition has first been given in Kovenock, Morath, and Münster (2010) for two-sided asymmetric information and a continuous distribution of types.

only secure itself a payoff equal to the difference in valuations between itself and its opponent. All other rents are dissipated through competition. With asymmetric information competition is less fierce and it can in addition earn informational rents. In fact, it can secure itself the exact same payoff with one-sided asymmetric information (by marginally overbidding group A's valuation) and might even do better. Technically speaking, in all-pay auctions both reaction functions are monotonically increasing until the valuation of the weakest lobbying group so there will be no discouragement effect in the relevant range.

Why is there no value to ignorance? When policy makers are perfectly responsive to lobbying expenditures, there is no advantage to pre-committing lobbying expenditures, as has been shown for example in Konrad and Leininger (2007). In fact, a low-valuation lobbying group is indifferent with respect to timing while a high-valuation group prefers to decide after its opponent chooses its expenditures. Hence the advantage from ignorance highlighted under an imperfectly discriminating political process does not apply this setting — ignorance cannot dampen competition to the benefit of both parties, it only benefits the opponent. Hence lobbying group A always acquires information.

What are the consequences for disclosure policy? First of all, Proposition 7 shows that lobbying groups don't agree on disclosure and hence it is no longer clear what happens under a laissez-faire transparency rule. Furthermore, a reduction in expected aggregate effort and an increase in expected allocative efficiency, two possible objectives of society, are no longer necessarily compatible as we show now in an example. We find that expected aggregate effort is typically smaller under complete information when A's value is not too close to either v_H or v_L and under asymmetric information else. Expected allocative efficiency is typically greater under asymmetric information except if v_A is relatively small and q is relatively large. The reason is the following. Asymmetric information has two effects on allocative efficiency when the policy maker is perfectly responsive to lobbying expenditures. On the one hand it stratifies the range of efforts of lobbying group B. A low-valuation group chooses its investment from an interval of the form $[0, \underline{x}]$ while the high-valuation group chooses from $[\underline{x}, \overline{x}]$. In contrast, under complete information they choose from the interval $[0, \overline{x}_i]$, $i = H, L$. This is beneficial for efficiency. On the other hand we showed that lobbying group B benefits from informational rents. Especially when A is very likely to face a low-valuation opponent and v_A is close to v_L, this becomes important for efficiency. B's informational advantage will lead to a low-valuation type winning too often, decreasing efficiency. In theses cases the detrimental effect of asymmetric information dominates and expected allocative efficiency is higher under complete information.

Figure 3 illustrates this for $v_L = 1$ and $v_H = 2$. In darkgray regions complete information is optimal while in lightgray regions asymmetric information is preferred. So decreasing expected aggregate effort often implies decreasing expected allocative efficiency. We can draw the following conclusions regarding mandatory and voluntary disclosure policy.

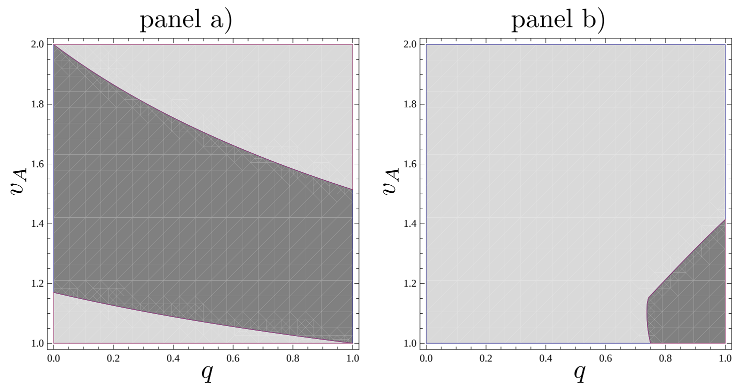


Figure 3: Aggregate effort (panel a)) and efficiency (panel b)).

Corollary 4. *Policy makers who are perfectly responsive to the influence of lobbyists make decentralized agreement impossible. In these circumstances, neither a laissez-faire transparency rule nor mandated disclosure is optimal in our framework. Furthermore, achieving an increase in expected allocative efficiency and a decrease in expected aggregate effort through disclosure policy becomes unlikely as these two goals are often in conflict.*

Summarizing our results, we find differential effects of transparency policy on lobbying competition depending on the noisiness of the political process. While under a sufficiently noisy political process a laissez-faire policy leads to the best outcome in terms of expected aggregate effort as well as allocative efficiency, this need not be true under a perfectly discriminating political process. Here the effect of transparency policy is ambiguous and no general results can be obtained to guide policy decisions.

9 Conclusion

How do we evaluate the recent proposals for more transparency in U.S. lobbying? If transparency were free to implement, would more transparency always be better for society? Even though we cannot give a conclusive answer to these questions, our analysis highlights a side-effect of transparency policy which has been absent from the policy debate so far. We show how an increase in transparency can lead to an increase in the wastefulness of lobbying competition and at the same time to a decrease in the probability that the lobbying group with the most pressing interests succeeds. Furthermore we show that in the absence of mandatory disclosure policy, competitors often agree whether or not to share information and this decision reduces wastefulness and increases allocative efficiency. Our results have implications beyond lobbying. These considerations hold weight for the analysis of transparency policy in other competitive settings like political campaigning or financial accounting of rival firms.

While we focused in our assessment of the welfare implication of transparency on an environment in which effort is considered wasteful, there are other environments in which effort is considered (socially) beneficial. An immediate example is student's effort in school or at university. Higher effort generates better educated graduates, which is beneficial for society as a whole. Typically grades are based on relative performance (grading on a curve), so students' competition for grades is a contest and we can apply our results. We know from Section 7 that transparency leads in expectation to increased effort. Consequently, to increase students' efforts a transparent studying environment is likely to be helpful. This can be achieved by promoting studying in groups or by testing students frequently over the term and publicizing the test scores.

An interesting extension of our analysis would be to allow for common values. This can be relevant in many settings. In our lobbying example the lobbyists might posses relevant information about the value of the policy at stake, as for example when lobbying for a monopoly position and each firm has done market research. Lobbying groups learn not only about their opponent's interest, but also about their own. Most importantly, to draw more precise policy conclusions a more general model of all affected parties is needed to evaluate all the possible effects of transparency policy and their interactions. For example transparency policy in lobbying will also affect the relationship between the policy maker and the general public. To combine these factors into one model is an important avenue for future research and will allow a more thorough evaluation of transparency policy.

Appendix

A Proof of Propositions 1, 2 and 3

A.1 Equilibrium under Full- and Asymmetric Information

Equilibrium efforts, probability of success and utility under complete information are equal to (see Nti (1999))

$$\begin{aligned} x_i^{CI}(v_i, v_j) &= \frac{v_i^2 v_j}{(v_i + v_j)^2} \\ p_i^{CI}(v_i, v_j) &= \frac{v_i}{v_i + v_j} \\ \pi_i^{CI}(v_i, v_j) &= \frac{v_i^3}{(v_i + v_j)^2}. \end{aligned} \tag{3}$$

It is easily verified that A will invest more against a high-value opponent than against a low-value one iff $v_A > \sqrt{v_H v_L}$. Under one-sided asymmetric information effort, probability of success and utility in an interior solution are

$$\begin{aligned} x_A^{AI}(v_A, v_L, v_H) &= \frac{v_L v_H v_A^2 \left((1-q)\sqrt{v_L} + q\sqrt{v_H}\right)^2}{\left(v_H v_L + v_A\left((1-q)v_L + q v_H\right)\right)^2} \\ x_H^{AI}(v_A, v_L, v_H) &= \frac{\left((1-q)\sqrt{v_L} + q\sqrt{v_H}\right) v_A v_H \sqrt{v_L v_H}}{\left(v_H v_L + v_A\left((1-q)v_L + q v_H\right)\right)^2}\left(\sqrt{v_H} v_L + q v_A\left(\sqrt{v_H} - \sqrt{v_L}\right)\right) \\ x_L^{AI}(v_A, v_L, v_H) &= \frac{\left((1-q)\sqrt{v_L} + q\sqrt{v_H}\right) v_A v_L \sqrt{v_L v_H}}{\left(v_H v_L + v_A\left((1-q)v_L + q v_H\right)\right)^2}\left(\sqrt{v_L} v_H - (1-q) v_A\left(\sqrt{v_H} - \sqrt{v_L}\right)\right) \\ p_A^{AI}(v_A, v_L, v_H) &= \frac{v_A\left((1-q)\sqrt{v_L} + q\sqrt{v_H}\right)^2}{\left(v_H v_L + v_A\left((1-q)v_L + q v_H\right)\right)} \\ p_H^{AI}(v_A, v_L, v_H) &= 1 - \frac{v_A\left((1-q)\sqrt{v_L} + q\sqrt{v_H}\right)}{\left(v_H v_L + v_A\left((1-q)v_L + q v_H\right)\right)}\sqrt{v_L} \\ p_L^{AI}(v_A, v_L, v_H) &= 1 - \frac{v_A\left((1-q)\sqrt{v_L} + q\sqrt{v_H}\right)}{\left(v_H v_L + v_A\left((1-q)v_L + q v_H\right)\right)}\sqrt{v_H} \\ \pi_A^{AI}(v_A, v_L, v_H) &= \frac{v_A^3\left(q\sqrt{v_H} + (1-q)\sqrt{v_L}\right)^2\left(q v_H + (1-q)v_L\right)}{\left(v_A\left(q v_H + (1-q)v_L\right) + v_L v_H\right)^2} \\ \pi_H^{AI}(v_A, v_L, v_H) &= \frac{\left(q v_A v_H\left(\sqrt{v_H} - \sqrt{v_L}\right) + v_H^{3/2} v_L\right)^2}{\left(q v_A(v_H - v_L) + v_L(v_A + v_H)\right)^2} \\ \pi_L^{AI}(v_A, v_L, v_H) &= \frac{\left(v_L^{3/2}(v_A(1-q) + v_H) - (1-q) v_A \sqrt{v_H} v_L\right)^2}{\left(q v_A(v_H - v_L) + v_L(v_A + v_H)\right)^2}. \end{aligned} \tag{4}$$

A.2 Acquiring Information

Let us consider lobbying group A's incentives to acquire information. The difference in expected utility is equal to

$$\begin{aligned}\Delta\pi_A \quad = \quad & \frac{(1-q)qv_A^3\left(\sqrt{v_H}-\sqrt{v_L}\right)^2\left(v_A-\sqrt{v_H}\sqrt{v_L}\right)}{(v_A+v_H)^2(v_A+v_L)^2(qv_A\left(v_H-v_L\right)+v_Av_L+v_Hv_L)^2}\\ & \times\Big(\left(v_H-v_L\right)q\left(v_A^3-3v_A^2\sqrt{v_Lv_H}-v_Av_Hv_L-v_H^{3/2}v_L^{3/2}\right)\\ & -2qv_A\sqrt{v_Lv_H}\left(v_H^2-v_L^2\right)+v_A^3v_L-3v_A^2\sqrt{v_H}v_L^{3/2}-4v_Av_H^{3/2}v_L^{3/2}\\ & -v_Av_H^2v_L-2v_A\sqrt{v_H}v_L^{5/2}-2v_Av_Hv_L^2-v_H^{5/2}v_L^{3/2}-2v_H^{3/2}v_L^{5/2}-2v_H^2v_L^2\Big)\end{aligned}$$

For $v_A<\sqrt{v_Hv_L}$ A clearly prefers to acquire information, while for $v_A=\sqrt{v_Hv_L}$ it is indifferent. For v_A slightly larger than $\sqrt{v_Hv_L}$ it prefers ignorance while for v_A approaching v_H it might prefer to acquire information again. This implies we have to be careful about staying in an interior solution, in other words we need $v_L \geq \frac{(1-q)^2v_A^2v_H}{((1-q)v_A+v_H)^2}$ or $v_A \leq \frac{v_H\sqrt{v_L}}{(1-q)\left(\sqrt{v_H}-\sqrt{v_L}\right)}$.

Let $q=\frac{1}{2}$. Then the difference in utility for group A between complete-information and asymmetric information is equal to

$$\begin{aligned}\Delta\pi_A\mid_{q=\frac{1}{2}} \quad = \quad & \frac{v_A^3\left(\sqrt{v_H}-\sqrt{v_L}\right)^2\left(v_A-\sqrt{v_H}\sqrt{v_L}\right)}{2(v_A+v_H)^2(v_A+v_L)^2(v_Av_H+v_Av_L+2v_Hv_L)^2}\\ & \times\Big(\left(v_H+v_L\right)\left(v_A^3-3v_A^2\sqrt{v_H}\sqrt{v_L}-3v_Av_Hv_L-3v_H^{3/2}v_L^{3/2}\right)\\ & -2v_A\sqrt{v_H}\sqrt{v_L}\left(v_H^2+4v_Hv_L+v_L^2\right)-4v_H^2v_L^2\Big)\end{aligned}$$

We can show that this is unambiguously positive for $v_A<\sqrt{v_Lv_H}$ and negative for $v_A>\sqrt{v_Lv_H}$ given that we are in an interior solution. For $v_H>9v_L$ the condition for an interior solution is binding. So for $v_H<9v_L$ v_A can be as high as v_H. Let us plug this into the expression in brackets: $v_H^4-5v_H^{7/2}\sqrt{v_L}-14v_H^{5/2}v_L^{3/2}-5v_H^{3/2}v_L^{5/2}-2v_H^3v_L-7v_H^2v_L^2$. This is clearly strictly negative for all $v_H<9v_L$. For $v_H>9v_L$ we insert the highest possible v_A into the expression in brackets carries the sign of: $-\left(4v_H^{3/2}-7v_H\sqrt{v_L}+v_L^{3/2}\right)$ which is always negative for $v_H>9v_L$.

A.3 Disclosing Information

To see whether group B prefers to disclose or not it is sufficient to look at group A's effort difference between full and asymmetric information. Since less investment of the opponent is strictly preferred given a fixed investment, it is even more so, if B can in addition optimally react. If A invests more under complete information against B, B will clearly prefer asymmetric information. Define $\Delta x_i := x_i^{CI} - x_i^{AI}$, $i = AH, AL$. Then the difference in A's effort is equal to

$$
\begin{aligned}
\Delta x_{AH} &= \frac{v_A^2 v_H}{(v_A+v_H)^2} - \frac{v_L v_H v_A^2 \left((1-q)\sqrt{v_L}+q\sqrt{v_H}\right)^2}{\left(v_H v_L + v_A\left((1-q)v_L+qv_H\right)\right)^2} \\
&= \frac{q v_A^2 v_H^{3/2}\left(\sqrt{v_H}-\sqrt{v_L}\right)\left(v_A-\sqrt{v_H}\sqrt{v_L}\right)}{(v_A+v_H)^2\left(v_H v_L + v_A\left((1-q)v_L+qv_H\right)\right)^2} \\
&\quad \times \left(q v_A\sqrt{v_H}\sqrt{v_L} + q v_A v_H + 2(1-q)v_A v_L + q v_H^{3/2}\sqrt{v_L} + (2-q)v_H v_L\right) \\
\Delta x_{AL} &= \frac{v_A^2 v_L}{(v_A+v_L)^2} - \frac{v_L v_H v_A^2 \left((1-q)\sqrt{v_L}+q\sqrt{v_H}\right)^2}{\left(v_H v_L + v_A\left((1-q)v_L+qv_H\right)\right)^2} \\
&= -\frac{(1-q)v_A^2 v_L^{3/2}\left(\sqrt{v_H}-\sqrt{v_L}\right)\left(v_A-\sqrt{v_H}\sqrt{v_L}\right)}{(v_A+v_L)^2\left(v_H v_L + v_A\left((1-q)v_L+qv_H\right)\right)^2} \\
&\quad \times \left((1-q)\left(v_A\sqrt{v_H}\sqrt{v_L} + v_A v_L + \sqrt{v_H}v_L^{3/2}\right) + 2q v_A v_H + q v_H v_L + v_H v_L\right).
\end{aligned}
$$

At $v_A = \sqrt{v_L v_H}$ A's effort is identical, while for $v_A > \sqrt{v_L v_H}$ A underinvests against a high-value opponent and overinvests against a low-value one under asymmetric information. The opposite holds true for $v_A < \sqrt{v_L v_H}$. Hence it follows that for $v_A > \sqrt{v_L v_H}$ a high-value B prefers not to disclose, while a low-value one prefers disclosure and vice versa for $v_A < \sqrt{v_L v_H}$. Now let us consider the ex-ante expected utility of group B when it has not yet learned its value. Define $\Delta \pi_i := \pi_i^{CI} - \pi_i^{AI}$, $i = H, L, B$. Then

$$
\begin{aligned}
&E[\Delta\pi_B] = q\Delta\pi_L + (1-q)\Delta\pi_H = \frac{-(1-q)q v_A\left(\sqrt{v_H}-\sqrt{v_L}\right)^2\left(v_A-\sqrt{v_H}\sqrt{v_L}\right)}{(v_A+v_H)^2(v_A+v_L)^2(q v_A(v_H-v_L)+v_A v_L+v_H v_L)^2} \\
&\times\left(\left(v_H^2-v_L^2\right)q v_A^2\left(v_A^2+v_A\sqrt{v_H v_L}+4v_H v_L\right) + q v_A\left(2v_A^2 v_H v_L + 2v_A v_H^{3/2}v_L^{3/2} + 2v_H^2 v_L^2\right)(v_H-v_L)\right. \\
&+ v_A^4 v_L^2 + v_A^3\left(2v_H^{3/2}v_L^{3/2} + 2v_H^2 v_L + \sqrt{v_H}v_L^{5/2} + 4v_H v_L^2 + 2v_L^3\right) + v_A\left(4v_H^3 v_L^2 + 6v_H^2 v_L^3 + 3v_H^{5/2}v_L^{5/2}\right) \\
&\left.+ v_A^2\left(2v_H^{5/2}v_L^{3/2} + 4v_H^{3/2}v_L^{5/2} + 2v_H^3 v_L + 7v_H^2 v_L^2 + 6v_H v_L^3\right) + 2v_H^3 v_L^3 + 2q v_A^3\left(v_H^3-v_L^3\right)\right)
\end{aligned}
$$

Hence for $v_A = \sqrt{v_L v_H}$ group B is also indifferent in expectation whether to disclose or not, while for $v_A > \sqrt{v_L v_H}$ it prefers not to disclose and for $v_A < \sqrt{v_L v_H}$ disclosure is optimal.

A.4 Signaling of Valuation

Now lobbying group B has the possibility to expend money before the contest in order to signal its valuation. To show whether and when a separating equilibrium exists, consider the following set up. Each group L and H can send a costly signal to A before the contest, which we denote by s_i. The signal is completely unproductive and only serves the signaling objective. We assume signaling costs are $c(s) = s$ for both groups. The game has a separating equilibrium when it is possible for L to send a signal which H does not want to mimic and vice versa.

We first look at $v_A > \sqrt{v_L v_H}$. In this situation we know from the above discussion that L prefers complete information, while H is better off under asymmetric information. Hence

L would like to signal its type and H would like to hinder it by mimicking its behavior by setting $s_H = s_L$. A's beliefs are the following: that any signal $s_B \geq \hat{s}_L$ indicates B has identity L, otherwise B has identity H. Because the signal is costly individual rationality implies $s_B \in \{0, \hat{s}_L\}$. In a separating equilibrium we must have that $s_L = \hat{s}_L$ and $s_H = 0$. That is, each group's incentive compatibility (IC) constraint has to hold and no group has an incentive to mimic the behavior of the other. The respective IC constraints are

$$\begin{aligned} IC_L(v_A > \sqrt{v_L v_H}) \quad &: \quad \frac{v_L^3}{(v_L+v_A)^2} - \hat{s}_L \geq v_L - \frac{2v_A\sqrt{v_L v_H}}{v_A+v_H} + \frac{v_A^2 v_H}{(v_A+v_H)^2} \\ IC_H(v_A > \sqrt{v_L v_H}) \quad &: \quad \frac{v_H^3}{(v_A+v_H)^2} \geq v_H - \frac{2v_A\sqrt{v_H v_L}}{v_A+v_L} + \frac{v_A^2 v_L}{(v_A+v_L)^2} - \hat{s}_L \end{aligned}$$

It is easily shown that it is not possible to find $\hat{s}_L > 0$ fulfilling both inequalities simultaneously. Hence, there does not exist a separating equilibrium when $v_A > \sqrt{v_L v_H}$, and as a result no information is transferred and both groups engage in an incomplete information contest.

Now turn to $v_A \leq \sqrt{v_L v_H}$. In this case, it is H who wants so signal its identity to overcome incomplete information, while L wants to hinder it. A believes it is facing H in the contest whenever the signal is $s_B \geq \hat{s}_H$. Otherwise it believes it is facing L. Individual rationality implies now $s_B \in \{0, \hat{s}_H\}$. In a separating equilibrium we must have $s_L = 0$ and $s_H = \hat{s}_H$. The respective IC constraints are now

$$IC_L(v_A \leq \sqrt{v_L v_H}) \quad : \quad \frac{v_L^3}{(v_L+v_A)^2} \geq v_L - \frac{2v_A\sqrt{v_L v_H}}{v_A+v_H} + \frac{v_A^2 v_H}{(v_A+v_H)^2} - \hat{s}_H \tag{5}$$

$$IC_H(v_A \leq \sqrt{v_L v_H}) \quad : \quad \frac{v_H^3}{(v_A+v_H)^2} - \hat{s}_H \geq v_H - \frac{2v_A\sqrt{v_H v_L}}{v_A+v_L} + \frac{v_A^2 v_L}{(v_A+v_L)^2} \tag{6}$$

It is now easily verified that there exists a range of signals $\hat{s}_H$ for which both inequalities hold simultaneously. From the intuitive criterion (Cho and Kreps, 1987) it follows that the equilibrium value of $\hat{s}_H$ makes L exactly indifferent between mimicking H or not, so that (5) holds with equality. Then we have

$$\hat{s}_H^+ = v_L + \frac{v_A^2 v_H}{(v_A+v_H)^2} - \frac{v_L^3}{(v_L+v_A)^2} - \frac{2v_A\sqrt{v_L v_H}}{v_A+v_H} > 0.$$

Also, if $\hat{s}_H = \hat{s}_H^+$ the beliefs of group A are correct and therefore there exists a separating equilibrium. Note, however, that all values $\hat{s}_H > \hat{s}_H^+$ also support a separating equilibrium as long as (6) still holds. Therefore, we proved that a separating equilibrium with endogenous information transmission exists if and only if $v_A \leq \sqrt{v_L v_H}$, which proves the proposition.

B Proof of Lemma 1

To see this, first note that (i) reaction functions are hump-shaped and (ii) reach a maximum where $x_A = x_B$, i.e. where the reaction function crosses the 45 degree line (for a proof see Yildirim (2005)). Moreover, we find an equilibrium on this line exactly when $v_A = v_B$, i.e. when the game is symmetric. Let us denote complete-information symmetric efforts for $v_A = v_L$ by x_L and for $v_A = v_H$ by x_H. Keeping the valuation of the opponent fixed, a group's effort is strictly increasing in its own valuation. So let v_A increase from v_L to v_H. Then the effort of the L-value type is strictly decreasing (strategic substitute) and the effort of the H-value type is strictly increasing (strategic complement). If the opponent is of the L-value type, x_A increases from x_L to some $x_{HL} > x_L$. To the contrary, if the opponent is of the H type x_A increases from some $x_{LH} < x_L$ to x_H. Note that $x_H > x_{HL} > x_L > x_{LH}$, i.e. if the opponent is of the H-value type A's effort is at the beginning lower and at the end higher compared to the L-value type. Accordingly, by continuity there has to be some $\widehat{v}_A \in (v_L, v_H)$ for which efforts against both types of the other group are identical and equal to $\widehat{x}_A$.

If $v_A = \widehat{v}_A$ group A will spend the same lobbying effort in the complete information games and in the asymmetric information game in equilibrium. Accordingly, both types of group B will choose the same effort independent of the informational environment, implying A's costs and winning probabilities are identical and thus A is indifferent between both information regimes. $\square$

C Proof of Proposition 4

We showed in Lemma 1 that at $v_A = \widehat{v}_A$ both groups are indifferent between complete information and asymmetric information. We now prove also Proposition 4. To do this we need to analyze the derivative of both groups' difference in utilities between complete and asymmetric information. We derive some preliminary results concerning effort comparative statics at $v_A = \widehat{v}_A$ under both informational arrangements with respect to changes in v_A. We then use these results to prove first the information acquisition part of the proposition and then also information disclosure.

C.1 Preliminaries

Here we derive some comparative statics results we need later on. Because we do not have closed form solutions for equilibrium efforts we totally differentiate the systems of first-order conditions and use Cramer's rule.

Under complete information the system of first-order conditions is:

$$
\begin{aligned}
\frac{\partial \pi_{AL}^{CI}}{\partial x_{AL}^{CI}}|_{v_A=\widehat{v}_A} &= \frac{\partial p_L(x_{AL}^{CI}, x_L^{CI})}{\partial x_{AL}^{CI}}\widehat{v}_A - 1 \stackrel{!}{=} 0 \\
\frac{\partial \pi_{AH}^{CI}}{\partial x_{AH}^{CI}}|_{v_A=\widehat{v}_A} &= \frac{\partial p_H(x_{AH}^{CI}, x_H^{CI})}{\partial x_{AH}^{CI}}\widehat{v}_A - 1 \stackrel{!}{=} 0 \\
\frac{\partial \pi_{L}^{CI}}{\partial x_{L}^{CI}}|_{v_A=\widehat{v}_A} &= -\frac{\partial p_L(x_{AL}^{CI}, x_L^{CI})}{\partial x_{AL}^{CI}}v_L - 1 \stackrel{!}{=} 0 \\
\frac{\partial \pi_{H}^{CI}}{\partial x_{H}^{CI}}|_{v_A=\widehat{v}_A} &= -\frac{\partial p_H(x_{AH}^{CI}, x_H^{CI})}{\partial x_{AH}^{CI}}v_H - 1 \stackrel{!}{=} 0
\end{aligned}
$$

Letting $i = L, H$, totally differentiating these first order conditions yields the following matrix system:

$$
\underbrace{\begin{pmatrix} \frac{\partial^2 p_i}{\partial (x_{Ai}^{CI})^2}\widehat{v}_A & \frac{\partial^2 p_i}{\partial x_{Ai}^{CI}\partial x_i^{CI}}\widehat{v}_A \\ -\frac{\partial^2 p_i}{\partial x_i^{CI}\partial x_{Ai}^{CI}}v_i & -\frac{\partial^2 p_i}{\partial (x_i^{CI})^2}v_i \end{pmatrix}}_{=A_i} \begin{pmatrix} \frac{dx_{Ai}^{CI}}{dv_A} \\ \frac{dx_i^{CI}}{dv_A} \end{pmatrix} = \begin{pmatrix} -\frac{\partial p_i}{\partial x_{Ai}^{CI}} \\ 0 \end{pmatrix}
$$

Define

$$
A_{i1} = \begin{pmatrix} -\frac{\partial p_i}{\partial x_{Ai}^{CI}} & \frac{\partial^2 p_i}{\partial x_{Ai}^{CI}\partial x_i^{CI}}\widehat{v}_A \\ 0 & -\frac{\partial^2 p_i}{\partial (x_i^{CI})^2}v_i \end{pmatrix}, \quad A_{i2} = \begin{pmatrix} \frac{\partial^2 p_i}{\partial (x_{Ai}^{CI})^2}\widehat{v}_A & -\frac{\partial p_i}{\partial x_{Ai}^{CI}} \\ -\frac{\partial^2 p_i}{\partial x_i^{CI}\partial x_{Ai}^{CI}}v_i & 0 \end{pmatrix}.
$$

From Cramer's rule it follows that $\frac{\partial x_{Ai}^{CI}}{\partial v_A} = \frac{|A_{i1}|}{|A_i|}$ as well as $\frac{\partial x_i^{CI}}{\partial v_A} = \frac{|A_{i2}|}{|A_i|}$ in equilibrium. Hence

$$
\frac{\partial x_{AL}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A} = \frac{-\frac{\partial^2 p_L}{\partial x_L^2}}{\left(\frac{\partial^2 p_L}{\partial x_A^2}\frac{\partial^2 p_L}{\partial x_L^2} - \left(\frac{\partial^2 p_L}{\partial x_A \partial x_L}\right)^2\right)\widehat{v}_A^2} > 0 \tag{7}
$$

$$
\frac{\partial x_{AH}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A} = \frac{-\frac{\partial^2 p_H}{\partial x_H^2}}{\left(\frac{\partial^2 p_H}{\partial x_A^2}\frac{\partial^2 p_H}{\partial x_H^2} - \left(\frac{\partial^2 p_H}{\partial x_A \partial x_H}\right)^2\right)\widehat{v}_A^2} > 0 \tag{8}
$$

$$
\frac{\partial x_{L}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A} = \frac{\frac{\partial^2 p_L}{\partial x_A \partial x_L}}{\left(\frac{\partial^2 p_L}{\partial x_A^2}\frac{\partial^2 p_L}{\partial x_L^2} - \left(\frac{\partial^2 p_L}{\partial x_A \partial x_L}\right)^2\right)\widehat{v}_A^2} < 0 \tag{9}
$$

$$
\frac{\partial x_{H}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A} = \frac{\frac{\partial^2 p_H}{\partial x_A \partial x_H}}{\left(\frac{\partial^2 p_H}{\partial x_A^2}\frac{\partial^2 p_H}{\partial x_H^2} - \left(\frac{\partial^2 p_H}{\partial x_A \partial x_H}\right)^2\right)\widehat{v}_A^2} > 0 \tag{10}
$$

These comparative statics show how equilibrium efforts at $v_A = \widehat{v}_A$ react to changes in v_A if there is complete information.

Under asymmetric information the system of first-order conditions is:

$$
\begin{aligned}
\frac{\partial \pi_A^{AI}}{\partial x_A^{AI}}|_{v_A=\widehat{v}_A} &= \left(q\frac{\partial p_L(x_A^{AI},x_L^{AI})}{\partial x_A^{AI}}+(1-q)\frac{\partial p_H(x_A^{AI},x_H^{AI})}{\partial x_A^{AI}}\right)\widehat{v}_A-1\overset{!}{=}0\\
\frac{\partial \pi_L^{AI}}{\partial x_L^{AI}}|_{v_A=\widehat{v}_A} &= -\frac{\partial p_L(x_A^{AI},x_L^{AI})}{\partial x_L^{AI}}v_L-1\overset{!}{=}0\\
\frac{\partial \pi_H^{AI}}{\partial x_H^{AI}}|_{v_A=\widehat{v}_A} &= -\frac{\partial p_H(x_H^{AI},x_H^{AI})}{\partial x_H^{AI}}v_H-1\overset{!}{=}0
\end{aligned}
$$

Totally differentiating yields the following matrix system:

$$
\underbrace{\begin{pmatrix}
\left(q\frac{\partial^2 p_L}{\partial (x_A^{AI})^2}+(1-q)\frac{\partial^2 p_H}{\partial (x_A^{AI})^2}\right)\widehat{v}_A & q\frac{\partial^2 p_L}{\partial x_A^{AI}\partial x_L^{AI}}\widehat{v}_A & (1-q)\frac{\partial^2 p_H}{\partial x_A^{AI}\partial x_H^{AI}}\widehat{v}_A\\
-\frac{\partial^2 p_L}{\partial x_L^{AI}\partial x_A^{AI}}v_L & -\frac{\partial^2 p_L}{\partial (x_L^{AI})^2}v_L & 0\\
-\frac{\partial^2 p_H}{\partial x_H^{AI}\partial x_A^{AI}}v_H & 0 & -\frac{\partial^2 p_H}{\partial (x_H^{AI})^2}v_H
\end{pmatrix}}_{=B}
\begin{pmatrix}
\frac{dx_A^{AI}}{dv_A}\\
\frac{dx_L^{AI}}{dv_A}\\
\frac{dx_H^{AI}}{dv_A}
\end{pmatrix}
=
\begin{pmatrix}
-q\frac{\partial p_L}{\partial x_A^{AI}}-(1-q)\frac{\partial p_H}{\partial x_A^{AI}}\\
0\\
0
\end{pmatrix}
$$

Define

$$
\begin{aligned}
B_1 &= \begin{pmatrix}
-q\frac{\partial p_L}{\partial x_A^{AI}}-(1-q)\frac{\partial p_H}{\partial x_A^{AI}} & q\frac{\partial^2 p_L}{\partial x_A^{AI}\partial x_L^{AI}}\widehat{v}_A & (1-q)\frac{\partial^2 p_H}{\partial x_A^{AI}\partial x_H^{AI}}\widehat{v}_A\\
0 & -\frac{\partial^2 p_L}{\partial (x_L^{AI})^2}v_L & 0\\
0 & 0 & -\frac{\partial^2 p_H}{\partial (x_H^{AI})^2}v_H
\end{pmatrix}\\
B_2 &= \begin{pmatrix}
\left(q\frac{\partial^2 p_L}{\partial (x_A^{AI})^2}+(1-q)\frac{\partial^2 p_H}{\partial (x_A^{AI})^2}\right)\widehat{v}_A & -q\frac{\partial p_L}{\partial x_A^{AI}}-(1-q)\frac{\partial p_H}{\partial x_A^{AI}} & (1-q)\frac{\partial^2 p_H}{\partial x_A^{AI}\partial x_H^{AI}}\widehat{v}_A\\
-\frac{\partial^2 p_L}{\partial x_L^{AI}\partial x_A^{AI}}v_L & 0 & 0\\
-\frac{\partial^2 p_H}{\partial x_H^{AI}\partial x_A^{AI}}v_H & 0 & -\frac{\partial^2 p_H}{\partial (x_H^{AI})^2}v_H
\end{pmatrix}\\
B_3 &= \begin{pmatrix}
\left(q\frac{\partial^2 p_L}{\partial (x_A^{AI})^2}+(1-q)\frac{\partial^2 p_H}{\partial (x_A^{AI})^2}\right)\widehat{v}_A & q\frac{\partial^2 p_L}{\partial x_A^{AI}\partial x_L^{AI}}\widehat{v}_A & -q\frac{\partial p_L}{\partial x_A^{AI}}-(1-q)\frac{\partial p_H}{\partial x_A^{AI}}\\
-\frac{\partial^2 p_L}{\partial x_L^{AI}\partial x_A^{AI}}v_L & -\frac{\partial^2 p_L}{\partial (x_L^{AI})^2}v_L & 0\\
-\frac{\partial^2 p_H}{\partial x_H^{AI}\partial x_A^{AI}}v_H & 0 & 0
\end{pmatrix}
\end{aligned}
$$

It follows again from Cramer's rule that $\frac{\partial x_A^{AI}}{\partial v_A}=\frac{|B_1|}{|B|}$, $\frac{\partial x_L^{AI}}{\partial v_A}=\frac{|B_2|}{|B|}$, and $\frac{\partial x_H^{AI}}{\partial v_A}=\frac{|B_3|}{|B|}$, and hence

$$
\frac{\partial x_A^{AI}}{\partial v_A}|_{v_A=\widehat{v}_A} = \frac{-\frac{\partial^2 p_H}{\partial x_H^2}\frac{\partial^2 p_L}{\partial x_L^2}}{\left(\frac{\partial^2 p_L}{\partial x_L^2}(1-q)\left(\frac{\partial^2 p_H}{\partial x_H^2}\frac{\partial^2 p_H}{\partial x_A^2}-\left(\frac{\partial^2 p_H}{\partial x_A\partial x_H}\right)^2\right)+\frac{\partial^2 p_H}{\partial x_H^2}q\left(\frac{\partial^2 p_L}{\partial x_L^2}\frac{\partial^2 p_L}{\partial x_A^2}-\left(\frac{\partial^2 p_L}{\partial x_A\partial x_L}\right)^2\right)\right)\widehat{v}_A^2} > 0 \quad (11)
$$

$$
\frac{\partial x_L^{AI}}{\partial v_A}|_{v_A=\widehat{v}_A} = \frac{\frac{\partial^2 p_L}{\partial x_A\partial x_L}\frac{\partial^2 p_H}{\partial x_H^2}}{\left(\frac{\partial^2 p_L}{\partial x_L^2}(1-q)\left(\frac{\partial^2 p_H}{\partial x_H^2}\frac{\partial^2 p_H}{\partial x_A^2}-\left(\frac{\partial^2 p_H}{\partial x_A\partial x_H}\right)^2\right)+\frac{\partial^2 p_H}{\partial x_H^2}q\left(\frac{\partial^2 p_L}{\partial x_L^2}\frac{\partial^2 p_L}{\partial x_A^2}-\left(\frac{\partial^2 p_L}{\partial x_A\partial x_L}\right)^2\right)\right)\widehat{v}_A^2} < 0 \quad (12)
$$

$$
\frac{\partial x_H^{AI}}{\partial v_A}|_{v_A=\widehat{v}_A} = \frac{\frac{\partial^2 p_H}{\partial x_A\partial x_H}\frac{\partial^2 p_L}{\partial x_L^2}}{\left(\frac{\partial^2 p_L}{\partial x_L^2}(1-q)\left(\frac{\partial^2 p_H}{\partial x_H^2}\frac{\partial^2 p_H}{\partial x_A^2}-\left(\frac{\partial^2 p_H}{\partial x_A\partial x_H}\right)^2\right)+\frac{\partial^2 p_H}{\partial x_H^2}q\left(\frac{\partial^2 p_L}{\partial x_L^2}\frac{\partial^2 p_L}{\partial x_A^2}-\left(\frac{\partial^2 p_L}{\partial x_A\partial x_L}\right)^2\right)\right)\widehat{v}_A^2} > 0 \quad (13)
$$

Those comparative statics are the marginal change of equilibrium efforts under asymmetric information if v_A changes at $\widehat{v}_A$.

C.2 Information Acquisition

We showed in Lemma 1 that if $v_A = \widehat{v}_A$ group A is indifferent between ignorance and complete information. To prove the proposition we show that the derivative of the difference of utilities of A with respect to v_A is non-zero at $v_A = \widehat{v}_A$. Using $p_i = \frac{f(x_A)}{f(x_A)+f(x_i)}$ and $x_i = x_B^i$, $i = H, L$ to shorten the exposition, the derivative of $\Delta\pi_A$ at $\widehat{v}_A$ is equal to

$$\begin{aligned}\frac{\partial \Delta\pi_A}{\partial v_A}|_{v_A=\widehat{v}_A} &= \left((1-q) \left(\frac{\partial p_H}{\partial x_A} \left(\frac{\partial x_{AH}^{CI}}{\partial v_A} - \frac{\partial x_A^{AI}}{\partial v_A} \right) + \frac{\partial p_H}{\partial x_H} \left(\frac{\partial x_H^{CI}}{\partial v_A} - \frac{\partial x_H^{AI}}{\partial v_A} \right) \right) \right. \\ &+ \left. q \left(\frac{\partial p_L}{\partial x_A} \left(\frac{\partial x_{AL}^{CI}}{\partial v_A} - \frac{\partial x_A^{AI}}{\partial v_A} \right) + \frac{\partial p_L}{\partial x_L} \left(\frac{\partial x_L^{CI}}{\partial v_A} - \frac{\partial x_L^{AI}}{\partial v_A} \right) \right) \right) \widehat{v}_A - \left((1-q) \frac{\partial x_{AH}^{CI}}{\partial v_A} + q \frac{\partial x_{AL}^{CI}}{\partial v_A} \right) + \frac{\partial x_A^{AI}}{\partial v_A}.\end{aligned}$$

We know that $v_A > 0$, $0 < q < 1$. $\frac{\partial p_H}{\partial x_A} = \frac{\partial p_L}{\partial x_A} = \frac{1}{v_A}$ and $\frac{\partial p_L}{\partial x_L} = -\frac{1}{v_L} < \frac{\partial p_H}{\partial x_H} = -\frac{1}{v_H} < 0$ follow from the first order conditions of the two groups. The derivative simplifies to

$$\frac{\partial \Delta\pi_A}{\partial v_A}|_{v_A=\widehat{v}_A} = -\left(\frac{(1-q)}{v_H} \left(\frac{\partial x_H^{CI}}{\partial v_A} - \frac{\partial x_H^{AI}}{\partial v_A} \right) + \frac{q}{v_L} \left(\frac{\partial x_L^{CI}}{\partial v_A} - \frac{\partial x_L^{AI}}{\partial v_A} \right) \right) \widehat{v}_A.$$

This derivative will only be zero, if a change in v_A induces the same effect on B's complete-information effort as on its asymmetric information effort, or if they just offset each other for the two types weighted by the probability q and their valuation. The relevant comparative statics were derived in equations (7), (8), (12), and (13). $\frac{\partial^2 p_L}{\partial x_A^2} < 0$, $\frac{\partial^2 p_H}{\partial x_A^2} < 0$, $\frac{\partial^2 p_H}{\partial x_H^2} > 0$ and $\frac{\partial^2 p_L}{\partial x_L^2} > 0$ follow from the shape of the CSF. $\frac{\partial^2 p_L}{\partial x_A x_L} > 0$ and $\frac{\partial^2 p_H}{\partial x_A x_H} < 0$ come from the fact that at $v_A = \widehat{v}_A$ A is an underdog against an opponent with valuation v_H but a favorite against an opponent with valuation v_L. Using this, the derivative of the difference in utilities equals

$$\begin{aligned}\frac{\partial \Delta\pi_A}{\partial v_A}|_{v_A=\widehat{v}_A} &= -\frac{\left(\frac{\partial^2 p_L}{\partial x_L^2} \left(\frac{\partial^2 p_H}{\partial x_H^2} \frac{\partial^2 p_H}{\partial x_A^2} - \left(\frac{\partial^2 p_H}{\partial x_A \partial x_H} \right)^2 \right) + \frac{\partial^2 p_H}{\partial x_H^2} \left(\left(\frac{\partial^2 p_L}{\partial x_A \partial x_L} \right)^2 - \frac{\partial^2 p_L}{\partial x_L^2} \frac{\partial^2 p_L}{\partial x_A^2} \right) \right)}{\left(\frac{\partial^2 p_L}{\partial x_A^2} \frac{\partial^2 p_L}{\partial x_L^2} - \left(\frac{\partial^2 p_L}{\partial x_A \partial x_L} \right)^2 \right) \left(\frac{\partial^2 p_H}{\partial x_A^2} \frac{\partial^2 p_H}{\partial x_H^2} - \left(\frac{\partial^2 p_H}{\partial x_A \partial x_H} \right)^2 \right) v_A \, v_H \, v_L} \times \qquad (14) \\ & \frac{\left(\frac{\partial^2 p_L}{\partial x_A \partial x_L} \, v_H \left(\frac{\partial^2 p_H}{\partial x_A^2} \frac{\partial^2 p_H}{\partial x_H^2} - \left(\frac{\partial^2 p_H}{\partial x_A \partial x_H} \right)^2 \right) + \frac{\partial^2 p_H}{\partial x_A \partial x_H} \, v_L \left(\left(\frac{\partial^2 p_L}{\partial x_A \partial x_L} \right)^2 - \frac{\partial^2 p_L}{\partial x_A^2} \frac{\partial^2 p_L}{\partial x_L^2} \right) \right) q\,(1-q)}{\left(\frac{\partial^2 p_L}{\partial x_L^2} (1-q) \left(\frac{\partial^2 p_H}{\partial x_H^2} \frac{\partial^2 p_H}{\partial x_A^2} - \left(\frac{\partial^2 p_H}{\partial x_A \partial x_H} \right)^2 \right) + \frac{\partial^2 p_H}{\partial x_H^2} q \left(\frac{\partial^2 p_L}{\partial x_L^2} \frac{\partial^2 p_L}{\partial x_A^2} - \left(\frac{\partial^2 p_L}{\partial x_A \partial x_L} \right)^2 \right) \right)}\end{aligned}$$

which has the sign of

$$\text{Sign}\left[\frac{\partial \Delta\pi_A}{\partial v_A}|_{v_A=\widehat{v}_A} \right] = \text{Sign}\left[-\left(\frac{\partial^2 p_L}{\partial x_L^2} \left(\frac{\partial^2 p_H}{\partial x_H^2} \frac{\partial^2 p_H}{\partial x_A^2} - \left(\frac{\partial^2 p_H}{\partial x_A \partial x_H} \right)^2 \right) - \frac{\partial^2 p_H}{\partial x_H^2} \left(\frac{\partial^2 p_L}{\partial x_L^2} \frac{\partial^2 p_L}{\partial x_A^2} - \left(\frac{\partial^2 p_L}{\partial x_A \partial x_L} \right)^2 \right) \right) \right].$$

Intuitively this term relates $\frac{\partial x_{AH}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A}$ to $\frac{\partial x_{AL}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A}$. For $\frac{\partial x_{AH}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A} > \frac{\partial x_{AL}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A}$ it will be negative and for $\frac{\partial x_{AH}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A} < \frac{\partial x_{AL}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A}$ it will be positive. For our CSF given in equation (2) it will always be negative. This means that starting at $x_A^L = x_A^H$ a slight increase in v_A will lead to a relatively higher increase in effort on the part of group A against the high-type opponent.[9] Hence we find that at $v_A = \widehat{v}_A$ the derivative of $\Delta\pi_A$ is strictly negative. Thus there exist some valuations $v_A > \widehat{v}_A$ where ignorance is bliss.

C.3 Information Disclosure

At $v_A = \widehat{v}_A$ group B is exactly indifferent whether it discloses its information or not, ex-ante as well as ex-interim, as group A always chooses the same lobbying effort. Let us now vary v_A marginally from there. The derivative of the difference in the expected utility of player B between complete information and asymmetric information with respect to v_A at $\widehat{v}_A$ can be written as

$$\begin{aligned}
\frac{\partial \Delta\pi_B}{\partial v_A}|_{v_A=\widehat{v}_A} &= (1-q)\left(v_H\left(-\frac{\partial p_H}{\partial x_A}\left(\frac{\partial x_{AH}^{CI}}{\partial v_A}-\frac{\partial x_A^{AI}}{\partial v_A}\right)-\frac{\partial p_H}{\partial x_H}\left(\frac{\partial x_H^{CI}}{\partial v_A}-\frac{\partial x_H^{AI}}{\partial v_A}\right)\right)-\left(\frac{\partial x_H^{CI}}{\partial v_A}-\frac{\partial x_H^{AI}}{\partial v_A}\right)\right) \\
&+ q\left(v_L\left(-\frac{\partial p_L}{\partial x_A}\left(\frac{\partial x_{AL}^{CI}}{\partial v_A}-\frac{\partial x_A^{AI}}{\partial v_A}\right)-\frac{\partial p_L}{\partial x_L}\left(\frac{\partial x_L^{CI}}{\partial v_A}-\frac{\partial x_L^{AI}}{\partial v_A}\right)\right)-\left(\frac{\partial x_L^{CI}}{\partial v_A}-\frac{\partial x_L^{AI}}{\partial v_A}\right)\right) \\
&= \left((1-q)v_H\left(\frac{\partial x_A^{AI}}{\partial v_A}-\frac{\partial x_{AH}^{CI}}{\partial v_A}\right)+q\,v_L\left(\frac{\partial x_A^{AI}}{\partial v_A}-\frac{\partial x_{AL}^{CI}}{\partial v_A}\right)\right)\frac{1}{\widehat{v}_A},
\end{aligned}$$

where we used $p_i = \frac{f(x_A)}{f(x_A)+f(x_i)}$ and $x_i = x_B^i$, $i = H, L$ to shorten the exposition. We know that $v_A > 0$, $0 < q < 1$. $\frac{\partial p_H}{\partial x_A} = \frac{\partial p_L}{\partial x_A} = \frac{1}{v_A}$ and $\frac{\partial p_L}{\partial x_L} = -\frac{1}{v_L} < \frac{\partial p_H}{\partial x_H} = -\frac{1}{v_H} < 0$ follow from the first-order conditions of the two groups. The relevant equilibrium comparative statics of efforts were derived in equations (7), (8), and (11). Using these in our derivative yields

$$\begin{aligned}
\frac{\partial \Delta\pi_B}{\partial v_A}|_{v_A=\widehat{v}_A} &= \frac{\left(\frac{\partial^2 p_H}{\partial x_H^2}\left(\left(\frac{\partial^2 p_L}{\partial x_A \partial x_L}\right)^2-\frac{\partial^2 p_L}{\partial x_L^2}\frac{\partial^2 p_L}{\partial x_A^2}\right)+\frac{\partial^2 p_L}{\partial x_L^2}\left(\frac{\partial^2 p_H}{\partial x_H^2}\frac{\partial^2 p_H}{\partial x_A^2}-\left(\frac{\partial^2 p_H}{\partial x_A \partial x_H}\right)^2\right)\right)}{\left(\frac{\partial^2 p_L}{\partial x_A^2}\frac{\partial^2 p_L}{\partial x_L^2}-\left(\frac{\partial^2 p_L}{\partial x_A \partial x_L}\right)^2\right)\left(\frac{\partial^2 p_H}{\partial x_A^2}\frac{\partial^2 p_H}{\partial x_H^2}-\left(\frac{\partial^2 p_H}{\partial x_A \partial x_H}\right)^2\right)v_A^3} \times \\
&\frac{\left(\frac{\partial^2 p_H}{\partial x_H^2}v_H\left(\left(\frac{\partial^2 p_L}{\partial x_A \partial x_L}\right)^2-\frac{\partial^2 p_L}{\partial x_A^2}\frac{\partial^2 p_L}{\partial x_L^2}\right)+\frac{\partial^2 p_L}{\partial x_L^2}v_L\left(\frac{\partial^2 p_H}{\partial x_A^2}\frac{\partial^2 p_H}{\partial x_H^2}-\left(\frac{\partial^2 p_H}{\partial x_A \partial x_H}\right)^2\right)\right)q\,(1-q)}{\left(\frac{\partial^2 p_L}{\partial x_L^2}(1-q)\left(\frac{\partial^2 p_H}{\partial x_H^2}\frac{\partial^2 p_H}{\partial x_A^2}-\left(\frac{\partial^2 p_H}{\partial x_A \partial x_H}\right)^2\right)+\frac{\partial^2 p_H}{\partial x_H^2}q\left(\frac{\partial^2 p_L}{\partial x_L^2}\frac{\partial^2 p_L}{\partial x_A^2}-\left(\frac{\partial^2 p_L}{\partial x_A \partial x_L}\right)^2\right)\right)} < 0,
\end{aligned} \tag{15}$$

where we use $\frac{\partial^2 p_L}{\partial x_A^2} < 0$, $\frac{\partial^2 p_H}{\partial x_A^2} < 0$, $\frac{\partial^2 p_H}{\partial x_H^2} > 0$ and $\frac{\partial^2 p_L}{\partial x_L^2} > 0$ which follow from the shape of the CSF. $\frac{\partial^2 p_L}{\partial x_A x_L} > 0$ and $\frac{\partial^2 p_H}{\partial x_A x_H} < 0$ come from the fact that at $v_A = \widehat{v}_A$ A is an underdog against an opponent with valuation v_H but a favorite against an opponent with valuation v_L and

$$\frac{\partial^2 p_H}{\partial x_H^2}\left(\left(\frac{\partial^2 p_L}{\partial x_A \partial x_L}\right)^2-\frac{\partial^2 p_L}{\partial x_L^2}\frac{\partial^2 p_L}{\partial x_A^2}\right)+\frac{\partial^2 p_L}{\partial x_L^2}\left(\frac{\partial^2 p_H}{\partial x_H^2}\frac{\partial^2 p_H}{\partial x_A^2}-\left(\frac{\partial^2 p_H}{\partial x_A \partial x_H}\right)^2\right) > 0.$$

[9] Note that for more general CSF the opposite case can arise and A increases its effort more against the low-type opponent. Then there will be a value of ignorance for $v_A < \widehat{v}_A$.

Intuitively this term relates $\frac{\partial x_{AH}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A}$ to $\frac{\partial x_{AL}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A}$. For $\frac{\partial x_{AH}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A} > \frac{\partial x_{AL}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A}$ it will be positive and for $\frac{\partial x_{AH}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A} < \frac{\partial x_{AL}^{CI}}{\partial v_A}|_{v_A=\widehat{v}_A}$ it will be negative. For our CSF given in equation (2) it will always be positive. This means that starting at $x_A^L = x_A^H$ a slight increase in v_A will lead to a relatively higher increase in effort on the part of group A against the high-type opponent. Hence we find that at $v_A = \widehat{v}_A$ the derivative in (15) is strictly negative.

Putting together the information disclosure and information acquisition part, the proof of the proposition follows from the proof of Corollary 1. □

D Proof of Propositions 5 and 6

Expected aggregate effort with contest success function $p_i = \frac{x_i}{x_i+x_j}$ under complete information is equal to

$$E\left[\sum_{i=\{A,B\}} x_i^{CI}\right] = \frac{v_A\left(\left(\left(1-q\right)v_H + qv_L\right)v_A + v_L v_H\right)}{\left(v_A+v_H\right)\left(v_A+v_L\right)},$$

while expected aggregate effort under one-sided asymmetric information is equal to

$$E\left[\sum_{i=\{A,B\}} x_i^{AI}\right] = \left(\left(1-q\right)\sqrt{v_H} + q\sqrt{v_L}\right)\frac{\left(\left(1-q\right)\frac{1}{\sqrt{v_H}} + q\frac{1}{\sqrt{v_L}}\right)}{\left(\frac{1}{v_A} + \left(\frac{(1-q)}{v_H} + \frac{q}{v_L}\right)\right)}.$$

Their difference is equal to

$$\begin{aligned} E\left[\sum_{i=\{A,B\}} \Delta x\right] &= \frac{v_A\left(\left(\left(1-q\right)v_H + qv_L\right)v_A + v_L v_H\right)}{\left(v_A+v_H\right)\left(v_A+v_L\right)} - \left(\left(1-q\right)\sqrt{v_H} + q\sqrt{v_L}\right)\frac{\left(\left(1-q\right)\frac{1}{\sqrt{v_H}} + q\frac{1}{\sqrt{v_L}}\right)}{\left(\frac{1}{v_A} + \left(\frac{(1-q)}{v_H} + \frac{q}{v_L}\right)\right)} \\ &= \frac{\left(1-q\right)qv_A\left(\sqrt{v_H} - \sqrt{v_L}\right)^2\left(v_A - \sqrt{v_H v_L}\right)\left(v_A\left(\sqrt{v_H v_L} + v_H + v_L\right) + v_H v_L\right)}{(v_A+v_H)(v_A+v_L)(qv_A(v_H-v_L) + v_L(v_A+v_H))}. \end{aligned}$$

It is easily observed that this is positive for $v_A > \sqrt{v_H v_L}$ and negative otherwise hence proving Proposition 5.

Efficiency implies that the informational regime should be chosen to maximize $q\frac{x_A}{x_A+x_L} + \left(1-q\right)\frac{x_H}{x_A+x_H}$ as we assume $v_L \leq v_A \leq v_H$. We get

$$\Delta\left(q\frac{x_A}{x_A+x_L} + \left(1-q\right)\frac{x_H}{x_A+x_H}\right) = -\frac{(1-q)qv_A(v_H-v_L)\left(v_A^2 - v_H v_L\right)}{(v_A+v_H)(v_A+v_L)(qv_A(v_H-v_L) + v_L(v_A+v_H))},$$

which is positive for $v_A < \sqrt{v_H v_L}$ and negative else. □

E Proof of Proposition 7

Full information strategies for a match with valuations $v_i > v_j$ are given by the bidding distribution functions

$$\begin{aligned}
F_j(x; v_j, v_i) &= \frac{v_i - v_j}{v_i} + \frac{x}{v_i} \\
F_i(x; v_i, v_j) &= \frac{x}{v_j},
\end{aligned}$$

for $x \in [0, v_j]$. In the following let $F_i(x; v_j)$ indicate the bidding distribution of group i facing another group j and denote the corresponding density function by $f_i(x; v_j)$. The ex-ante expected complete information payoffs are

$$\begin{aligned}
\pi_H^{CI} &= v_H - v_A \\
\pi_L^{CI} &= 0 \\
\pi_A^{CI} &= q\left(v_A - v_L\right).
\end{aligned}$$

Those results are standard and the proofs can be found for example in Hillman and Riley (1989) or Baye, Kovenock, and de Vries (1996). Using the equilibrium strategies it is easily verified that expected aggregate effort is equal to

$$\begin{aligned}
X^{CI} &= q \int_0^{v_L} \left(f_A(x; v_L) + f_L(x; v_A)\right) x\, dx + (1-q) \int_0^{v_A} \left(f_A(x; v_H) + f_H(x; v_A)\right) x\, dx \\
&= q \int_0^{v_L} \left(\frac{x}{v_L} + \frac{x}{v_A}\right) dx + (1-q) \int_0^{v_A} \left(\frac{x}{v_A} + \frac{x}{v_H}\right) dx \\
&= \frac{q}{2}\left(\frac{v_L^2}{v_A} + v_L\right) + \frac{(1-q)}{2}\left(v_A + \frac{v_A^2}{v_H}\right)
\end{aligned}$$

and that expected allocative efficiency (the ex-ante probability that the player with higher valuation wins) equals

$$\begin{aligned}
EF^{CI} &= q \int_0^{v_L} F_L^{CI}(x; v_A)\, f_A^{CI}(x; v_L)\, dx + (1-q) \int_0^{v_A} F_A^{CI}(x; v_H)\, f_H^{CI}(x; v_A)\, dx \\
&= q \int_0^{v_L} \left(\frac{v_A - v_L}{v_A} + \frac{x}{v_A}\right) \frac{1}{v_L}\, dx + (1-q) \int_0^{v_A} \left(\frac{v_H - v_A}{v_H} + \frac{x}{v_H}\right) \frac{1}{v_A}\, dx \\
&= (1-q)\left(1 - \frac{v_A}{2v_H}\right) + q\left(1 - \frac{v_L}{2v_A}\right).
\end{aligned}$$

Under one-sided asymmetric information consider first the case where v_A is relatively small, $v_A \leq \tilde{v}_A \equiv \frac{v_L}{q + \frac{v_L}{v_H}(1-q)}$. We then find that A's bidding/effort distribution function has a mass point at zero. The groups' equilibrium strategies are given by the distribution functions

$$\begin{aligned}
F_A^{AI}(x;v_L,v_H) &= \begin{cases} \frac{v_H-(1-q)v_A}{v_H} - \frac{qv_A}{v_L} + \frac{x}{v_L} & \text{for} \quad x\in[0,qv_A] \\ \frac{v_H-v_A}{v_H} + \frac{x}{v_H} & \text{for} \quad x\in[qv_A,v_A] \end{cases} \\
F_L^{AI}(x;v_A) &= \frac{x}{qv_A} \text{ for } x\in[0,qv_A] \\
F_H^{AI}(x;v_A) &= \frac{x-qv_A}{(1-q)\,v_A} \text{ for } x\in[qv_A,v_A].
\end{aligned}$$

That those distribution functions indeed characterize an equilibrium is easily verified and we leave this to the reader (a proof is available upon request). Equilibrium payoffs in this case are

$$\begin{aligned}
\pi_A^{AI} &= 0 < \pi_A^{CI} = q\,(v_A - v_L) \\
\pi_H^{AI} &= v_H - v_A = \pi_H^{CI} \\
\pi_L^{AI} &= v_L \frac{v_H-(1-q)\,v_A}{v_H} - qv_A > \pi_L^{CI} = 0.
\end{aligned}$$

A prefers complete information while B weakly prefers asymmetric information — the L-type is better off while the H-type is indifferent.

Expected aggregate effort is equal to

$$\begin{aligned}
X_{v_A\le\tilde{v}_A}^{AI} &= q\int_0^{qv_A}\left(f_A^{AI}(x;v_L,v_H)+f_L^{AI}\right)x\,dx + (1-q)\int_{qv_A}^{v_A}\left(f_A^{AI}(x;v_L,v_H)+f_H^{AI}\right)x\,dx \\
&= \int_0^{qv_A}\left(\frac{x}{v_A}+\frac{x}{v_L}\right)dx + \int_{qv_A}^{v_A}\left(\frac{x}{v_A}+\frac{x}{v_H}\right)dx \\
&= \frac{v_A\,\left(q^2v_A(v_H-v_L)+v_L(v_A+v_H)\right)}{2v_Hv_L}
\end{aligned}$$

and expected allocative efficiency is equal to

$$\begin{aligned}
EF_{v_A\le\tilde{v}_A}^{AI} &= q\int_0^{qv_A} F_L^{AI}(x;v_A)f_A(x;v_L)\,dx + (1-q)\int_{qv_A}^{v_A} F_A^{AI}(x;v_H)f_H(x;v_A)\,dx \\
&= q\int_0^{q\,v_A}\frac{x}{q\,v_A}\frac{1}{v_L}\,dx + (1-q)\int_{qv_A}^{v_A}\left(\frac{v_H-(1-q)v_A}{v_H}-\frac{qv_A}{v_L}+\frac{x}{v_L}\right)\frac{1}{(1-q)v_A}\,dx \\
&= \frac{q^2v_Av_H-(q-1)v_L[(q-1)v_A+2v_H]}{2v_Hv_L}.
\end{aligned}$$

Now consider $v_A > \tilde{v}_A = \frac{v_L}{q+\frac{v_L}{v_H}(1-q)}$. Here only L's effort distribution has a mass point, which is at zero.

$$
\begin{aligned}
F_A^{AI}(x;v_L,v_L) &= \begin{cases} \frac{x}{v_L} & \text{for} \quad x\in[0,\underline{x}] \\ \frac{x}{v_H}+\left(1-\frac{(1-q)v_A}{v_H}\right)\left(1-\frac{v_L}{v_H}\right) & \text{for} \quad x\in[\underline{x},\overline{x}] \end{cases} \\
F_L^{AI}(x;v_A) &= \frac{x}{qv_A}+1-\frac{v_L}{qv_A}+\frac{v_L(1-q)}{qv_H} \text{ for } x\in[0,\underline{x}] \\
F_H^{AI}(x;v_A) &= \frac{x}{(1-q)\,v_A}+\frac{v_L}{v_H}-\frac{v_L}{(1-q)\,v_A} \text{ for } x\in[\underline{x},\overline{x}],
\end{aligned}
$$

where $\underline{x}=v_L-(1-q)\,v_A\frac{v_L}{v_H}$ and $\overline{x}=v_L+(1-q)\,v_A\left(1-\frac{v_L}{v_H}\right)$. The corresponding expected equilibrium payoffs are

$$
\begin{aligned}
\pi_A^{AI} &= qv_A-v_L+\frac{(1-q)\,v_Av_L}{v_H}<\pi_A^{CI}=q\,(v_A-v_L) \\
\pi_H^{AI} &= v_H-v_L-v_A\,(1-q)\left(1-\frac{v_L}{v_H}\right)>v_H-v_A=\pi_H^{CI} \\
\pi_L^{AI} &= 0=\pi_L^{CI}.
\end{aligned}
$$

B prefers asymmetric information, since the H-type is better off while the L-type is indifferent, whereas A prefers full information. Ex-ante expected aggregate effort is equal to

$$
\begin{aligned}
X_{v_A>\tilde{v}_A}^{AI} &= \int_0^{\underline{x}}\left(f_A^{AI}(x;v_L)+f_L^{AI}(x;v_A)\right)\,x\,dx+\int_{\underline{x}}^{\overline{x}}\left(f_A^{AI}(x;v_L)+f_L^{AI}(x;v_A)\right)\,x\,dx \\
&= \frac{\frac{v_L(v_A+v_L)((q-1)v_A+v_H)^2}{v_A}+(q-1)(v_A+v_H)((q-1)v_A(v_H-2v_L)-2v_Hv_L)}{2v_H^2}
\end{aligned}
$$

and expected allocative efficiency equals

$$
\begin{aligned}
EF_{v_A>\tilde{v}_A}^{AI} &= q\int_0^{\underline{x}}F_L^{AI}(x;v_A)\,f_A(x;v_L)\,dx+(1-q)\int_{\underline{x}}^{\overline{x}}F_A^{AI}(x;v_L)\,f_H(x;v_A)\,dx \\
&= \frac{v_Av_H\left(\left(q^2-1\right)v_A+2v_H\right)-v_L((q-1)v_A+v_H)^2}{2v_A{v_H}^2}.
\end{aligned}
$$

To complete the proof note that when A and B disagree on information transmission, we assumed their payoffs to be smaller than $\max\left\{\pi_i^{CI},\pi_i^{AI}\right\}$, the exact value depending on how exactly information transmission works. Hence disclosing information is weakly dominated for B and staying ignorant is weakly dominated for A. □

F Continuous uniform distribution

Let us assume that B's value is distributed uniformly on $[\underline{v},\overline{v}]$, with $v_A \in [\underline{v},\overline{v}]$. In case both lobbying groups know their respective valuations, equilibrium efforts are equal to

$$x_i^{CI}(v_i,v_j) \quad = \quad \frac{v_i^2 v_j}{(v_i+v_j)^2},$$

and utilities

$$\begin{aligned}
\pi_A^{CI} &= \int_{\underline{v}}^{\overline{v}} \frac{v_A^3}{(v_A+v_B)^2} dF(v_B) = \frac{1}{\overline{v}-\underline{v}}\left(\frac{v_A^3}{v_A+\underline{v}} - \frac{v_A^3}{v_A+\overline{v}}\right) \\
\pi_B^{CI} &= \frac{v_B^3}{(v_B+v_A)^2} \\
E[\pi_B^{CI}] &= \frac{\frac{v_A^3}{v_A+\overline{v}} + 3v_A^2\ln[v_A+\overline{v}] - 2v_A\overline{v} + \frac{\overline{v}^2}{2} - \left(\frac{v_A^3}{v_A+\underline{v}} + 3v_A^2\ln[v_A+\underline{v}] - 2v_A\underline{v} + \frac{\underline{v}^2}{2}\right)}{\overline{v}-\underline{v}}.
\end{aligned}$$

The expected utility of lobbying group A if it does not know the value of group B is equal to

$$\pi_A^{AI} \quad = \quad \frac{1}{\overline{v}-\underline{v}}\left(\int_{\underline{v}}^{\overline{v}} \frac{x_A}{x_A+x_B(v_B)} dv_B\right) v_A - x_A.$$

Taking the derivative and setting it equal to zero

$$\frac{\partial \pi_A^{AI}}{\partial x_A} \quad = \quad \frac{1}{\overline{v}-\underline{v}}\left(\int_{\underline{v}}^{\overline{v}} \frac{x_B(v_B)}{(x_A+x_B(v_B))^2} dv_B\right) v_A - 1$$

we get A's first order condition. Plugging this into group B's reaction function $x_B(x_A) = \max\left\{\sqrt{x_A v_B} - x_A, 0\right\}$ we can solve for the equilibrium efforts. Focussing on interior solutions we get the following equilibrium efforts.

$$\begin{aligned}
x_A^{AI} &= \left(\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}\right)^2 \\
x_B^{AI} &= \sqrt{v_B\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}} - \left(\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}\right)^2
\end{aligned}$$

A and B's equilibrium utility under one-sided asymmetric information is equal to

$$\begin{aligned}
\pi_A^{AI} &= \frac{\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A(\ln[\overline{v}]-\ln[\underline{v}])+(\overline{v}-\underline{v})}}{\overline{v}-\underline{v}}\left(\int_{\underline{v}}^{\overline{v}}\frac{1}{\sqrt{v_B}}dv_B\right)v_A-\left(\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}\right)^2 \\
&= \frac{\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A(\ln[\overline{v}]-\ln[\underline{v}])+(\overline{v}-\underline{v})}}{\overline{v}-\underline{v}}2\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)v_A-\left(\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}\right)^2
\end{aligned}$$

$$\begin{aligned}
\pi_B^{AI} &= \frac{\sqrt{v_Bx_A}-x_A}{\sqrt{v_Bx_A}}v_B-\sqrt{v_Bx_A}+x_A=v_B-2\sqrt{x_Av_B}+x_A \\
&= v_B-2\sqrt{\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}v_B}+\left(\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}\right)^2
\end{aligned}$$

and B's expected utility before it learns its type

$$E[\pi_B^{AI}] = \frac{\overline{v}-\underline{v}}{2}-\frac{4}{3}\left(\overline{v}^{\frac{3}{2}}-\underline{v}^{\frac{3}{2}}\right)\sqrt{\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}}+\left(\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}\right)^2.$$

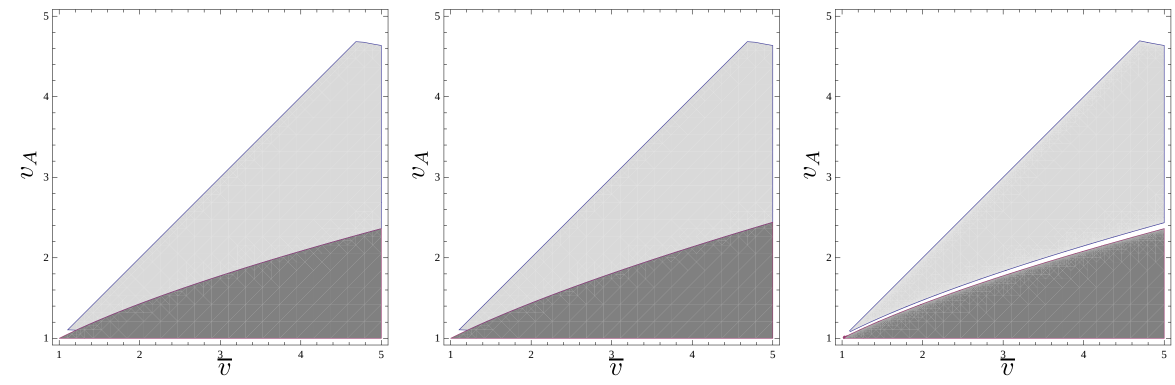
Now we consider the incentives to disclose or acquire information. The difference in utilities for A and B is equal to

$$\begin{aligned}
\Delta\pi_A &= \frac{1}{\overline{v}-\underline{v}}\left(\frac{v_A^3}{v_A+\underline{v}}-\frac{v_A^3}{v_A+\overline{v}}\right)-\left(\frac{\frac{\left(2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)\right)^2}{v_A(\ln[\overline{v}]-\ln[\underline{v}])+(\overline{v}-\underline{v})}}{\overline{v}-\underline{v}}-\left(\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}\right)^2\right) \\
\Delta\pi_B &= \frac{v_B^3}{(v_B+v_A)^2}-v_B-2\sqrt{\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}v_B}+\left(\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}\right)^2.
\end{aligned}$$

Ex-ante, before B knows its valuation the difference in expected utility is equal to

$$\begin{aligned}
\Delta E[\pi_B] &= \frac{\frac{v_A^3}{v_A+\overline{v}}+3v_A^2\ln[v_A+\overline{v}]-2v_A\overline{v}+\frac{\overline{v}^2}{2}-\left(\frac{v_A^3}{v_A+\underline{v}}+3v_A^2\ln[v_A+\underline{v}]-2v_A\underline{v}+\frac{\underline{v}^2}{2}\right)}{\overline{v}-\underline{v}} \\
&\quad -\frac{\overline{v}-\underline{v}}{2}+\frac{4}{3}\left(\overline{v}^{\frac{3}{2}}-\underline{v}^{\frac{3}{2}}\right)\sqrt{\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}}-\left(\frac{2v_A\left(\sqrt{\overline{v}}-\sqrt{\underline{v}}\right)}{v_A\left(\ln[\overline{v}]-\ln[\underline{v}]\right)+(\overline{v}-\underline{v})}\right)^2.
\end{aligned}$$

These expressions are quite unwieldy and hence we illustrate the equivalents of Propositions 1 to 6 only graphically. Normalizing the lowest valuation to one, $\underline{v}=1$, we plot the differences in utility for A as well as B (from an ex-ante) between full and asymmetric information in Figure 4. $\overline{v}$ is plotted on the abscissa while v_A is on the ordinate. We plot only valuation pairs for which an interior solution exists. In the lightgray regions the lobbying groups prefer ignorance/non-disclosure, while in the darkgray region the lobbying groups prefer to acquire/disclose information. If A is relatively weak, information disclosure is favorable for both players while if A is relatively strong both players prefer asymmetric information exactly as in our baseline set-up in Section 2.

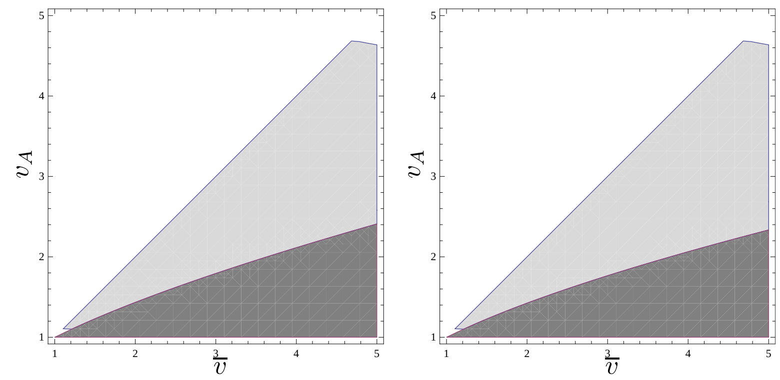


panel a) panel b) panel c)

Figure 4: Difference in expected utility for lobbying group A (panel a)) and B (panel b)). Zone of agreement (panel c))

We find that players generally agree whether to disclose B's valuation. Interestingly, only in a small region where A has an about average valuation, in other words v_A is close to $E[v_B]$, the players' preferences diverge. In these cases B prefers disclosure while A prefers to stay ignorant about B's value. This can be seen in panel c) of Figure 4.

To illustrate Propositions 5 and 6 we plot the difference in expected aggregate effort and expected efficiency under complete and asymmetric information. Figure 5 illustrates these differences. In the darkgray region disclosure leads to lower expected aggregate effort or higher expected allocative efficiency while in the lightgray region non-disclosure is preferable.



panel a) panel b)

Figure 5: Difference in aggregate effort (panel a)) and expected allocative efficiency (panel b)).

Overall we find that our results under a continuous uniform distribution are remarkably similar to the ones under only two types of player B, v_H and v_L.

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