DISCUSSION PAPER SERIES

No. 9199

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INTERNATIONAL TRADE AND REGIONAL ECONOMICS and PUBLIC POLICY

Centre for Economic Policy Research

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Available online at: **www.cepr.org/pubs/dps/DP9199.asp**

ISSN 0265-8003

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Discussion Paper No. 9199
October 2012

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CEPR Discussion Paper No. 9199

October 2012

ABSTRACT

Centralized decision making against informed lobbying*

We re-address the tradeoff between centralized and decentralized decision making of local policies when policymakers are subject to capture by special interest groups. In particular, we consider the case where lobbies have private information about their ability to exert influence. We find a new informational effect in the political game under centralized structures that gives the policymaker additional bargaining power against lobbies. Thus, when compared to decentralization, centralization reduces capture, and is more likely to be welfare enhancing in the presence of information asymmetries. Then, we apply the model to the classical problem of local public goods provision and to the incentives towards the creation of customs unions agreements.

JEL Classification: D72, D82, F15 and H41
Keywords: asymmetric information, centralization, custom unions, lobbying and public goods

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*We thank Carlos da Costa, Emanuel Ornelas, Filipe Campante, Giovanni Maggi for useful comments and seminar participants in EPGE-FGV, USP, USP-RP, Ibmec-RJ, Lames Rio, EEA Barcelona, NASM Evanston. A preliminary version of this paper circulated under the title "Lobbying and information transmission in customs unions." The first two authors thank Capes and CNPq of Brazil for financial support.

Submitted 22 October 2012

1 Introduction

The problem of allocation of decision rights inside governments is a central question in Public Economics. This is perhaps best illustrated by the classical debate on the costs and benefits of centralization versus decentralization of public decision making. In his seminal work on the provision of local public goods, Oates (1972) addressed this issue and emphasized the tradeoff between the relative importance of inter-district externalities (favoring centralized systems) and heterogeneity of preferences across districts (favoring decentralized systems). A subsequent literature embedded the discussion within a political economy framework reflecting the fact that centralized and decentralized systems face different political constraints or incentives in terms of public spending (Inman and Rubinfeld (1997), Lockwood (2002), and Besley and Coate (2003)).

Important dimensions along this line of research are that policymakers may be subject to political influence by specific interest groups and that the structure of public decision making may affect the likelihood of such political capture (Bardhan and Mokherjee (2000)). It is recognized that interest groups may influence the policy process through two specific channels. The first one is knowledge of private information that can be disclosed strategically according to one's own agenda. Alternatively, interest groups may also act as competing rent-seeking actors, influencing policymakers through bribes or financial contributions conditional on the policies they favor. Whatever the mechanism, the effectiveness of pressure groups is likely to depend on how the structure of decision rights in the government frames competition for political influence. In such a context, what are the costs and benefits of centralized and decentralized systems? What should the optimal structure of government be from the point of view of society?

The purpose of this paper is to consider these issues in a simplified context in which the two sources of influence (asymmetry of information and contributions) are closely connected. Specifically, we consider situations where special interest groups have private information on how policies affect their payoffs and at the same time may influence the political process through the use of financial contributions to politicians and policymakers. In such a setting, we compare the influence informed lobbying in centralized and decentralized decisions structures. Our starting point is to recognize the fact that centralized systems concentrate the political competition for influence at a higher common level of government and also generate more policy uniformity across localities than decentralized structures.

In such a context, we identify two effects that help reduce political capture in centralized systems. The first effect is a *preference dilution effect* that occurs independently from the structure of information asymmetries. In centralized systems, public decision making takes more encompassing policy views across districts. As a consequence, centralized policies tend to accommodate more preference tradeoffs across locations and the scope of influence by lobby groups located in different areas is reduced compared to decentralized systems. This preference dilution effect in turn reduces lobbies' incentives to spend money for political capture and therefore promotes policies that are more aligned with the general public interest.

Our main contribution is to show that in a context of asymmetric information, centralization also induces another effect: an *information transmission effect* that tends to reduce the degree of political capture by privately informed lobbying groups. This effect arises from the fact that in centralized systems, policies integrate cross-district specificities and therefore may create strategic informational interdependences for privately informed lobbies located in these districts. In fact, a centralized policymaker's willingness to grant a favorable policy to a lobby located in one area depends on how much that policy is also serving a "rival" lobby in another area. Lobbies having private information implies that each interest group's optimal influence strategy depends not only on her[1] own private information but also on the private information possessed by the other rival lobby. Under centralization however, each lobby proposes to the common policymaker financial contributions that may reveal part of her private information characteristics. In equilibrium, this feature allows the common policymaker to learn something about each lobby's private information. Since this is relevant for the design of his optimal influence strategy, a given lobby then has an incentive to screen from the policymaker what the latter has learned from rival lobbies. Screening however is costly and therefore induces lobbies to exert less influence. Additionally, information transmission increases the policymaker's bargaining power, so the latter enjoys political (informational) rents. As a consequence, policies get closer to the society's optimum and the level of capture decreases with information asymmetry.

Our second contribution is to discuss the conditions under which centralized systems are preferable to decentralized systems. In our simple setting, the tradeoff weights the preference dilution and information transmission effects against the standard costs of making a uniform central policy. Specifically, our analysis indicates that the larger the degree of lobbies' private information and the greater the extent of lobbies' preferences, the stronger the information transmission effect and dilution effect and therefore the more likely the centralized regime dominates the decentralized regime from a normative perspective. While an analytical characterization of the policy regimes is not possible for general preference functional forms, we provide a fully explicit solution of the political game under centralized and decentralized systems for simple linear and linear-quadratic parametric specifications.

Finally, we use the two previous examples to illustrate our model's implications in two classical problems of joint policy making: the provision of local public goods and the setting of an import tariff in customs unions agreements. The first application is quite direct: the amount of public good is a local policy decision. This decision can be undertaken by one policymaker in each district, or by a unique policymaker for both districts. Centralization implies that the unique policymaker has to set a uniform policy for both districts, but a centralized policy cannot satisfy districts with different policy preferences. In centralized decision making, information transmission increases the bargaining power of the policymaker. Therefore, the tradeoff between centralization and decentralization balances the gains from designing a policy tailored to the districts' influence-adjusted preferences in decentralization and the gains from decreased capture due to information transmission in centralization.

The second application considers the effects of a customs union agreement. In this agreement, countries remove all import tariffs between them and coordinate their trade policies to the same external import tariff for countries outside the union. The type of agreement therefore corresponds to a centralized decision structure. Conversely, when countries do not sign an agreement, the choice of the import tariff is decentralized. Abstracting from standard terms of trade effects associated with customs unions, our model highlights again the effects of information on the political game of trade protection. Setting a uniform tariff decided by a common policymaker changes the incentives of protectionist lobbies in each country participating in the union. This example illustrates how

[1]we refer to lobbies with feminine pronouns and to policy makers with masculine pronouns.

the information transmission effect can be a driving force for the creation of a customs union agreement.

The plan of the paper is the following. In the next section we discuss the related literature. Section 3 introduces a basic model of policy making under lobbying influence with two social entities and one lobby group associated with each entity. Section 4 computes the equilibrium policies of the political game under centralization and decentralization when there is perfect information. Section 5 then considers the case with lobby specific private information. In particular, we provide the explicit characterization of the equilibrium policies and contributions for the linear and linear-quadratic parametric examples. Section 6 discusses the optimality of the centralized and the decentralized structures under both perfect and asymmetric information. Sections 7 and 8 provide the application of our simple parametric examples to the contexts of local public good provision and customs union agreements. Finally, Section 9 concludes and discusses avenues for future research.

2 Related literature

This paper investigates how capture affects policy decisions according to the structure of decision making. Bardhan and Mookherjee (2000) and Bordingnon, Colombo, and Galmarini (2008) have also approached this issue. In Bardhan and Mookherjee (2000) centralization is better when lobbies are less well-organized at the national level while decentralization dominates when local districts have a strong preferences for one party. Centralized and decentralized structures have different impacts because voters have different levels of awareness and lobbies have different levels of cohesion in the two decision structures. In particular, policies are uniform under centralized structures. In our case, the centralized and decentralized structures affect differently political competition because of information screening and its implications for lobbying incentives.

Bourdignon, Colombo, and Galamarini (2008) also studied the effects of lobbying under centralization and decentralization in a setting similar to ours.[2] They find that centralization is better when the lobbies' preferences are conflicting while decentralization is better when these preferences are aligned. In our paper, we restrict lobbies' preferences to be aligned (apart from a difference in intensity) but we allow information asymmetries between lobbies and the policymaker. This is crucial to the generation of our *information transmission* effect under centralization.

As already mentioned, our paper is related to the classical work of Oates (1972). As in Oates (1972), we allow for heterogeneity in districts' preferences. However, in order to present the effects of lobbying and *information transmission* in the simplest possible way, we do not allow inter-district spillovers. In our setting, decentralization is always welfare superior in the absence of lobbying. The benefits from centralization come uniquely from the dilution of lobbying influences and from the *information transmission* effect. As is well known in a perfect information context, introducing district spillovers would make the case for centralization even stronger. Moreover, under asymmetric information, our basic argument for the existence of a beneficial *information transmission* effect also would be reinforced. Indeed with cross-districts spillovers, a central policymaker would design his policies to correct for such cross-district externalities. These policies would naturally depend on cross-district characteristics. Under lobbies' private information about

[2] However, they allow lobbies to influence policymakers of other districts even under decentralization and there are interdistrict externalities which, for simplification, we do not address in our model.

these characteristics, this feature would create the information strategic interdependence in the political game between lobbies that is at the heart of our *information transmission* effect.

In the context of local public good provision, other papers address different political economy aspects of the tradeoff between centralization and decentralization (Seabright (1996), Lookwood (2002), Besley and Coate (2003), and Redoano and Scharf (2004)). For instance, Seabright (1996) focuses on the effect of greater accountability of politicians in decentralized decisions versus the increased coordination in centralized decisions. Lockwood (2002) and Besley and Coate (2003) break down the uniformity of policies in centralized decisions, but consider a "common pool" system of financing for local public goods, so one district could end up financing the public good for the other district. As a result, centralization can lead to overspending on local public goods. Redoano and Scharf (2004) investigate the incentives for policy centralization in direct and indirect democracies.

Our second application to customs unions is related to the large literature on the political economy of trade agreements. Similar to our work, De Melo, Panagariya, and Rodrik (1993) also identify a preference dilution effect and finds that a trade agreement (not only a customs union) reduces the relative weight of lobbies in the objective function of decision makers when such policymakers take into consideration the impact of policies on partner countries. Richardson (1993) compares free trade areas (FTAs) and customs unions, and finds the second type of agreement to be welfare superior because tariffs become a public good for lobbies in the same sector but from different countries. Hence, in customs unions the lobbies free ride on the contributions of each other and the overall protection decreases. Grossman and Helpman (1995) and Krishna (1998) also consider the role of politics in the incentives to sign preferential trade agreements (PTAs). In a context where tariffs are defined endogenously by lobbying, they find that trade diverting FTAs were more likely to be supported. Krishna (1998) also finds that the incentives for engaging in multilateral liberalization decrease after joining an FTA. More recently, Ornelas (2005a,b) and Maggi and Rodrigues-Clare (2007) discuss the role for lobbying before and after an agreement is signed. The first paper shows that rents that lobbies can capture decrease in an FTA, which makes these welfare decreasing agreements less likely to be implemented. The second paper considers the role of trade agreements as a commitment against future lobbying and also finds that trade agreements result in deeper liberalization when countries are more politically motivated. In contrast to these papers, we consider a lobbying model with asymmetric information which allows us to underline the role of our *information transmission* effect on the political incentives to create custom unions.

Compared to the previous literature, our main contribution is to address the tradeoff between centralization and decentralization with privately informed lobbying. In this sense, our paper also connects to the large literature on the role of lobbies as providers of information, such as Austen-Smith (1995), Austen-Smith and Wright (1992), Potters and Van-Winden (1992), and Bennedsen and Feldman (2006). In that literature, the lobby group owns information that is relevant for the decision maker and it may disclose this information, according to its interests. Therefore, lobbying potentially may improve efficiency. Our work follows a different approach, closer to Costa Lima and Moreira (2012) work which treats lobbies as rent-seekers with private information about their own preferences or technologies.

From a technical perspective, our analysis borrows from the literature on informed principal problems (Maskin and Tirole (1990)), and the recent theoretical literature on common agency with privately informed principals (Martimort and Moreira (2010) and Costa Lima and Moreira (2012)). The first literature provides the appropriate framework to analyze our political game under decentralization, while the second allows us to characterize the political game under centralization. We apply the techniques developed therein to contrast how centralized versus decentralized policy structures differentially affect political competition between privately informed interest groups. For linear and quadratic linear specifications, this allows us to uncover precisely how the *information transmission* effect contributes positively to the benefit of centralized systems.

3 The model

We consider an economy with two distinct entities (groups, districts, communities, countries,...), A and B. In each entity $i \in \{A, B\}$, a policymaker is needed to implement a local policy p_i.[3] Each entity is composed of two types of agents with different preferences regarding implementation of policy p_i. First, there is a continuum of identical individuals (the size of which is normalized to 1) having the following preferences:

$$W_i(p_i) = -\frac{1}{2}(p_i - \alpha_i)^2,$$

where α_i reflects the individual's preferred policy level in entity i. Second, there is also a politically organized lobby group. That lobby group reflects the interests of a small fraction of agents in entity i that have different preferences from the first group above. On top of that, the lobby can disburse money to influence the policymaker responsible for implementation of the policy. More precisely, we assume that the lobby's objective function can be described as:

$$V(\theta_i, p_i, C_i) = v(\theta_i, p_i) - C_i,$$

where θ_i is a specific parameter of the group and C_i the amount of money contributions that can be spent to influence policymaking.

Under decentralized decision making, each entity i is endowed with one policymaker. As is common in the influence lobbying literature (Bernstein and Whinston (1986) and Grossman and Helpman (1994, 1995)), we assume that this policymaker cares about the society's welfare but likes to receive money contributions, C_i. Specifically, his preferences are given by

$$U_i(p_i, C_i) = C_i - \frac{\lambda}{2}(p_i - \alpha_i)^2,$$

where λ is the relative preference between contributions and the society's welfare function.

Under centralization, the two entities can delegate the policy decision to a joint policymaker. In that case, this agent cares about the aggregate society's welfare and can be influenced by both lobbies. Additionally, we assume that the policymaker has to set a common policy p for both entities. This assumption of policy uniformity is natural when, by definition, centralization imposes

[3]For example, the policy p_i can be an amount of a local public good, a specific local tax or a regulation when the entities are geographic districts within the same national territory. It can be a "border" policy such as trade, immigration or international capital flow regulations when the entities themselves are national governments.

a common policy instrument between the two entities. For instance this is the case with a custom union or a regional economic union that uniformly regulates "border" policies of different national entities. In the case of fiscal federalism, this feature is not necessarily satisfied and may demand specific assumptions (see Besley and Coates (2003), Lockwood (2002), and Loeper (2011)). Still, as a first pass it may be useful to capture the idea that centralized decision making is less sensitive to local specificities than decentralized decision making. Moreover, as will be clear in the sequel, this assumption is not crucial for our basic conclusions. What is important for the *information transmission* effect that we identify is the fact that the policy of one entity generates externalities (any kind of externality) for the other entity. In this respect, uniformization of policies induces a public good component of centralized policymaking, which is then the simplest case of externalities that we need for our political game.

Specifically, the preferences of the joint policymaker under centralization can be represented as:

$$U(p, C_A, C_B) = \Sigma_i \left[C_i - \frac{\lambda}{2} (p - \alpha_i)^2 \right],$$

reflecting the sum of the preferences of the decentralized case over the two entities. We make the following assumptions.

Assumption 1

1. $\frac{\partial^2 v}{\partial^2 p}(\theta, p) \leq 0$, that is, for a given θ, $v(\theta, p)$ is concave in p.

2. $\frac{\partial v}{\partial p}(\theta, \alpha_i) > 0$, that is, the interest group's preferred policy is always greater than the society's preferred policy.[4]

Assumption 1.1 is made to ensure that we have interior solutions to the lobbies' utility maximization problem. Assumption 1.2 implies that the lobbies do not have opposing preferences for the policy. That is, apart from the differences in intensity, their preferences are aligned. This is reasonable for a situation when the main conflict of interest is between lobbies and the rest of society, and not between lobbies from different entities.

In order to get explicit analytical solutions for the basic tradeoffs of the model, we will also consider two specific functional forms for the lobbies' preference function $v(\cdot)$. These two functional forms will be useful to illustrate stylized versions of our problem in two interesting examples of policy centralization: the provision of local public goods within a federation (Section 7) and trade policy harmonization within a customs union (Section 8).

Example. (Quadratic) The lobbies' preferred policies are different from those of the society and are captured by the following function

$$v(\theta_i, p_i) = -\frac{1}{2} (p_i - \theta_i)^2.$$

Assumption 1.2 implies that $\theta_i > \alpha_i$ for both lobbies.

[4]The model could be set up with $\frac{\partial v}{\partial p}(\theta, \alpha_i) < 0$ without significant differences in the results. However, severe technical complications arise when there is no definite sign for this derivative.

Example. (Linear) The lobby preferences are not satiated in p. This can be represented by the following function

$$v(\theta_i, p_i) = \theta_i p_i.$$

In this case, the lobby's preferred policy is infinity.

The timing of the game is as follows:

(0) In each entity $i \in \{A, B\}$ nature draws the lobby types θ_i;

(1) Lobbies offer contributions to the policymaker(s);

(2) The policymaker(s) accept(s) or reject(s) the contributions;

(3) The policies are set, and if contributions are accepted, payments are made accordingly.

Benchmarks

To understand the effects of lobbying and political influence, it is first useful to present benchmark results without lobbying. With decentralized policies, each policymaker chooses the policy that maximizes the society's preferences. In this simple setup, that is exactly the society's preferred policy α_i. Therefore, in a decentralized policy making $\widetilde{p_i} = \alpha_i$, for all i, where $\widetilde{p_i}$ is the decentralized policy of district i without lobbying influence.

When the policymaker has to set a uniform policy for both entities, he solves the following problem

$$\max_p -\frac{1}{2}\left[(p-\alpha_A)^2 + (p-\alpha_B)^2\right],$$

which provides the optimal policy

$$\hat{p} = \frac{\alpha_A + \alpha_B}{2},$$

as simply the average of the districts' optimal policies.

Social welfare under decentralization is given by $W_i(\widetilde{p_i}) = 0$, for all i, while centralization provides $W_A(\hat{p}) + W_B(\hat{p}) = -\left(\frac{\alpha_A - \alpha_B}{2}\right)^2 < 0$. Obviously, decentralization yields higher payoffs since policies are tailored to meet the entities' social preferences. Under centralization, neither entity gets its preferred policy. By construction, the model therefore has a "decentralization bias," since we do not introduce any cross-entity externality that is part of the usual argument for policy centralization.

4 Political influence

Consider now the situation where policymakers can be influenced by the interest groups. We follow the standard influence lobby group literature (Bernheim and Whinston (1986) and Grossman and Helpman (1994, 1996)) that views the determination of policymaking as the outcome of a common agency game with different lobbies (principals) that use lobbying contributions as an incentive device to induce the policymaker (agent) to make specific policy choices. Compared to that literature however, we introduce the possibility of asymmetry of information between informed principals and uninformed agents, and focus on the interplay between lobbying and information asymmetries under centralized and decentralized structures. To do this, we first present the political game with perfect information under both decentralization and centralization.

Decentralization

By assumption there is one lobby in each entity i. The political game of influence in a decentralized system collapses therefore to a simple principal-agent model where each lobby incentivizes her local policymaker to implement her favored policy p_i. More precisely, given the realization of her specific parameter θ_i, the lobby of each entity i solves the following program

$$\max_{p_i} v\left(\theta_i, p_i\right) - C_i,$$

subject to the policymaker's participation constraint

$$C_i - \frac{\lambda}{2}\left(p - \alpha_i\right)^2 \geq 0,$$

which simplifies to

$$\max_{p_i} v\left(\theta_i, p_i\right) - \frac{\lambda}{2}\left(p_i - \alpha_i\right)^2.$$

The policy that solves this problem, $\check{p}(\theta_i)$, is the solution of the following first-order condition

$$\frac{\partial v}{\partial p_i}\left(\theta_i, \check{p}_i\right) = \lambda\left(\check{p}_i - \alpha_i\right). \tag{1}$$

From Assumption 1.2, it naturally follows that $\check{p}(\theta_i) > \alpha_i$, namely that the implemented policy $\check{p}(\theta_i)$ is above the policy level that maximizes the entity's social welfare. For our specific functional forms, we get the following expressions.

Example. (Quadratic)

$$\check{p}(\theta_i) = \frac{\theta_i}{1+\lambda} + \frac{\lambda\alpha_i}{1+\lambda}, \tag{2}$$

i.e., the policy is a weighted average between the lobby's preferred policy θ_i and the society's optimal policy α_i.

Example. (Linear)

$$\check{p}(\theta_i) = \frac{\theta_i}{\lambda} + \alpha_i, \tag{3}$$

i.e., the policy is given by the lobby's relative strength weighted by λ^{-1} plus the society's target.

In both cases, the policy is increasing in the lobby's type θ_i and, as θ_i tends to 0, it tends to the welfare optimal policy α_i.

Centralization

In a centralized structure, the policy is common to both entities. As a consequence, there is a public good component for both lobbies who offer contributions to the joint policymaker. While that policy maker now cares about the welfare of both districts, he is also subject to the influence of the two lobbies. After the realization of the specific parameters θ_A and θ_B, the political game becomes a standard common agency game in which each lobby i proposes a contribution schedule $C(p, \theta_i)$ to influence the choice of p. We follow Bernheim and Whinston (1996) and, as usual, assume that lobbies play truthful strategies. Thus, the equilibrium of the political game is equivalent to the solution of a centralized problem

$$\max_p v(\theta_A, p) + v(\theta_B, p) - \frac{\lambda}{2}\left((p - \alpha_A)^2 + (p - \alpha_B)^2\right).$$

The policy that solves this problem is $\bar{p}(\theta_A, \theta_B)$ such that

$$\frac{\partial v}{\partial p}(\theta_A, \bar{p}) + \frac{\partial v}{\partial p}(\theta_B, \bar{p}) = \lambda(2\bar{p} - \alpha_A - \alpha_B). \tag{4}$$

Again, from Assumption 1.2, we have that $\bar{p}(\theta_A, \theta_B) > {}^{(\alpha_A+\alpha_B)}/_{2}$. Equation (4) shows that under centralized decision making the equilibrium policy will reflect both the society's average preference and the lobbies' preferences. Again, for our specific functional forms, we get the following expressions.

Example. (Quadratic)

$$\bar{p}(\theta_A, \theta_B) = \frac{\theta_A + \theta_B}{2(1+\lambda)} + \frac{\lambda(\alpha_A + \alpha_B)}{2(1+\lambda)}. \tag{5}$$

Notice that as $\theta_A + \theta_B$ tends to $\alpha_A + \alpha_B$, the policy tends to the welfare optimal uniform policy.

Example. (Linear)

$$\bar{p}(\theta_A, \theta_B) = \frac{\theta_A + \theta_B}{2\lambda} + \frac{\alpha_A + \alpha_B}{2}. \tag{6}$$

Notice that as both θ_A and θ_B tend to zero, the policy tends to the welfare optimal uniform policy.

In both cases, the policy is the average of the decentralized policies under influence and is increasing in the lobbies' types.

5 Lobbying with private information

We consider now the situation where lobbies are privately informed about the parameter θ. As a result, the influence level is unknown ex-ante by the society and the policymaker. For simplicity, we restrict ourselves to the case where the lobby's private information is not "policy relevant," that is, it does not enter the society's welfare function directly. We assume that in each entity i the lobby's type θ_i is drawn from an i.i.d. uniform distribution $f(\theta) = 1/\left(\bar{\theta} - \underline{\theta}\right)$ on the interval $\left[\underline{\theta}, \bar{\theta}\right]$ with $3\underline{\theta} > \bar{\theta}$. We first begin with the analysis of the decentralized structure.

Decentralization

In a decentralized structure, each lobby offers contributions to the policymaker of her entity. The political game is thus an informed principal problem. Our model is set up so that the policymaker does not care directly about the type of lobby, i.e., this is a private value informed principal problem. Thus, the policymaker does not care about how far the lobby's preference is from his own, once the lobby's private information does not helps him make a better decision. What matters is whether or not the contribution compensates him for shifting away from his preferred policy. Hence, the policymaker does not take into account weather or not the contribution is revealing.[5]

Moreover, different types of a lobby want different policies, so they do not wish to offer a pooling contribution, and on the other hand, information is not relevant for the policy maker. This results in a political game where the lobby has no incentive to withdraw information. Hence, we can focus on informative contributions. As a consequence, there are no distortions due to information asymmetry and the equilibrium policies are the same as in the perfect information decentralized structure, namely $\check{p}(\theta_i)$ given by (1).

Centralization

In a centralized structure, lobbies offer contributions to the same policymaker. Each lobby is privately informed about the realization of his type θ_i and does not know his rival's type. Therefore, the utility maximization problem of each lobby can be tackled as an informed principal problem with the policymaker. Several remarks are in order. First, in this informed principal problem, each lobby has private information about his own type while the policymaker has no direct private information. However, the policymaker simultaneously receives the contributions from both lobbies. When the latter's contributions are separating, the policymaker learns the lobbies types in equilibrium. Given that lobbies with higher type ask for greater policy, the type of one lobby is relevant for the rival lobby' payoff. Then, each lobby's problem becomes a principal-agent problem where the policymaker is privately informed about the rival's type.

Second, from Maskin and Tirole (1990), we know that informed principals do not gain by postponing information revelation. This justifies our focus on informative equilibria with separating differentiable contribution schedules.[6] As a consequence, our political common agency game with exogenous asymmetric information between informed principals and an uninformed agent becomes endogenously, from the perspective of each principal, a principal-agent problem with an agent who is asymmetrically informed agent about the characteristics of the other principal.

[5]In informed principal problems, the principal can benefit from delaying information revelation if the agent's decision is influenced when the offered contract is contingent on the realization of a random variable. This requires a more complex contract, one where the policy and contribution are contingent on the information the principal reveals after the contract's acceptance. This complex contract introduces an *ex-ante* uncertainty to the agent at the moment of acceptance of the contract. Depending on the agent's utility, this uncertainty can help relax his individual rationality and incentive compatibility constraints (the constraints would only have to hold in expected value, not in every state), which can increase the surplus of the principal-agent relationship. Such a contract does not reveal the lobby's private information directly, but the principal would reveal her private information before the implementation of the policy. Nonetheless, Maskin and Tirole (1990) show that revelation delaying creates no surplus when the agent's preferences are quasi-linear, which is the case we analyze in this model. Thus, there is no benefit in offering a contract that delays revelation.

[6]This is also in the spirit of equilibrium allocations that are informative as in Spence (1973) and Riley (1979).

In solving that game, we follow closely Martimort and Moreira (2010). As stated previously, we restrict ourselves to separating equilibrium strategies reflecting the fact that a given lobby i chooses different contribution schedules $(C_i(\cdot, \theta_i))$ as his type θ_i changes. We first consider one lobby i's best response contribution schedules to the rival lobby j's strategy, assuming that the latter uses a separating strategy $(C_j(\cdot, \theta_j))$ with $\theta_j \in [\underline{\theta}, \overline{\theta}]$. Because of this, before choosing the level of the joint policy p in the second stage of the game, the policymaker received endogenous private information on θ_j by simply observing the contribution schedule $(C_j(\cdot, \theta_j))$ proposed by the rival j. From this, it follows that lobby i's own optimal contribution schedule has to take into account the informational rent that the policymaker obtains from his endogenous knowledge about θ_j. One may then characterize the optimal contribution schedule of lobby i, assuming that the policymaker is perfectly informed on lobby i's type θ_i. As noticed by Martimort and Moreira (2010), the fact that the two lobbies' types do not enter directly into the policymaker's objective function ensures that the corresponding profile of contribution schedules is also a best response in the more general asymmetric information game where lobby i has asymmetric information on θ_i.[7] Applying this approach, it turns out that lobby i's best response is itself separating and therefore conveys information on his type to the policymaker. This observation then justifies the fact that the same techniques can be used to compute the rival lobby j's best response in a symmetric way. The approach consistently characterizes the informative equilibria we are seek.

Specifically, we denote the realization of the type of district i lobby by θ_i and the realization of rival lobby j by θ_j. Solving backwards, given that we are in a separating equilibrium, the policymaker's problem has full knowledge about θ_i and θ_j when deciding his policy p. Given the separating contribution schedules $C_i(p, \theta_i)$ and $C_i(p, \theta_j)$, he then solves

$$\max_p C_i(p, \theta_i) + C_j(p, \theta_j) + \lambda W(p), \tag{7}$$

where we denote the utilitarian welfare of both entities by $W(p) = W_A(p) + W_B(p)$. This problem has the following first-order condition

$$\frac{\partial C_i}{\partial p}(p, \theta_i) + \frac{\partial C_j}{\partial p}(p, \theta_j) + \lambda W'(p) = 0. \tag{8}$$

It is important to note that the equilibrium policy depends on the slopes $\partial C_i/\partial p$ and $\partial C_j/\partial p$ of the contribution schedules which in turn depend on the lobbies' types θ_i and θ_j. It follows that the equilibrium policy $p(\theta_i, \theta_j)$ satisfying (8) depends as well on the lobbies' types. Moreover, when the necessary second-order conditions of (7) hold and the contribution schedules $C_i(p, \theta_i)$ satisfy the Spence-Mirrlees property[8] $\partial^2 C_i/\partial\theta_i\partial p \geq 0$ and $\partial^2 C_j/\partial\theta_j\partial p \geq 0$, simple differentiation of (8) provides that the equilibrium policy $p(\theta_i, \theta_j)$ is increasing in the lobbies' types θ_i and θ_j.

Now consider each lobby's utility maximization problem. Since equilibrium policies are assumed to be increasing in lobbies' types, the problem of choosing a contribution schedule and a price can

[7] The reason is that the incentive and participation constraints of the policymaker do not depend on his beliefs about lobby i's type but only on the schedule that this lobby offers to him. Therefore, it follows that the policymaker' decisions to enter into the bilateral coalition with lobby i and to implement the policy p accordingly are also independent of his beliefs about the lobby's type. Any deviation from the contribution that lobby i would optimally offer if the policymaker were informed about his type is dominated for any out-of equilibrium beliefs.

[8] This is something that has to be checked ex-post after computing the equilibrium contributions $C_A(p, \theta)$ and $C_B(p, \theta)$.

be reduced for each lobby i to the problem of choosing a value $\hat{\theta}_i$ that defines the slopes of the contributions, given (8) and given the lobby's true type θ_i. Moreover, lobby i chooses her contribution non-cooperatively, uninformed about her rival's type θ_j. Therefore, she solves the following problem

$$\max_{\hat{\theta}_i} E\left[v\left(\theta_i, p\left(\hat{\theta}_i, \cdot\right)\right) - C_i\left(p\left(\hat{\theta}_i, \cdot\right), \hat{\theta}_i\right)\right], \tag{9}$$

subject to (8).

The fact that we focus on informative (truthful) strategies implies that the solution of (9) should be $\hat{\theta}_i = \theta_i$ for all $\theta_i \in \left[\underline{\theta}, \overline{\theta}\right]$. Following Martimort and Moreira (2010) and focusing on point-wise optimization, we obtain the following proposition characterizing the optimality conditions of each lobby, given his type. All proofs are presented in Appendix B.

Proposition 1. *The optimality conditions of (9) for lobby i are given by the first-order condition*

$$\frac{\partial v}{\partial p}\left(\theta_i, p\left(\theta_i, \theta_j\right)\right) + \frac{\partial C_j}{\partial p}\left(p\left(\theta_i, \theta_j\right), \theta_j\right) - \lambda W'\left(p\left(\theta_i, \theta_j\right)\right) = \left(\bar{\theta} - \theta_j\right)\frac{\partial^2 C_j}{\partial \theta_j \partial p}\left(p\left(\theta_i, \theta_j\right), \theta_j\right), \tag{10}$$

and the second-order condition

$$\frac{\partial p}{\partial \theta_i}\left(\theta_i, \theta_j\right) \geq 0,$$

for all $(i, j) \in \{A, B\}$, $i \neq j$, and $(\theta_i, \theta_j) \in \left[\underline{\theta}, \overline{\theta}\right]^2$.

This first-order condition is a standard condition in screening models. It states that the marginal surplus of the bilateral coalition between lobby i and the policymaker on the left side of (10) is equal to the marginal cost of the latter's informational rent (the right side of (10). It looks similar to the first-order condition obtained under perfect information, except for the fact that there is now a new term due to the information distortion. Since lobby i does not know his rival's type θ_j, he has to give incentives to the policymaker to report his type correctly. This means that he has to screen the rival's information from the policymaker. As in most screening problems, informational rents have to be given to induce the policymaker to reveal this piece of information and choose a policy p according to the true type of the rival. To save on such rents enjoyed by the high-type rivals, lobby i distorts the policy it demands when facing low-type rivals, reducing the slope of his contribution schedule with respect to the policy. The second-order condition requires only that policies are increasing in the lobby's own type. This will be obtained when the second-order conditions of (7) are satisfied and the equilibrium contribution schedules $C_A(p, \theta)$ and $C_B(p, \theta)$ satisfy a Spence-Mirrlees property $\partial^2 C_A / \partial \theta_A \partial p \geq 0$ and $\partial^2 C_B / \partial \theta_B \partial p \geq 0$.

To compute the equilibrium policy p^* and the equilibrium informative contribution schedules $C_A(p, \theta)$ and $C_B(p, \theta)$, we solve the system of first-order conditions (10) together with (8), the policymaker's first-order condition. The second-order conditions then can be checked ex-post in the computed equilibrium. The equations (8) and (10) define a system of partial differential equations in the contribution schedules $C_A(p, \theta)$ and $C_B(p, \theta)$ with boundary conditions given by the fact that the policymaker's participation constraints should be binding (no informational rent) for low types $\theta_i = \theta_j = \underline{\theta}$. Martimort and Moreira (2010) show that a solution exists to this system for the symmetric case. From now on we will only consider the symmetric equilibrium. Moreover it can be shown that the equilibrium policy $p^*(\theta_i, \theta_j)$ is such that

$$p^*\left(\theta_i, \theta_j\right) \leq \bar{p}\left(\theta_i, \theta_j\right),$$

where $\bar{p}(\cdot)$ is the centralized policy under perfect information with the equality holding only when both lobbies are of the high type (i.e., $\theta_i = \theta_j = \bar{\theta}$). Hence, asymmetry of information on the lobbies' side reduces the joint policy implemented by the policymaker.

The intuition for this result comes from the fact that at a best-response, each lobby induces a lower policy level from the common policymaker than what would be ex-post efficient for their bilateral coalition. This downward distortion reduces the informational rent that the policymaker gets from his endogenous private knowledge of the other lobby's type. Since both lobbies frame their contribution schedules in a way that induces the policymaker to reduce his chosen policy level, the actual equilibrium policy will be reduced compared to the one obtained under perfect information. Under centralization, an *information transmission* effect exists between the two lobbies through the joint policy maker. This effect endogenously creates informational advantage that the policymaker can exploit, therefore, increasing the cost of influence of the lobbies. As the latter consequently reduces the intensity of their contributions, policy distortions are reduced. The *information transmission* effect brings a new perspective to the design of decision making under political influence. In a context of asymmetric information, centralization through delegation to a common policymaker creates a mechanism that provides informational leverage for the policymaker against interest groups. The result of this is less influence and reduced policy distortions.

This is readily illustrated with our quadratic and linear examples that provide explicit characterizations of the equilibrium policies and contribution schedules in an informative equilibrium.

Proposition 2. *When the lobbies' preferences are given by $v(\theta, p) = -\frac{1}{2}(p-\theta)^2$,*

i) the equilibrium policy is given by

$$p^*(\theta_i, \theta_j) = \frac{3(\theta_i + \theta_j) - 2\bar{\theta}}{4(1+\lambda)} + \frac{\lambda\left(\alpha^A + \alpha^B\right)}{2(1+\lambda)} = \bar{p}(\theta_i, \theta_j) - \frac{2\bar{\theta} - (\theta_i + \theta_j)}{4(1+\lambda)}, \tag{11}$$

for all $(\theta_i, \theta_j) \in \left[\underline{\theta}, \bar{\theta}\right]^2$, where $\bar{p}(\cdot)$ is the centralized policy under perfect information;

ii) the separating equilibrium contribution schedules are given by

$$C^*(p, \theta) = C^*(p, \theta) = \frac{2\lambda - 1}{6} p^2 + \left(\frac{\theta}{2} - \frac{\bar{\theta}}{6} - \frac{\lambda\left(\alpha^A + \alpha^B\right)}{3}\right) p + C_0(\theta),$$

for all $\theta \in \left[\underline{\theta}, \bar{\theta}\right]$, where $C_0(\theta)$ is an increasing quadratic function of θ (whose exact shape is provided in Appendix B).

Two things can be noticed. First we can see in explicit terms that the policy level under asymmetric information is smaller than the perfect information centralized policy, since it has an additional negative term $-\left(\bar{\theta} - 1/2(\theta_i + \theta_j)\right)/(2(1+\lambda))$. This term is due to *information transmission* that makes lobbies less aggressive and consequently diminishes their influence. Second, the informative equilibrium contribution schedules are quadratic both on the policy level p and the lobby parameter θ. Moreover, one can immediately verify that this equilibrium contribution satisfies the Spence-Mirrlees condition, since

$$\frac{\partial^2 C}{\partial\theta\partial p} = \frac{1}{2} > 0.$$

Also the second-order conditions of the problem (7) are satisfied.[9] Hence, the second-order conditions of Proposition 1 are also satisfied. Finally, one also can see that this contribution schedule is increasing in the lobby's own parameter θ. Thus, it is informative and allows the policymaker to learn the parameter of each lobby for the second policy implementation stage.

Proposition 3. *When the lobbies' preferences are given by $v(\theta, p) = \theta p$,*
i) the equilibrium policy is given by

$$p^*(\theta_i, \theta_j) = \frac{1}{2\lambda}\left(\frac{3}{2}(\theta_i + \theta_j) - \overline{\theta}\right) + \frac{\alpha_A + \alpha_B}{2} = \bar{p}(\theta_i, \theta_j) - \frac{1}{2\lambda}\left(\overline{\theta} - \frac{\theta_i + \theta_j}{2}\right), \tag{12}$$

for all $(\theta_i, \theta_j) \in \left[\underline{\theta}, \overline{\theta}\right]^2$, where $\bar{p}(\cdot)$ is the centralized policy under perfect information;
ii) the separating equilibrium contribution schedules are given by

$$C^*(p, \theta) = C^*(p, \theta) = \frac{\lambda}{3}p^2 + \left(\frac{\theta}{2} - \frac{\overline{\theta}}{6} - \frac{\lambda(\alpha_A + \alpha_B)}{3}\right)p + C_0(\theta),$$

for all $\theta \in \left[\underline{\theta}, \overline{\theta}\right]$, where $C_0(\theta)$ is an increasing quadratic function of θ (whose exact shape is provided in Appendix B).

The policy level in a centralized structure is smaller under asymmetric information than under perfect information. Also, the remarks discussed under the quadratic case equally apply to the linear specification. Hence, the second-order conditions of Proposition 1 are also satisfied and the equilibrium contribution schedules are informative - the policymaker is fully informed about each lobby's characteristic after receiving his contribution and policy offer.

6 Comparing centralization and decentralization

In this section we compare the welfare of the two structures. We define welfare as the sum of the districts' welfare functions, $W(\cdot) = W_A(\cdot) + W_B(\cdot)$. This criterion excludes the payoffs of the players of the political game. It is a reasonable criterion if the lobbies' and the policy maker's sizes are negligible compared to the society, as is the case in the examples we consider in the following sections.

Given that we wish to highlight in the most transparent way the role of lobbies' information asymmetries and the importance of the information transmission effect in the comparison between centralized and decentralized structures, we simplify drastically the way the two entities A and B

[9] The second-order condition of (7) is given by

$$\frac{\partial^2 C}{\partial^2 p}(p, \theta_i) + \frac{\partial^2 C}{\partial^2 p}(p, \theta_j) + \lambda\frac{\partial^2 W}{\partial^2 p}(p) < 0$$

which, after substitution of the equilibrium schedule $C^*(p, \theta)$ and welfare function $W(p) = \frac{1}{2}\left[(p - \alpha_A)^2 + (p - \alpha_B)^2\right]$, provides

$$\frac{2\lambda - 1}{3} - \lambda < 0,$$

interact. Indeed, we only include the fact that centralized decision making tends to produce policies less responsive to the local environment than decentralized decision making (i.e., our "uniformity" assumption). However, we should keep in mind that this setting avoids important dimensions that are generally discussed in the literature on centralization and decentralization. In particular, our framework does not include features such as direct budgetary or environmental externalities, or strategic delegation across entities. Those elements are known to be important determinants of the comparison between centralized and decentralized structures. Nevertheless, under perfect information, our setting will first reproduce two effects that already have been emphasized under different forms in the literature. The first one is a standard "uniformization effect." As emphasized by the traditional literature on centralization (Oates (1972)), this effect favors decentralization. The second one is the "preference dilution" effect that was first illustrated in the political economy of centralization and regional agreements (De Melo, Panagariya and Rodrik (1993)). This effect tends to favor centralized decision making. The introduction of asymmetric information then allows us to highlight a third new effect into this tradeoff: the *information transmission* effect that provides informational leverage to centralized decision making, subject to the lobbies' influence.

We start the discussion of our basic tradeoffs in the context of our general framework. We then proceed to our two quadratic and linear parameterizations that allow us to obtain explicit analytical conditions for the different dimensions of the tradeoffs. Without loss of generality, we assume $\Delta\alpha = \alpha_A - \alpha_B > 0$. We also denote $\bar{\theta} - \underline{\theta}$ by $\Delta\theta$.

6.1 General model discussion

Perfect information

There are two main differences in the political game between centralization and decentralization. The first one is that under centralization the policy is uniform, and the policy maker cannot adjust its level according to the specificities of the entity's preference. This effect is a standard "uniformization effect" generally emphasized by the traditional literature on centralization (Oates (1972)). The second difference is the fact that the lobbies offer contributions to the same (unique) policymaker. As a consequence, being subject to different sources of political influence, the policymaker cannot fully adjust his policy to reflect the preference of one specific lobby. He has to set the policy according to the "mix of political preferences" of the interest groups he faces. We refer to this effect as a "preference dilution" effect.

As is well known, uniformization of policies decreases social welfare. The size of the welfare loss is directly related to the extent of differences between the entities' preferences, $\Delta\alpha$. On the other hand, the "preference dilution" effect tends to increase social welfare. Indeed because the welfare function $W(\cdot)$ is concave on the policy level p, welfare associated with the average of the two distinct policies is greater than the average welfare of these two policies. Hence centralized policymaking that is subject to an "average political influence" of two lobbies generates higher social welfare for the two entities than decentralized policymaking where each entity's policymaker is subject to the influence of one specific lobby. Moreover this effect increases with the range of lobbies types, $\Delta\theta$, which determines the probability of having distinct lobbies across entities. In this perfect information setup, the tradeoff between centralization and decentralization comes from the comparison between these two effects: the "preference dilution" effect favors centralization, whereas the "uniformization" effect favors decentralization. Given that the "uniformization" effect (or conversely the "preference dilution"effect) is positively related to $\Delta\alpha$ (or conversely, $\Delta\theta$), the tradeoff between centralization and decentralization will depend on the relative sizes of $\Delta\theta$ and $\Delta\alpha$. This is most clearly illustrated by looking at two extreme cases where one of the two effects disappears.

Consider first the case in which $\Delta\alpha$ tends to 0 (i.e. entities have similar preferences) while $\Delta\theta > 0$. In such a case, there is no "uniformization" effect. Simple inspection of (1) and (4) when $\Delta\alpha = 0$ shows that the expression for the welfare loss of the policy is the same under centralization and decentralization. On the other hand, (4) shows that the policy obtained under centralization reflects the marginal preference of the average of both lobbies, while in (1) the policy obtained under decentralization reflects for each entity the marginal preference of the entity's own lobby. Hence, only the "preference dilution" effect prevails resulting in centralization dominating decentralization from a welfare point of view.

Consider next the other limit case in which $\Delta\theta = 0$ (with $\Delta\alpha > 0$): the two lobbies have the same policy preferences. In such a case, there is no "preference dilution" effect. Indeed comparing (1) and (4), the lobbies' marginal contribution $\frac{\partial v}{\partial p}(\theta, p)$ for a given p is the same across entities. Hence, (1) sets decentralized policies according to the lobby's marginal preference and each entity's preference while (4) sets centralized policies according to the lobbies' (similar) preferences and the average of the entities' preferences. This results in no "preference dilution" effect. The uniformization effect then implies that decentralization is welfare superior to centralization.

Asymmetric information

Under centralization, Section 4 tells us that the lobbying game between the two interest groups and the joint policymaker generates an *information transmission* effect. This effect tends to reduce the equilibrium level of the centralized policy. On the other hand, such an effect does not arise under decentralized decision making. Given that lobbies intrinsically have preferences biased towards excessively large policy levels, the *information transmission* effect contributes positively to social welfare under centralization, while there is no such effect under decentralization. Consequently, for parameter configurations that make the two decision making structures socially equivalent under perfect information, the *information transmission* effect under asymmetric information shifts the tradeoff in favor of centralization. The *information transmission* effect is directly related to the degree of asymmetric information that exists between the lobbies and the policymaker. Therefore, it depends positively on the range of lobbies types, $\Delta\theta$, and has no impact on the model when $\Delta\theta = 0$. Together with the two preceding "uniformization" and "preference dilution" effects already identified under perfect information, the *information transmission* effect provides an additional component of the tradeoff between centralization and decentralization that favors centralization.

As under perfect information, we may again expect the tradeoff to depend on the relative sizes of $\Delta\theta$ and $\Delta\alpha$. Clearly there will be a configuration of these two parameters such that social welfare under centralized and decentralized systems will be the same. Departing from this situation, a larger value of $\Delta\theta$ strengthens the "preference dilution" and the *information transmission* effects, and therefore makes centralization superior. On the other hand, a larger value of $\Delta\alpha$ reinforces the "uniformization" effect and therefore make decentralization superior. Moreover, when lobbies have private information, the same configuration of parameters is more likely to induce centralization.

With general functional forms $v(\cdot)$ for the lobbies' policy preferences, one cannot explicitly compute the value of the various thresholds that characterize the preceding tradeoff. The following sections consider the quadratic and linear parameterizations and provide analytical conditions for the comparisons between centralized and decentralized decision making. Hence, from this point on, we work only with the two examples.

6.2 Quadratic and linear examples

Perfect information

Proposition 4. *Suppose that types are perfect information. The expected social welfare under centralization is greater than under decentralization if and only if*

a)

$$\Delta\theta > \sqrt{6\lambda(2+\lambda)}\Delta\alpha, \tag{13}$$

when $v(\theta, p) = -\frac{1}{2}(p-\theta)^2$*; and,*

b)

$$\Delta\theta > \sqrt{6}\lambda\Delta\alpha, \tag{14}$$

when $v(\theta, p) = \theta p$.

Proposition 4 confirms that the choice between centralization and decentralization compares the size of the range of lobbies types with the size of the asymmetry of societies' preferences. These clear cut thresholds will help identify how information transmission makes a stronger case for centralization. From Proposition 4, as $\Delta\theta$ increases, the left side of (13) and (14) increases and centralization tends to be welfare superior. On the other hand, as $\Delta\alpha$ increases, the right side of (13) and (14) increases and decentralization tends to be welfare superior. Also, as λ increases, decentralization is more likely to be welfare superior. The reason is simply that, as λ increases, the effectiveness of political influence on policymaking is reduced both under centralization and decentralization. This in turn tends to reduce the strength of lobbies' influence and therefore the "preference dilution" effect that favors centralization under perfect information. Figures 1 and 2 illustrate the determinants of the comparison between centralization and decentralization under perfect information for the linear specification; the quadratic case could be illustrated in a similar way. Figure 1 considers welfare as a function of $\Delta\alpha$ for a given $\Delta\theta > 0$, while Figure 2 considers welfare as a function of $\Delta\theta$ for a given $\Delta\alpha > 0$.

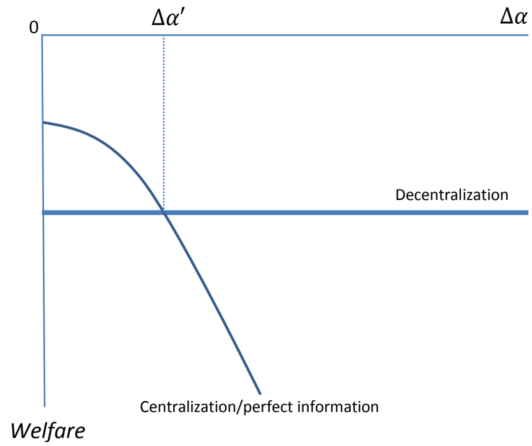

Figure 1: Centralization versus decentralization under perfect information.

In Figure 1 the thick line represents social welfare under decentralization. It is constant with respect to $\Delta\alpha$ because policies can be adjusted to local preferences. The thin line represents the social welfare under centralization. It is decreasing with respect to $\Delta\alpha$ since the welfare cost of uniformization of policies increases with it. Therefore, as $\Delta\alpha$ increases, decentralization becomes welfare superior. Figure 1 also shows that as $\Delta\alpha$ tends to 0, centralization eventually becomes better than decentralization, as a consequence of the "preference dilution" effect. Finally, to the left of the threshold $\Delta\alpha'$, centralization is welfare superior, while to the right decentralization is welfare superior.

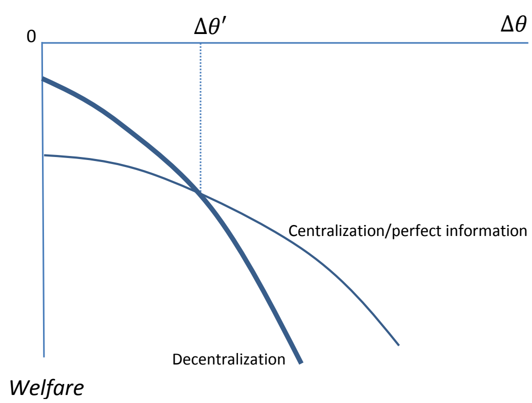

Figure 2: Centralization versus decentralization under perfect information.

Similarly, Figure 2 shows social welfare under centralization and decentralization with perfect information as a function of $\Delta\theta$ for a given value of $\Delta\alpha$. Again, the thick line is the social welfare under decentralization and the thin line represents the social welfare under centralization. Notice that when $\Delta\theta = 0$, welfare under decentralization is higher than under centralization because lobbies have the same type. There is no "preference dilution" effect, only the "uniformization" effect that promotes decentralization. As $\Delta\theta$ increases, welfare decreases under any decision making structure. However, welfare under decentralization decreases faster than under centralization, due to the "preference dilution" effect that becomes stronger. Eventually centralization dominates decentralization when $\Delta\theta$ is higher than a threshold $\Delta\theta'$. Hence, to the right of $\Delta\theta'$, centralization is welfare superior while on the left side decentralization remains welfare superior.

Asymmetric information

When lobbies have private information, the *information transmission* effect emerges under a centralized structure. This effect gives more bargaining power to the policymaker who chooses policies closer to the society's ideal policy. More precisely we have:

Proposition 5. *Suppose that lobbies have private information about their types. Then centralization is welfare superior if and only if*

a)

$$\frac{17}{24}(\Delta\theta)^2 + [2\underline{\theta} - (\alpha_A + \alpha_B)]\,\Delta\theta > \lambda(2+\lambda)(\Delta\alpha)^2, \tag{15}$$

when $v(\theta, p) = -\frac{1}{2}(p-\theta)^2$*; and,*

b)

$$\frac{17}{24}(\Delta\theta)^2 + 2\underline{\theta}\Delta\theta > \lambda^2(\Delta\alpha)^2, \tag{16}$$

when $v(\theta, p) = \theta p$*.*

Notice that for both specifications, the conditions for centralization to be welfare superior are different from those of Proposition 4. Comparisons of (13) and (15) for the quadratic case and (14) and (16) for the linear case reveal that centralization is more likely to be welfare superior under asymmetric information. Indeed, for the quadratic case, the left side of the inequality (15) has an additional term related to the *information transmission* effect. Since $2\underline{\theta} > \alpha_A + \alpha_B$, this term is positive and favors centralization, confirming our preceding discussion for the general case. Similarly in (16), the additional term on the left side also reflects the *information transmission* effect that favors centralization over decentralization. As a consequence of our previous discussion, we have the following:

Corollary 1. *If* $v(\theta, p) = -\frac{1}{2}(p-\theta)$ *or* $v(\theta, p) = \theta p$*, centralization is more likely to dominate decentralization when lobbies have private information about their individual parameter* θ*.*

Under lobbies' private information, the *information transmission* effect promotes centralization for a wider range of parameters. This is illustrated in Figures 3 and 4 in the linear case; the quadratic case could be illustrated in a similar way. Figure 3 reproduces Figure 1 adding the value of the *information transmission* effect under asymmetric information. We observe that, under centralization with asymmetric information, the social welfare curve is always above the corresponding one under centralization with perfect information, and both curves are decreasing in $\Delta\alpha$. Conversely, under decentralization, social welfare remains the same with both perfect and asymmetric information (and is also constant in $\Delta\alpha$). As a consequence, the threshold value above which decentralization dominates centralization increases from $\Delta\alpha'$ to $\Delta\alpha''$. Since centralization is welfare superior when $\Delta\alpha < \Delta\alpha''$, the range of parameters where centralization is welfare superior is larger.

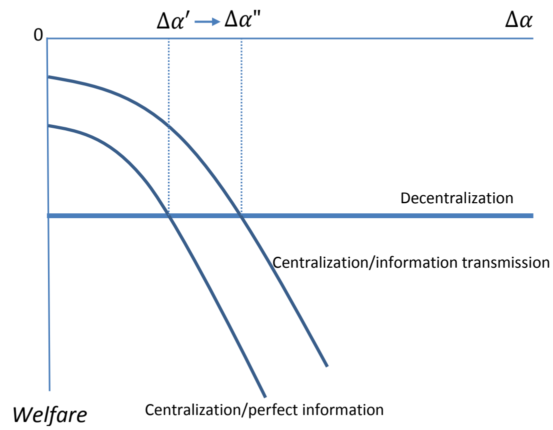

Figure 3: Centralization versus decentralization under asymmetric information.

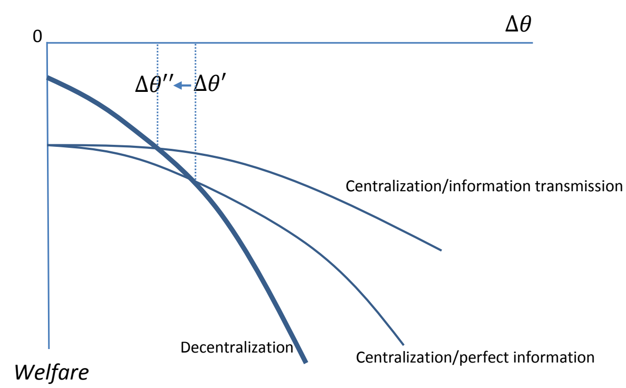

Figure 4: Centralization versus decentralization under asymmetric information.

Similarly, Figure 4 reproduces Figure 2, adding the value of the *information transmission* effect as a function of $\Delta\theta$ for the linear case. Centralization with information transmission yields higher welfare than centralization under perfect information, except at the point $\Delta\theta = 0$. Both curves are decreasing in $\Delta\theta$. On the other hand, the welfare value of decentralization remains the same with both perfect and asymmetric information. However, the social welfare under decentralization decreases faster than the social welfare under centralization as $\Delta\theta$ increases. Since the welfare curve under decentralization crosses the welfare curve under centralization from above (unlike Figure 3), the threshold value decreases from $\Delta\theta'$ to $\Delta\theta''$. Hence, under asymmetric information, centralization becomes welfare superior for smaller values of $\Delta\theta$ and we get a larger range of parameters for which centralization is welfare superior.

7 Provision of local public goods

In this section, we illustrate our previous results showing that our quadratic example can be framed as the classical problem of centralization and decentralization of local public goods provision across communities or districts. The discussion generally states that centralization becomes more desirable when there are strong inter-district externalities of local public goods, since a centralized decision would internalize these externalities. On the other hand, decentralization is more desirable when there are significant differences between districts' preferred policies, such as in decentralized structures, where the amount of local public goods is more sensitive to the districts' preferences. This type of discussion however ignores the issue of political capture of the policymaker who is delegated to implement the policy. A recent literature emphasizes several political economy dimensions in the discussion between centralization and decentralization (see, for instance, the discussion in Section 2). Still this literature tends to consider only situations with symmetric information between interest groups and policymakers. Following a well-established literature that indicates that lobbies have better information than governments, our framework allows us to reconsider the classical local public good problem in the presence of lobbies who are privately informed about their abilities to exert influence.

The model presented in the previous section applies almost directly to the classic case of public goods provision. Two districts, $i \in \{A, B\}$, have to decide how much of a local public good to provide. In order to highlight how lobbies' private information interacts with the optimal structure of decision making in the most transparent way, we assume that there are no inter-district externalities.[10] For consistency, we denote the amount of public good by p_i. The population of each district has size one and a utility function given by the quadratic form

$$u_i(p_i, m_i) = \left(a_i - \frac{p_i}{2}\right) p_i + m_i,$$

where m_i is the individual income. The public good is provided by the government and is financed through lump-sum taxes. Assuming the public good is produced from income on a one-to-one

[10]By excluding inter-district externalities, we therefore bias the model against centralization. We do this not because we believe that they are irrelevant in the discussion, but only to introduce the new *information transmission* effect that favors centralization in the simplest possible model.

basis, the consumer's utility function is given by

$$u_i(p) = \left(a_i - 1 - \frac{p}{2}\right)p.$$

Denoting $\alpha_i = a_i - 1$, this utility function becomes a suitable transformation of the society's welfare function, where the policy is the amount of public good provided[11]

$$u_i(p) = W_i(p) + \frac{\alpha_i^2}{2}.$$

The lobbies represent organized members of the society with higher valuation for the public good. (Results would be similar if lobbies had lower valuation for the public good.) In particular, lobbies could be interpreted as organized elites with preferences not aligned with the average citizen. Specifically assume that these elite preferences are given by

$$V(\bar{a}_i, p, C) = \left(\bar{a}_i - 1 - \frac{p}{2}\right)p - C,$$

where $\bar{a}_i > a_i$ and C reflects the money contribution to be paid to influence the policymaker(s). Define $\theta_i = \bar{a}_i - 1$. Then these preference structures become transformations of the lobbies' and social preferences of our quadratic example.[12] One may then easily re-interpret the results of our generic model presented in the previous sections. Under political influence and perfect information, the level of local public good obtained in each district under decentralization is given by (2) as a weighted average of the lobby's and society's preferred policies. The centralized public good provision under influence is given by (5) which is a weighted average of preferences of lobbies and districts. As mentioned in Proposition 4, the comparison between centralization and decentralization under perfect information reflects a tradeoff between the "uniformization" effect of supply of local public goods against the "preference dilution" effect on political capture.

Assume now that for each lobby, θ_i is private information and drawn from a uniform distribution over $\left[\underline{\theta}, \bar{\theta}\right]$. When lobbies are privately informed, the policymaker does not know their preferences for local public good. Under a decentralized structure, this private information does not affect the political game since no lobby has incentives to hide information from her local policymaker. Thus, each district provides the same amount of public good whether or not lobbies are privately informed. Under centralization, the two lobbies offer contributions to the same policymaker. Besides the "uniformization effect" on the supply of local public goods, one also has the *information transmission* effect uncovered in Proposition 5. Through the contribution schedules offered to him, the centralized policymaker learns each lobby's private information in equilibrium. This centralization of information provides a capacity to extract rents from the lobbies. As a consequence, lobbies are less able to exert influence. Provision of public goods under centralization is given by (11) and is therefore closer to the districts' average preferences when compared to the perfect information case. The *information transmission* effect makes centralization more likely to be welfare improving, compared to the perfect information situation threshold.

[11] Alternatively, we could have different districts with the same valuation for the public good, but with different cost of converting money into public goods. Different costs of providing the public good would also result in different values of α_i.

[12] An alternative explanation for the difference between θ and α would be a difference in the marginal value of money for the fraction of society organized as a lobby.

8 Lobbying for tariff protection in customs unions

In this section, we illustrate how our second analytical linear example can be useful to analyze the influence of lobbying on trade agreements. Motivated by the increasing number of regional trade agreements following the creation of the World Trade Organization, there has been a growing literature on preferential trade agreements (PTAs), recognizing lobbying and political influence as central elements of trade policy making (see, for instance, the related literature in Section 3). In such models, decisions to enter into a trade agreement and tariff levels are endogenously chosen by governments subject to the pressure of special interest groups. The political game generally is assumed to have perfect information between lobbies and governments. Our generic model of political influence under asymmetric information allows us to reconsider the issue of PTAs when there is private information on the side of protectionist lobbies. As will be seen below, our linear example can be directly related to the costs and benefits of the formation of a customs union agreement.

Consider the following very simple situation of two small open countries A and B that trade with the rest of the word. In each country there is a protectionist lobby that undertakes exerts political influence to obtain tariff protection against foreign imports. Without a trade agreement between the two countries, each lobby demands protection from the government of her own country. In a customs union, the lobbies from both countries compete to influence the common level of trade protection decided by the customs union. Additionally, lobbies have private information about their strength as a group.

More precisely, we consider a simple partial equilibrium model with a good x that can be imported by both countries A and B. When the domestic price of good x in country $i \in \{A, B\}$ is p_i, the domestic demand for good x is given by

$$x_i\left(p_i\right) = a - bp_i,$$

with $a, b > 0$. In each country good x is produced with labor and a specific factor that is in limited supply. Therefore, producers have capacity constraints. To simplify the analysis, we assume that the marginal cost of production is zero for production below the output capacity. Therefore, the sector's competitive profits are given by $\pi_i\left(p_i\right) = \gamma p_i$, where γ is the capacity constraint.

Each government collects import taxes. The tariff revenue is given by

$$TR = \left(p_i - p^e\right)\left(x\left(p_i\right) - y\left(p_i\right)\right),$$

where p^e is the international price of good x, $y\left(p\right)$ is the home supply of x which, by the envelope theorem, is equal to γ. With such specifications, the sum of the firm's profits, consumer surplus, and the government's tariff revenue gives the welfare of the society, which takes the following quadratic form:

$$W_i\left(p_i\right) = \bar{w} - \frac{b}{2}\left(p_i - p^e\right)^2,$$

where $\bar{w}$ is a constant that is a function of the parameters. Thus, apart from the constant term and parameter b, this is a rescaled version of the welfare function presented in Section 2.

A political influence game takes place within each economy. The lobby of each country offers contributions C_i to the policymaker in order to influence the tariff decision. Each economy has a lobby that represents the producers of good x. Lobbies are "principals" of the political game. Their objective functions are represented by

$$\widetilde{V}\left(\delta_i, p_i, C_i\right) = \pi\left(p_i\right) - \frac{C_i}{\delta_i},$$

where δ_i represents an organizational cost parameter of the lobbies. Therefore, the higher δ_i, the more costly is one dollar when offered as a contribution by the lobby of economy i. There is an isomorphic transformation of the lobby's utility function that will be useful for our purposes. Multiplying the utility by δ_i gives

$$V\left(\theta_i, p_i, C_i\right) = \theta_i p_i - C_i,$$

where $\theta_i = \gamma\delta_i$. Therefore, the lobby's preference is identical to our linear specification example.

Policymakers are agents in the political game. We consider two situations. In the first one, the two countries do not form a customs union. This is the situation of decentralized decision making. In such a case, each country delegates its trade policy decision to a national policy maker who chooses the import tariff of the economy or equivalently the economy's domestic price p_i. In country i, the policy maker's preferences are given by

$$U_i\left(p_i, C_i\right) = C_i + \widetilde{\lambda} W_i\left(p_i\right),$$

where $\widetilde{\lambda}$ is the relative preference between contributions and welfare.

The second case is the situation where the two countries sign a customs union agreement. By doing this, they delegate the policy choice to a single policymaker who is restricted to setting a uniform policy (the tariffs of the two economies are the same). This is the situation of centralized decision making. In this case the policymaker's preferences are given by

$$U\left(p, C_A, C_B\right) = \Sigma_i C_i + 2\widetilde{\lambda} W\left(p\right).$$

Therefore, the model is a re-parameterization of our linear example, with $\alpha_A = \alpha_B = p^e$, $\lambda = \widetilde{\lambda} b$ and the loss function has a constant $\bar{w}$. Assume that θ is drawn from a uniform $\left[\underline{\theta}, \overline{\theta}\right]$ distribution. We can apply the results from Section 3. Domestic prices without a trade agreement (with perfect and with asymmetric information) are therefore given by

$$\check{p}\left(\theta_i\right) = p^e + \frac{\theta_i}{\lambda}.$$

Under a customs union with perfect information these prices are given by

$$p^e\left(\theta_i, \theta_j\right) = p^e + \frac{\theta_i + \theta_j}{2\lambda},$$

while under a customs union with privately informed lobbies, they become

$$p^*\left(\theta_i, \theta_j\right) = p^e + \frac{1}{2\lambda}\left(\frac{3}{2}\left(\theta_i + \theta_j\right) - \overline{\theta}\right).$$

It is simple to see that $p^e(\theta_i, \theta_j) - p^*(\theta_i, \theta_j) > 0$. Therefore, there is less protection in a customs union agreement when lobbies have private information. This is because under asymmetric information, the *information transmission* effect increases, , the cost of political influence on a joint policymaker. As a consequence, lobbies' private information under a customs union leads to a fall of protection, and an increase in imports and social welfare.

From a social welfare perspective it is important to notice that the two countries' optimal policy is free trade. Consequently, this model is similar to our linear example with $\alpha_A = \alpha_B$. Thus, from Proposition 4, under perfect information, customs union agreements are always welfare superior to the decentralized protectionist game in each country. The reason is because both countries unilaterally have the same optimal trade policy: free trade. Therefore, there is no "uniformization effect" associated with centralized decision making. Only the "preference dilution" effect remains, which promotes the "customs union" regime (i.e., centralized decision making). When lobbies have private information, the *information transmission* effect provides an additional effect in favor of the customs union mechanism.

Obviously, this model is extremely simple and the results have to be viewed as purely illustrative of how lobbies' private information may interact with the types of trade policy mechanisms that one discusses in the literature. There are many direct trade effects that are very important to qualify the potential gains from a customs union agreement. One of these in particular is the fact that we set up the model such that there are no terms of trade effects between the two countries. Nonetheless, the *information transmission* effect that we identify will certainly remain in more complex situations. When lobbies have private information, centralization of decision making gives policymakers additional bargaining power to negotiate with other rent-seekers. Hence, the *information transmission* effect in a customs union is likely to have a positive welfare impact.

9 Conclusions

In this paper, we considered the tradeoff between centralized and decentralized policy making when policymakers are subject to capture by privately informed lobbies. We identified a new *information transmission* effect in the political game under centralized structures that reduces the extent of political capture by interest groups. The basic insight comes from two features. First, in centralized systems, policies tend to integrate cross-entity specificities and therefore create strategic informational interdependences for privately informed lobbies associated with these entities. Each lobby's optimal influence strategy depends on privately known characteristics of rival lobbies. Second, centralization forces competition for political influence to be focused on one central policymaker. Since this competition is information revealing, the common policymaker has a privileged position to obtain valuable private information about each lobby's characteristics. Such information is relevant to rival lobbies. Therefore, centralization allows the policymaker to enjoy informational rents, increasing thereby his bargaining capacity in bilateral relationships with interest groups. As a consequence, the cost of political influence increases and the extent of political capture declines.

The framework we used to highlight this insight clearly abstracts from many dimensions relevant to the comparison between centralized and decentralized systems. As already mentioned, one could introduce cross-entity externalities. This feature would also generate the typical strategic informational interdependence across lobbies that is necessary to get the *information transmission* effect and would reinforce the case for centralized systems. One may also introduce the possibility of asymmetry across entities for the costs and benefits of centralization and decentralization. As can be seen in Appendix A, this introduces the possibility that adoption of a given decision making structure is efficient at the global level but not necessarily preferred by both entities.[13]

More substantially, one may also think about enriching the political process of policy determination under centralization. Rather than having a central common policymaker, one may think about more complex process involving bargaining between district representatives, each being subject to influence by a district-specific interest group. One could also allow for mix ed situations in which district-specific lobbies also have the capacity to influence representatives of other districts. It would be interesting to see how such variations in the political structure interact with privately informed rent-seeking groups.

Another worthwhile extension would be to allow the possibility of private information possessed by lobbies to be efficiency improving. In that case, lobbying activity could play a positive social role. How this affects public decision making under centralized and decentralized systems and whether it increases or decreases the relative benefits of centralization are interesting questions that would merit further investigation.

Finally, we applied our model to examples such as local public good provision and the incentives to form customs union agreements. We hope that these simple applications pave the way for the investigation of other political economy contexts where the interplay between political influence competition and asymmetry of information may generate rich and interesting insights for the optimal allocation of decision rights in public policy areas.

Appendix A - Pareto criterion

Whenever the districts have distinct preferences for the policy, the costs and benefits from centralization/decentralization are asymmetric between districts. Thus, a particular structure may be welfare dominating, without both districts prefering it. As a result, if the gains for one district are greater than the losses of the other, the winning district desires the structure while the other does not.

If one district cannot be forced into a centralized decision structure, then centralization can only be achieved if it is desirable for both districts. In such a case, the asymmetry of the gains from centralization becomes important. In this appendix we identify the threshold parameters that make centralization welfare superior for both districts at once (Pareto superior). What we find is that centralization is less likely to be implemented when it must be Pareto superior.

However, we find that the direction of the “uniformization” effects, “preference dilution” and *information transmission* remain the same. A high $\Delta\theta$ with low $\Delta\alpha$ make centralization more likely to be implemented, while low $\Delta\theta$ with high $\Delta\alpha$ make it more likely that decentralization will be implemented. To simplify matters, we compute the results for the quadratic and linear examples.

[13] This would clearly occur when cross entity transfers are not possible and the gains for one entity are larger than the losses for the other.

Perfect information

Proposition 6. *If* $v(\theta,p) = -\frac{1}{2}(p-\theta)^2$*, and types are perfect information, centralization is Pareto superior when*

$$\frac{(\Delta\theta)^2}{6} > 2\lambda\Delta\alpha\left(\bar{\theta}+\underline{\theta}\right) + \lambda\Delta\alpha\left(\lambda\Delta\alpha - 4\alpha_B\right).$$

Notice that the threshold from Proposition 6 is different from that of Proposition 4a. Thus, for a certain range of parameters, centralization may be welfare superior, but not Pareto superior for districts. Hence, different structures will be implemented depending on the selection criterion. However, the tradeoff is the same: as $\Delta\theta$ increases, centralization is more likely to be superior while as $\Delta\alpha$ increases, decentralization is more likely to be welfare superior.

For the linear example we have a similar result:

Proposition 7. *If* $v(\theta,p) = \theta p$*, and types are perfect information, centralization is Pareto superior when*

$$\frac{(\Delta\theta)^2}{6} > 2\lambda\left(\bar{\theta}+\underline{\theta}\right)\Delta\alpha + \lambda^2(\Delta\alpha)^2.$$

The directions of the effects of $\Delta\theta$, λ and $\Delta\alpha$ are the same as in Proposition 6. Comparing with Proposition 4b we also observe that there is a smaller range of parameters for which centralization is desirable for both districts.

Asymmetric information

Proposition 8. *If* $v(\theta,p) = -\frac{1}{2}(p-\theta)^2$ *and types are lobbies' private information, centralization is Pareto superior when*

$$\frac{17}{24}(\Delta\theta)^2 + \left(2\underline{\theta} - 2\alpha_B\right)\Delta\theta > \left(\bar{\theta}+3\underline{\theta}\right)\lambda\Delta\alpha - 4\alpha_B\lambda\Delta\alpha + \lambda^2(\Delta\alpha)^2.$$

Notice that the expression above is different from that of Proposition 5a. The *Information transmission* effect makes centralization more likely to be welfare superior than under perfect information.

For the linear example we also have:

Proposition 9. *If* $v(\theta,p) = \theta p$ *and types are lobbies' private information, centralization is Pareto superior when*

$$\frac{17}{24}(\Delta\theta)^2 + 2\underline{\theta}\Delta\theta > \left(\bar{\theta}+3\underline{\theta}\right)\lambda\Delta\alpha + \lambda^2(\Delta\alpha)^2.$$

The interpretation of the results is similar to these last three propositions.

Information transmission effect also changes the incentives for districts to block centralized structures. In both cases, it makes centralization less likely to be blocked.

Corollary 2. *If* $v(\theta,p) = -\frac{1}{2}(p-\theta)$ *or* θp*, centralization is Pareto improving for a larger range of parameters when lobbies have private informed about their types.*

This corollary shows that the *information transmission* effect makes the implemntation of centralization more likely when districts are able to veto centralization.

Appendix B - Proofs

Proof of Proposition 1. This proof presents the computations for obtaining the first-order condition of problem (9) in detail. This proof is a direct application of Martimort and Moreira (2010).

Following the tradition of the literature, we eliminate the contribution from the objective function before computing the best-responses. We have that

$$E\left[C\left(p\left(\hat{\theta}_i,.\right),\hat{\theta}_i\right)\right]=\int_{\underline{\theta}}^{\bar{\theta}}C\left(p\left(\hat{\theta}_i,\theta_j\right),\hat{\theta}_i\right)f\left(\theta_j\right)d\theta_j.$$

We can write the right side of the previous equation as

$$\begin{aligned}\int_{\underline{\theta}}^{\bar{\theta}}C\left(p\left(\hat{\theta}_i,\theta_j\right),\hat{\theta}_i\right)f\left(\theta_j\right)d\theta_j &= -\left(1-F\left(\theta_j\right)\right)C\left(p\left(\hat{\theta}_i,\theta_j\right),\hat{\theta}_i\right)\big|_{\underline{\theta}}^{\bar{\theta}}\\ &\quad +\int_{\underline{\theta}}^{\bar{\theta}}\left(1-F\left(\theta_j\right)\right)\frac{\partial C}{\partial p}\left(p\left(\hat{\theta}_i,\theta_j\right),\hat{\theta}_i\right)\frac{\partial p}{\partial\theta_j}\left(\hat{\theta}_i,\theta_j\right)d\theta_j.\end{aligned}$$

In what follows we are going to omit the argument of $p\left(\hat{\theta}_i,\cdot\right)$ and its derivatives. Substituting the policymaker first-order condition (8) in the equation above gives

$$E\left[C\left(p,\hat{\theta}_i\right)\right]=C\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\hat{\theta}_i\right)-E\left[\left(\frac{\partial C}{\partial p}\left(p,\cdot\right)+\lambda W'\left(p\right)\right)\frac{1-F\left(\cdot\right)}{f\left(\cdot\right)}\frac{\partial p}{\partial\theta_j}\right].$$

Then, inserting this last expression back into (9) gives

$$\max_{\hat{\theta}_i}\quad E\left[v\left(\theta_i,p\right)+\left(\tfrac{\partial C}{\partial p}\left(p,\cdot\right)+\lambda W'\left(p\right)\right)\tfrac{1-F(\cdot)}{f(\cdot)}\tfrac{\partial p}{\partial\theta_j}\right]-C\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\hat{\theta}_i\right).$$

Now we can compute the first-order condition of problem (9)

$$\begin{aligned}E&\left[\frac{\partial v}{\partial p}\left(\theta_i,p\right)\frac{\partial p}{\partial\theta_i}+\left(\frac{\partial^2 C}{\partial^2 p}\left(p,\cdot\right)+\lambda W''\left(p\right)\right)\frac{1-F\left(\cdot\right)}{f\left(\cdot\right)}\frac{\partial p}{\partial\theta_i}\frac{\partial p}{\partial\theta_j}\right]\\ &+E\left[\left(\frac{\partial C}{\partial p}\left(p,\cdot\right)+\lambda W'\left(p\right)\right)\frac{1-F\left(\cdot\right)}{f\left(\cdot\right)}\frac{\partial^2 p}{\partial\theta_i\partial\theta_j}\right]\\ &-\frac{\partial C}{\partial p}\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\hat{\theta}_i\right)\frac{\partial p}{\partial\theta_i}\left(\hat{\theta}_i,\underline{\theta}\right)-\frac{\partial C}{\partial\theta_i}\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\hat{\theta}_i\right)=0.\end{aligned}\tag{17}$$

We integrate by parts the term in the second line of (17) to get

$$\begin{aligned}&\left(\frac{\partial C}{\partial p}\left(p,\cdot\right)+\lambda W'\left(p\right)\right)\left(1-F\left(\cdot\right)\right)\frac{\partial p}{\partial\theta_i}\big|_{\underline{\theta}}^{\bar{\theta}}\\ &-\int_{\underline{\theta}}^{\bar{\theta}}\left[\left(\frac{\partial^2 C}{\partial^2 p}\left(p,\cdot\right)+\lambda W''\left(p\right)\right)\frac{\partial p}{\partial\theta_j}-\frac{\partial^2 C}{\partial\theta_j\partial p}(p,\cdot)\right]\left(1-F\left(\cdot\right)\right)\frac{\partial p}{\partial\theta_i}d\theta_j\\ &+\int_{\underline{\theta}}^{\bar{\theta}}\left(\frac{\partial C}{\partial p}\left(p,\cdot\right)+\lambda W'\left(p\right)\right)f\left(\cdot\right)\frac{\partial p}{\partial\theta_i}d\theta_j.\end{aligned}$$

This last expression can be simplified to

$$
\begin{aligned}
&-\left(\frac{\partial C}{\partial p}\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\hat{\theta}_i\right)+\lambda W'\left(p\left(\hat{\theta}_i,\underline{\theta}\right)\right)\right)\frac{\partial p}{\partial \theta_i}\left(\hat{\theta}_i,\underline{\theta}\right) \\
-E&\left[\left(\left(\frac{\partial^2 C}{\partial^2 p}(p,\cdot)+\lambda W''(p)\right)\frac{\partial p}{\partial \theta_j}+\frac{\partial^2 C}{\partial \theta_j \partial p}(p,\cdot)\right)\frac{(1-F(\cdot))}{f(\cdot)}\frac{\partial p}{\partial \theta_i}\right] \\
&\qquad +E\left[\left(\frac{\partial C}{\partial p}(p,\cdot)+\lambda W'(p)\right)\frac{\partial p}{\partial \theta_i}\right].
\end{aligned} \tag{18}
$$

Substituting (18) back into the first-order condition (17) and using (8) give

$$
\begin{aligned}
E\left[\left(\frac{\partial v}{\partial p}(\theta_i,p)+\frac{\partial C}{\partial p}(p,\cdot)+\lambda W'(p)-\frac{\partial^2 C}{\partial \theta_j \partial p}(p,\cdot)\frac{1-F(\cdot)}{f(\cdot)}\right)\frac{\partial p}{\partial \theta_i}\right]& \\
-\frac{\partial C}{\partial \theta_i}\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\hat{\theta}_i\right) &= 0.
\end{aligned} \tag{19}
$$

Now we define a bound to contributions. It is based on the fact that if the rival lobby is low type, the lobby has no reason to leave rents to the policymaker. In such a case the policymaker gets his reserve utility. That implies

$$
C\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\hat{\theta}_i\right)+C\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\underline{\theta}\right)+\lambda W\left(p\left(\hat{\theta}_i,\underline{\theta}\right)\right)=\lambda W(p^e),\ \forall \hat{\theta}_i.
$$

Differentiating this expression with respect to $\hat{\theta}_i$ gives

$$
\left[\frac{\partial C}{\partial p}\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\hat{\theta}_i\right)+\frac{\partial C}{\partial p}\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\underline{\theta}\right)+\lambda W'\left(p\left(\hat{\theta}_i,\underline{\theta}\right)\right)\right]\frac{\partial p}{\partial \theta_i}\left(\hat{\theta}_i,\underline{\theta}\right)+\frac{\partial C}{\partial \theta_i}\left(p\left(\hat{\theta}_i,\underline{\theta}\right),\hat{\theta}_i\right)=0.
$$

Therefore, from (8) the last term of (19) is zero. This simplifies the first-order condition to

$$
E\left[\left(\frac{\partial v}{\partial p}(\theta_i,p)+\frac{\partial C}{\partial p}(p,\cdot)+\lambda W'(p)-\frac{1-F(\cdot)}{f(\cdot)}\frac{\partial^2 C}{\partial \theta_j \partial p}(p,\cdot)\right)\frac{\partial p}{\partial \theta_i}(\theta_i,.)\right]=0.
$$

And, given the concavity of the functional (9), the second-order condition of the problem is

$$
E\left[\frac{\partial p}{\partial \theta_i}(\theta_i,.)\right]=0.
$$

Since we require truth-telling and we focus on pointwise optimization, we have

$$
\begin{aligned}
\frac{\partial v}{\partial p}(\theta_i,p(\theta_i,.))+\frac{\partial C}{\partial p}(p(\theta_i,\theta_j),\theta_j)+\lambda W'(p(\theta_i,\theta_j))-\frac{1-F(\theta_j)}{f(\theta_j)}\frac{\partial^2 C}{\partial \theta_j \partial p}(p(\theta_i,\theta_j),\theta_j) &= 0, \text{ and} \\
\frac{\partial p}{\partial \theta_i}(\theta_i,\theta_j) &\geq 0,
\end{aligned}
$$

for all $(\theta_i,\theta_j)\in\Theta^2$.

When the distribution of θ is uniform in the interval $\left[\overline{\theta}, \underline{\theta}\right]$, we have that

$$\begin{aligned}\frac{1-F(\theta_j)}{f(\theta_j)} &= \overline{\theta}-\theta_j, \text{ and}\\ \lambda W'(p) &= -\lambda 2b(p-p^e).\end{aligned}$$

Substituting this into the first-order condition gives

$$\frac{\partial v}{\partial p}(\theta_i, p(\theta_i,\theta_j)) + \frac{\partial C}{\partial p}(p(\theta_i,\theta_j),\theta_j) - \lambda 2b(p(\theta_i,\theta_j)-p^e) = \left(\overline{\theta}-\theta_j\right)\frac{\partial^2 C}{\partial\theta_j\partial p}(p(\theta_i,\theta_j),\theta_j).$$

See Martimort and Moreira (2010) who use a more general first-order condition to show that the second-best optimal policy provision is lower than the provision under perfect information. Thus, we have

$$p^*(\theta_i,\theta_j) \leq \bar{p}(\theta_i,\theta_j),$$

with equality when $\theta_i = \theta_j = \bar{\theta}$. □

Proof of Proposition 2. We follow Martimort and Moreira (2010), and anticipate that the optimal contribution is quadratic when the distribution of types is uniform. For the quadratic case the first-order conditions (8) and (10) become

$$\begin{aligned}\theta_i - p(\theta_i,\theta_j) + \frac{\partial C}{\partial p}(p(\theta_i,\theta_j),\theta_j) - \lambda(2p(\theta_i,\theta_j)-\alpha_A-\alpha_B) &= \left(\overline{\theta}-\theta_j\right)\frac{\partial^2 C}{\partial\theta_j\partial p}(p(\theta_i,\theta_j),\theta_j),\\ \theta_j - p(\theta_i,\theta_j) + \frac{\partial C}{\partial p}(p(\theta_i,\theta_j),\theta_i) - \lambda(2p(\theta_i,\theta_j)-\alpha_A-\alpha_B) &= \left(\overline{\theta}-\theta_i\right)\frac{\partial^2 C}{\partial\theta_i\partial p}(p(\theta_i,\theta_j),\theta_j), \text{ and}\\ \frac{\partial C}{\partial p}(p(\theta_i,\theta_j),\theta_i) + \frac{\partial C}{\partial p}(p(\theta_i,\theta_j),\theta_j) - \lambda(2p(\theta_i,\theta_j)-\alpha_A-\alpha_B) &= 0.\end{aligned}$$

The expression for the contribution is

$$C(\theta,p) = \frac{g}{2}p^2 + (e\theta+f)p + C_0(\theta),$$

so that the marginal contribution is linear in p and separable in its arguments. Given this contribution, the above system of equations becomes

$$\theta_i - p + gp + e\theta_j + f - \lambda(2p-\alpha_A-\alpha_B) = \left(\overline{\theta}-\theta_j\right)e, \tag{20}$$

$$\theta_j - p + gp + e\theta_i + f - \lambda(p-\alpha_A-\alpha_B) = \left(\overline{\theta}-\theta_i\right)e, \text{ and} \tag{21}$$

$$2gp + 2f + e(\theta_i+\theta_j) - \lambda(2p-\alpha_A-\alpha_B) = 0. \tag{22}$$

We can re-write (20) as

$$\theta_i + 2e\theta_j = (1-g+2\lambda)p - f - \lambda(\alpha_A+\alpha_B) + e\overline{\theta}.$$

Interchanging θ_i and θ_j we must have

$$\theta_i + 2e\theta_j = \theta_j + 2e\theta_i,$$

which can only be true for any given (θ_i, θ_j) when $e = \frac{1}{2}$. Combining (20) and (22) gives

$$\frac{\theta_i}{2} - p - gp - f = \frac{\left(\overline{\theta} - \theta_j\right)}{2}.$$

Rearranging gives

$$f + (1+g)\,p = \frac{\theta_i + \theta_j - \overline{\theta}}{2}. \tag{23}$$

Substituting (23) back into (22) gives

$$\theta_i + \theta_j - \overline{\theta} + \frac{1}{2}(\theta_i + \theta_j) - 2p = \lambda\,(2p - \alpha_A - \alpha_B).$$

Thus,

$$p = \frac{1}{2(1+\lambda)}\left(\frac{3}{2}(\theta_i + \theta_j) - \bar{\theta} + \lambda\,(\alpha_A + \alpha_B)\right), \tag{24}$$

which defines the equilibrium prices for the economy. Moreover, to obtain an explicit form for f and g we substitute (24) back into (23) and get the following equation

$$f + \frac{1+g}{2(1+\lambda)}\left(\frac{3}{2}(\theta_i + \theta_j) - \bar{\theta} + \lambda\,(\alpha_A + \alpha_B)\right) = \frac{\theta_i + \theta_j - \overline{\theta}}{2}.$$

There are many combinations of f and g that solve this equation. However, by definition, f and g are values that do not depend on θ. The only value of g that ensures this equation holds for whatever realization of type is $g = (2\lambda - 1)/3$, which results in $f = -\left(\overline{\theta} + 2\lambda\,(\alpha_A + \alpha_B)\right)/6$. Therefore, the contribution is given by

$$C(p, \theta_i) = \frac{2\lambda - 1}{6}p^2 + \left(\frac{\theta_i}{2} - \frac{\overline{\theta}}{6} - \frac{\lambda\,(\alpha_A + \alpha_B)}{3}\right)p + C_0(\theta_i).$$

We still need to define the term that is independent of p, $C_0(\theta_i)$. This term is computed from the policymaker's binding participation constraint. That is, when the rival lobby is $\underline{\theta}$ the lobby does not leave informational rents to the policymaker. Therefore, from the policymaker's binding participation constraint and the expression for the contributions we have

$$\begin{aligned}
C(p, \underline{\theta}) + C(p, \theta_i) - \frac{\lambda}{2}(p - \alpha_A)^2 - \frac{\lambda}{2}(p - \alpha_B)^2 &= -\frac{\lambda}{4}(\Delta\alpha)^2, \\
\frac{2\lambda - 1}{6}p^2 + \frac{1}{3}\left(\frac{3\underline{\theta} - \bar{\theta}}{2} - \lambda\,(\alpha_A + \alpha_B)\right)p + C_0(\underline{\theta}) &= C(p, \underline{\theta}), \text{ and} \\
\frac{2\lambda - 1}{6}p^2 + \frac{1}{3}\left(\frac{3\theta_i - \overline{\theta}}{2} - \lambda\,(\alpha_A + \alpha_B)\right)p + C_0(\theta_i) &= C(p, \theta_i).
\end{aligned}$$

We begin computing $C_0(\underline{\theta})$ for the symmetric case where both lobbies have the lowest type. In this case we have

$$\begin{aligned}
&\frac{2\lambda - 1}{3}p^2 + \frac{1}{3}\left(3\underline{\theta} - \bar{\theta} - 2\lambda\,(\alpha_A + \alpha_B)\right)p + 2C_0(\underline{\theta}) \\
&\quad -\frac{\lambda}{2}\left[\left(p^2 - 2p\alpha_A + \alpha_A^2\right) + \left(p^2 - 2p\alpha_B + \alpha_B^2\right)\right] = -\frac{\lambda}{4}\left(\alpha_A^2 - 2\alpha_A\alpha_B + \alpha_B^2\right),
\end{aligned}$$

where $p = p(\underline{\theta}, \underline{\theta})$. This expression simplifies to

$$-\frac{\lambda+1}{3}p^2 + \frac{1}{3}\left(3\underline{\theta} - \bar{\theta} + \lambda\left(\alpha_A + \alpha_B\right)\right)p + 2C_0\left(\underline{\theta}\right) = \frac{\lambda}{4}\left(\alpha_A + \alpha_B\right)^2,$$

and substituting $p = p(\underline{\theta}, \underline{\theta})$ into (24), we rearrange the last expression as

$$C_0\left(\underline{\theta}\right) = -\frac{\lambda+1}{6}\left(\frac{3\underline{\theta} - \bar{\theta} + \lambda\left(\alpha_A + \alpha_B\right)}{2\left(1+\lambda\right)}\right)^2 + \frac{\lambda}{8}\left(\alpha_A + \alpha_B\right)^2.$$

Now we can compute $C_0\left(\theta_i\right)$ from the binding participation constraint, for non-symmetric realization of types. We have

$$\begin{aligned}
&\frac{2\lambda-1}{3}p^2 + \frac{1}{3}\left(\frac{3\theta_i - \bar{\theta}}{2} - \lambda\left(\alpha_A + \alpha_B\right)\right)p \\
&+\frac{1}{3}\left(\frac{3\underline{\theta} - \bar{\theta}}{2} - \lambda\left(\alpha_A + \alpha_B\right)\right)p + C_0\left(\underline{\theta}\right) + C_0\left(\theta_i\right) \\
&-\frac{\lambda}{2}\left[\left(p^2 - 2p\alpha_A + \alpha_A^2\right) + \left(p^2 - 2p\alpha_B + \alpha_B^2\right)\right] \quad = \quad -\frac{\lambda}{4}\left(\alpha_A^2 - 2\alpha_A\alpha_B + \alpha_B^2\right),
\end{aligned}$$

where $p = p(\theta_i, \underline{\theta})$. This expression simplifies to

$$\begin{aligned}
&-\frac{\lambda+1}{3}p^2 + \left(\frac{3/2\left(\theta_i + \underline{\theta}\right) - \bar{\theta}}{3} + \frac{\lambda\left(\alpha_A + \alpha_B\right)}{3}\right)p \\
&-\frac{\lambda+1}{6}\left(\frac{3\underline{\theta} - \bar{\theta} + \lambda\left(\alpha_A + \alpha_B\right)}{2\left(1+\lambda\right)}\right)^2 + \frac{\lambda}{8}\left(\alpha_A + \alpha_B\right)^2 + C_0\left(\theta_i\right) \quad = \quad \frac{\lambda}{4}\left(\alpha_A + \alpha_B\right),
\end{aligned}$$

which gives

$$C_0\left(\theta_i\right) = -\frac{\lambda+1}{3}\left[\left(\frac{3/2\left(\theta_i + \underline{\theta}\right) - \bar{\theta} + \lambda\left(\alpha_A + \alpha_B\right)}{2\left(1+\lambda\right)}\right)^2 - \frac{1}{2}\left(\frac{3\underline{\theta} - \bar{\theta} + \lambda\left(\alpha_A + \alpha_B\right)}{2\left(1+\lambda\right)}\right)^2\right] + \frac{\lambda}{8}\left(\alpha_A + \alpha_B\right)^2.$$

Notice that this contribution is increasing in the lobby's own type, since

$$\frac{\partial C}{\partial \theta_i} = \frac{1}{2}\left[p\left(\theta_i, \theta_j\right) - p\left(\theta_i, \underline{\theta}\right)\right] \geq 0,$$

and the policy is increasing in the lobby's type. Additionally, this contribution satisfies the Spence-Mirrlees condition, since

$$\frac{\partial^2 C}{\partial \theta \partial p} = \frac{1}{2} > 0.$$

□

Proof of Proposition 3. Again, we follow Martimort and Moreira (2010) and anticipate that the optimal contribution is quadratic when the distribution is uniform. For the linear example the system of first-order conditions is given by

$$\begin{aligned}
\theta_i + \frac{\partial C}{\partial p}\left(p\left(\theta_i,\theta_j\right),\theta_j\right) - \lambda\left(2p\left(\theta_i,\theta_j\right) - \alpha_A - \alpha_B\right) &= \left(\overline{\theta} - \theta_j\right)\frac{\partial^2 C}{\partial \theta_j \partial p}, \\
\theta_j + \frac{\partial C}{\partial p}\left(p\left(\theta_i,\theta_j\right),\theta_i\right) - \lambda\left(2p\left(\theta_i,\theta_j\right) - \alpha_A - \alpha_B\right) &= \left(\overline{\theta} - \theta_i\right)\frac{\partial^2 C}{\partial \theta_i \partial p}, \text{ and} \\
\frac{\partial C}{\partial p}\left(p\left(\theta_i,\theta_j\right),\theta_i\right) + \frac{\partial C}{\partial p}\left(p\left(\theta_i,\theta_j\right),\theta_j\right) - \lambda\left(2p\left(\theta_i,\theta_j\right) - \alpha_A - \alpha_B\right) &= 0.
\end{aligned}$$

The steps that lead to the equilibrium policy and contribution schedule are the same as those presented in Proposition 2. □

Proof of Proposition 4 (a). In this proof we compute the difference between the expected welfare evaluated at the decentralized policies and at the centralized policies, for $v(\theta,p) = -{}^1\!/_2\,(p-\theta)^2$. The lobbies' types are perfect information. The difference is positive if, and only if, decentralization is welfare superior.

The society's social welfare of each district evaluated at the centralization policy under perfect information is given by

$$\begin{aligned}
W_A(\bar{p}) &= -\frac{1}{2}\left(\frac{\theta_A + \theta_B - 2\alpha_A - \lambda\Delta\alpha}{2(1+\lambda)}\right)^2, \text{ and} \\
W_B(\bar{p}) &= -\frac{1}{2}\left(\frac{\theta_A + \theta_B - 2\alpha_B + \lambda\Delta\alpha}{2(1+\lambda)}\right)^2.
\end{aligned}$$

Hence, the sum of the surpluses is given by

$$W(\bar{p}) = -\frac{1}{8(1+\lambda)^2}\left[\ 2\left(\theta_i+\theta_j\right)^2 - 4\left(\alpha_A+\alpha_B\right)\left(\theta_i+\theta_j\right) + 2\lambda(2+\lambda)\Delta\alpha + \left(2\alpha_A\right)^2 + \left(2\alpha_B\right)^2\ \right].$$

The society's welfare evaluated at the decentralization policy under perfect information is the same as under perfect information

$$W\left(\check{p}_A,\check{p}_B\right) = -\frac{1}{2(1+\lambda)^2}\left[\theta_i^2 + \theta_j^2 - 2\left(\alpha_A\theta_i + \alpha_B\theta_j\right) + \alpha_A^2 + \alpha_B^2\right].$$

Therefore, the welfare of decentralization minus the welfare of centralization is given by

$$W\left(\check{p}_A,\check{p}_B\right) - W_A(\bar{p}) - W_B(\bar{p}) = -\frac{1}{4(1+\lambda)^2}\left[\ \left(\theta_i-\theta_j\right)^2 - 2\left(\theta_i-\theta_j\right)\Delta\alpha - \lambda(2+\lambda)(\Delta\alpha)^2\ \right].$$

Computing the expected value of this expression gives

$$E\left[W\left(\check{p}_A,\check{p}_B\right) - W(\bar{p})\right] = -\frac{1}{4(1+\lambda)^2(\Delta\theta)^2}\int_{\underline{\theta}}^{\bar{\theta}}\int_{\underline{\theta}}^{\bar{\theta}}\left[\begin{array}{c}\theta_i^2 - 2\theta_i\theta_j + \theta_j^2 - 2\left(\theta_i-\theta_j\right)\Delta\alpha \\ -\lambda(2+\lambda)(\Delta\alpha)^2\end{array}\right]d\theta_i d\theta_j,$$

which simplifies to

$$E\left[W\left(\check{p}_A,\check{p}_B\right) - W(\bar{p})\right] = -\frac{1}{4(1+\lambda)^2}\left[\frac{(\Delta\theta)^2}{6} - \lambda(1+\lambda)(\Delta\alpha)^2\right].$$

If the expression inside the brackets is negative, decentralization is welfare superior while if it is positive, centralization is welfare superior. □

The proofs of Propositions 4b, 5a and 5b follow the same steps as the proof of Proposition 4a.

Proof of Proposition 6. In this proof we compute the difference between the welfare evaluated at decentralization and the welfare evaluated at centralization for each district if $v(\theta, p) = -\frac{1}{2}(p-\theta)^2$. The lobbies types are perfect information. When districts have to agree to join a centralized structure, then both must desire it. Hence we identify the district that favors to centralization less and identify under which circumstances it will be willing to agree on centralizing the decision.The difference between the welfare of the two regimes for each district is given by

$$\begin{aligned} W_A(\check{p}_A) - W_A(\bar{p}) &= -\frac{1}{8(1+\lambda)^2}\left[\begin{array}{c} 3\theta_i^2 - 2\theta_i\theta_j - \theta_j^2 - 4\alpha_A(\theta_i - \theta_j) + 2\lambda\Delta\alpha(\theta_i + \theta_j) \\ -\lambda\Delta\alpha(\lambda\Delta\alpha + 4\alpha_A) \end{array}\right], \text{ and} \\ W_B(\check{p}_B) - W_B(\bar{p}) &= -\frac{1}{8(1+\lambda)^2}\left[\begin{array}{c} 3\theta_j^2 - 2\theta_i\theta_j - \theta_i^2 + 4\alpha_B(\theta_i - \theta_j) - 2\lambda\Delta\alpha(\theta_i + \theta_j) \\ -\lambda\Delta\alpha(\lambda\Delta\alpha - 4\alpha_B) \end{array}\right]. \end{aligned}$$

Computing the expectation of these terms, we get

$$\begin{aligned} E[W_A(\check{p}_A) - W_A(\bar{p})] &= -\frac{1}{8(1+\lambda)^2}\left[\tfrac{(\Delta\theta)^2}{6} + 2\lambda\Delta\alpha\left(\bar{\theta} + \underline{\theta}\right) - \lambda\Delta\alpha(\lambda\Delta\alpha + 4\alpha_A)\right], \text{ and} \\ E[W_A(\check{p}_A) - W_A(\bar{p})] &= -\frac{1}{8(1+\lambda)^2}\left[\tfrac{(\Delta\theta)^2}{6} - 2\lambda\Delta\alpha\left(\bar{\theta} + \underline{\theta}\right) - \lambda\Delta\alpha(\lambda\Delta\alpha - 4\alpha_B)\right]. \end{aligned}$$

Since $\bar{\theta} + \underline{\theta} > \alpha_A + \alpha_B$, and $\alpha_A > \alpha_B$, then district B is more inclined towards decentralization. Thus, if district B prefers centralization, so does district A. Therefore, if

$$\frac{(\Delta\theta)^2}{6} - 2\lambda\Delta\alpha\left(\bar{\theta} + \underline{\theta}\right) - \lambda\Delta\alpha(\lambda\Delta\alpha - 4\alpha_B) \geq 0,$$

then centralization is Pareto superior, otherwise, at least one district prefers decentralization. □

The proofs of Propositions 7, 8 and 9 follow the same steps as the proof of Proposition 6.

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