Fiscal Federalism and Lobbying

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Abstract

Which government functions should be decentralized (resp. centralized) once lobbying behavior is taken into account? We find that the answer largely depends on how the interests of the regional lobbies are positioned with respect to the function to be decentralized (resp. centralized). When regional lobbies have *conflicting* interests, then lobbying is less damaging for social welfare under centralization. On the contrary, when regional lobbies have *aligned* interests, then lobbying is less damaging for social welfare under decentralization, provided that policy spillovers on the non-organized groups are not too strong.

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1 Introduction

One of the most fundamental questions in the theory of fiscal federalism concerns the correct allocation of functions to different levels of government. This question has not only theoretical appeal. Given the recent and widespread tendency towards decentralization within countries, and centralization (of some functions) across countries, it also has a deep policy content. Economists are not completely devoid of answers. According to Oates (1972) celebrated 'decentralization theorem', we should centralize (decentralize) functions with more (less) spillover effects and less (more) heterogeneity of preferences across jurisdictions. In its simplicity, this is a recipe that can carry one some way (see, for instance, Alesina, Angeloni and Schuknecht, 2005, and Tabellini, 2003, on the European Union). However, an important limitation of Oates's analysis is that he assumes welfare maximizing governments, and it is not clear how far his insights could go in more realistic political environments.

As an example, consider the current debate on the role that the European Union (EU) should play on the supply side of the economy, in fields such as labor markets institutions, competition and regulation policy, education, pensions and infrastructures. In these fields, currently largely under the control of national governments, many observers would agree that the most important policy distortions come from the pressure of powerful organized interest groups on governments (e.g. Tabellini and Wyplosz, 2006). The important policy question, over which theoretical analysis should then attempt to cast some light, is then whether these pressures are likely to become more or less powerful once these functions were centralized at the EU level. However, this is not the issue that has been considered in the attempts to extend Oates' analysis to a political economy framework (see Besley and Coate, 2003; Lockwood, 2002). Moreover, despite the large economic literature on lobbying (see Grossman and Helpman, 2001, for a comprehensive survey), very few studies have concentrated on the specific relationship between interest groups and (de)centralization. And when they have done so, they mostly focused on the higher heterogeneity of preferences under centralization as the main discriminating factor (e.g. De Melo *et al.,* 1993, and Redoano, 2002). But, for example, differences in preferences among EU countries do not seem to play an important role in the cases discussed above (see again Alesina, Angeloni and Schuknecht, 2005, for empirical evidence).

A more extensive discussion of the relationship between decentralization and lobbying is offered by Bardhan and Mookherjee (2000, 2002). They consider a probabilistic model of voting, where rich voters may decide to form an interest group which offers campaign contributions to Downsian parties before the elections, in order to influence the voting behavior of poorer and less informed voters. Comparing national versus local elections, they find many arguments supporting the idea that interest groups are more powerful at the local level (such as increased cohesiveness, lower level of voter awareness, lower electoral competition, etc.) and many others that pull in the opposite direction (more fungibility of campaign funds at the national level, less electoral uncertainty, etc.).[1] Other studies are also somewhat connected to the topic, although they do not explicitly focus on the relationship between decentralization and lobbying. For example, Treisman (2006) criticizes the usual argument in favor of decentralizing tax resources, by noting that the incentives given to local politicians for improving the local economy (which may include bribes from the private sector) may be counterbalanced by the opposite incentives given to the central government. Brou and Ruta (2006) consider the effect of political integration when lobbies are asymmetrically distributed among integrating countries, arguing that the country with more organized groups should fare better in the ensuing political game. Endogeneizing lobbying formation, they then conclude that political integration (e.g. centralization) should promote more lobbying formation.

While we do not question the potential importance of all these factors, we argue here that there is another important channel which has so far escaped attention. This has to do with the simple idea, very widespread in the political debate, that local governments care more for local interests than for foreign ones, as supporting a local interest generates additional benefits for the local politicians than supporting a foreign one (e.g. Prud'homme, 1994). As an example, advocates of the European Union traditionally argue that more competencies should be assigned to the Union, because otherwise each country would have an interest in defending its own 'national champions'. Notice that this argument seems to point out to a more fundamental difference between centralization and decentralization, concerning the influence of interest groups on policy, than the ones identified by the above literature. Local governments do not

[1] Therefore, in Bardhan and Mookherjee the problem rests essentially on empirical grounds. We are not aware of any specific empirical work studying the relationship between decentralization and lobbying. There are, however, some empirical works discussing the relationship between corruption and decentralization, usually finding a negative correlation between the two. For recent examples, see Treisman (2000) and Fisman and Gatti (2002).

internalize the effects of their policy on foreign interests and, as a result of this failure, they make inefficient choices that a central government would avoid. While interesting, this argument is also however clearly incomplete. It fails to recognize that interest groups would attempt to influence policy even under centralization, so that the true question to ask, as argued above, is whether and under which circumstances these pressures are likely to become less important once those functions were centralized.

To address this issue, we build a simple model, but which encompasses several possible realistic interactions among national lobbies and national residents (real world examples are discussed in the main text below). In our model, there are two identical regions and, in each region, one organized group which may lobby politicians to the detriment of non-organized interests. Organized groups may have either *conflicting* interests – when the successful lobbying activities of a regional lobby hurt the other regional organized group – or *aligned* interests – when the lobbying activities of a regional lobby benefit also the other. Similarly, non-organized groups may be damaged only by the policies decided in their regions of residence or by the policies decided in both regions. Finally, we consider lobbying behavior under both *centralization*, when a national policy maker is in charge of all decisions, and *decentralization*, when local policy makers (simultaneously) set local policies. Following Grossman and Helpman (2001) (see also Grossman and Helpman, 1994, and Dixit *et al.*, 1997), we model lobbying by using the common agency approach of Bernheim and Whinston (1986a), extending it to multiple principals and multiple agents when considering the decentralized case (see Prat and Rustichini, 2003; Segal, 1999). In this approach, as it is well known, politicians maximize a weighted utility function which takes into account both social welfare and money contributions from the interest groups. This is of course a 'reduced form' of political behavior and lacks many details emphasized by the more recent literature. But, in our view, this simpler approach has the advantage of maintaining a larger generality.

We get very sharp results. While decentralization and centralization turn out to be (under our parametric restrictions) equivalent regimes when there is no lobbying or when the lobbies do not affect each other, our results are very different when there is interdependence. In particular, provided policy spillovers on non-organized groups are not too large, lobbying behavior is unambiguously more damaging for welfare under centralization when the interests of the lobbies are aligned, and it is unambiguously more damaging under decentralization when the lobbies have conflicting interests. The intuition is very simple and rests on an externality argument. When the interests of the two lobbies are aligned, decentralization means that the local policy maker does not take into account the beneficial effect of its policy on the other regional interest groups; hence, *ceteris paribus*, it distorts less policies. Vice versa, when the interests of the two lobbies are conflicting, centralization means that policy maker takes also into account the interests of the group hurt by the policy, thus leading to less distortion under lobbying. Hence, our model offers one important insight. It suggests that the answer to the normative question of the allocation of functions to different levels of government may also depend on the specific function under consideration, and in particular on how the interests of the national lobbies are positioned with respect to that particular function. We further discuss some implications of this argument for the European Union debate in the concluding section.

Naturally, in order to get clear-cut results we do not consider many other plausible differences which could exist between centralization and decentralization. For example, our model abstracts from heterogeneity of preferences, agents' mobility, intergovernmental transfers, tax competition, differences in the preferences of local versus national politicians, and so on. Of course, this eliminates additional features which may also have a bearing on the role of interest groups on policy, but which seems somewhat less fundamental that the difference we focus on here.[2]

The rest of the paper is organized as follows. In Section 2 we set up the model and in Section 3 we consider the benchmark allocations in the absence of lobbying. In Sections 4 and 5 we examine lobbying behavior under centralization and decentralization, respectively. The comparison between the two institutional regimes is done in Section 6. Finally, Section 7 concludes by summarizing the results and suggesting avenues for further research. The technical point concerning the non-negativity of equilibrium contributions is taken up in the Appendix.

[2] Furthermore, these features have already been scrutinized by a large literature. For instance, see Persson (1998) for 'common pool' effects which may arise out of transfers from the central level to local ones, Wilson (1999) for 'fiscal competition' effects which may arise out of the mobility of the tax base, Keen and Kotsogiannis (2002) for 'spillover effects' in taxation, and Seabright (1996) for honesty effects induced by the larger accountability of local politicians.

2 The model

We consider an economy composed of two identical regions (or jurisdictions), labelled $r = \alpha, \beta$. The residents in each jurisdiction are divided into two groups: a 'majority' group, of mass 1, and a 'minority' group, of mass θ, $\theta \in (0,1)$. Let A and B be the majority groups, and a and b the minority groups, resident in regions α and β, respectively. There is no mobility of individuals across groups or across regions.

In each region, two kinds of policy instruments, labelled p and q, are set by the policy maker in power (either a central or a regional policy maker, depending on the institutional setting). Let $p_r \geq 0$ and $q_r \geq 0$ denote the levels of policies p and q set in region r.

Members of each group inside each region have identical preferences but there is heterogeneity across groups and regions. In particular, the per capita welfare of members belonging to groups a and b, which for simplicity is additive and linear in the policy variables, is represented by the utility functions:

$$U_a = h[p_\alpha + \lambda p_\beta + \delta(q_\alpha + \lambda q_\beta)], \tag{1}$$

$$U_b = h[q_\beta + \lambda q_\alpha + \delta(p_\beta + \lambda p_\alpha)], \tag{2}$$

where h is some positive constant and $\delta \in (-1,1]$, $\lambda \in [0,1]$.

The value of the parameter δ determines the way in which policies p and q affect the two groups, *no matter* the region, α or β, in which the policy is implemented. If $\delta = 0$ then group a (resp. b) benefits from a positive level of policy p (resp. q) but not from policy q (resp. p). If $\delta \in (0,1]$ both groups benefit from both policies, although for $\delta < 1$ group a values one unit of policy p more than one unit of policy q, while the reverse holds for group b. Finally, if δ is negative, $\delta \in (-1,0)$, then policy p benefits, whereas policy q harms, group a; and the reverse is true for group b.

The value of the parameter λ accounts for the location, α or β, in which the policy is implemented, *no matter* the kind of policy, p or q. At one end, if $\lambda = 0$ then each group i is affected only by the policies implemented in its own region. At the other end, if $\lambda = 1$ then both groups are evenly affected by both types of policies implemented in the two regions. In between, for $\lambda \in (0,1)$, each group i is more affected by policies implemented in its own region than by policies implemented in the other region.

The model is meant to encompass a variety of real world situations where lobbying may be relevant. For instance, p could represent antitrust policy (with high levels of p representing *soft* policies, allowing firms to collude and earn monopoly profits) and q labor markets legislation (with high levels of q representing legislations that offer little protection to non-unionized workers). In this case, groups a and b would represent firms resident in regions α and β, and it would be natural to assume $\delta = 1$ since firms are interested in high levels of both policies. Moreover, if markets are open so that firms operate in both regions, then λ should be set close to one, whereas if firms mostly operate within their own region, then λ should be given a value close to zero. Alternatively, suppose that firms supplying equipments to the railways industry are mostly located in region α whereas firms supplying the aviation sector are mostly located in region β and let policies p and q represent respectively public investments in the railway sector and in the aviation sector. In this case, a natural interpretation of the model would read $\lambda = 1$ and $\delta < 0$, since firms belonging to group a benefit from public investments in the railway sector made in both regions, but their business may be crowded out by investments in the aviation sector made in both regions, and *vice versa* for firms belonging to group b.

Members of group I, $I = A, B$, are negatively affected by positive levels of the policy variables, p_r and q_r, set in both regions. Members of each group have identical preferences and strictly prefer that policies are set to zero. The per capita welfare of members belonging to groups A and B is:

$$U_A = -(1-\sigma)L(p_\alpha, q_\alpha) - \sigma L(p_\beta, q_\beta), \tag{3}$$

$$U_B = -(1-\sigma)L(p_\beta, q_\beta) - \sigma L(p_\alpha, q_\alpha), \tag{4}$$

where $\sigma \in [0, \frac{1}{2}]$ and L is a welfare loss function that for simplicity takes the quadratic form:

$$L(p_r, q_r) = [1 + (p_r + q_r)/2](p_r + q_r), \quad r = \alpha, \beta. \tag{5}$$

Again, the parameter σ is introduced to add generality to the model. Specifically, if $\sigma = 0$ then members of groups I are negatively affected only by policies set in the 'home' region, while if $\sigma > 0$ then also policies set in the 'foreign' region harm the members of these groups. For instance, in the first example given above, groups I may represent non-organized citizens that are negatively affected, as consumers, by soft antitrust policies and, as workers, by *pro* employers labor market legislations. In this example, if both consumers and workers are relatively immobile, it is then reasonable to set $\sigma = 0$. Alternatively p and q could represent environmental policies in two different geographical areas, such as the preservation of forests (mainly located in region α)

and water protection (with coastlines mainly located in region β). Group a may then represent firms interested in exploiting the forests while group b firms interested in exploiting water resources. In this case, the relevant parameters would be δ and λ close to zero (since the business activities of groups a and b are not linked) and σ close to $\frac{1}{2}$ (since the citizens of both regions care for both the preservation of forests and of water resources).[3]

3 Policy making, social optima, and lobbying

Policy makers are assumed to use a Benthamite utilitarian criteria to aggregate groups' welfare into a social welfare function. In jurisdiction r per capita social welfare, $W_r = \theta U_i + U_I$, is then equal to

$$W_\alpha = \theta h[p_\alpha + \lambda p_\beta + \delta(q_\alpha + \lambda q_\beta)] - (1-\sigma)L(p_\alpha, q_\alpha) - \sigma L(p_\beta, q_\beta), \tag{6}$$

$$W_\beta = \theta h[q_\beta + \lambda q_\alpha + \delta(p_\beta + \lambda p_\alpha)] - (1-\sigma)L(p_\beta, q_\beta) - \sigma L(p_\alpha, q_\alpha). \tag{7}$$

Similarly, national social welfare, $W = W_\alpha + W_\beta$, is then equal to

$$W = \theta h[(1+\lambda\delta)(p_\alpha + q_\beta) + (\lambda + \delta)(p_\beta + q_\alpha)] - L(p_\alpha, q_\alpha) - L(p_\beta, q_\beta). \tag{8}$$

We consider two types of institutional settings in which policy choices are taken. Under the regime of policy *centralization*, a single policy maker is in charge of public policy in both regions. Under *decentralization*, there is an independent policy maker in charge of local public policy in each region. As a normative benchmark, we begin by examining how policies would be set by benevolent policy makers whose only goal is social welfare maximization under both regimes. Under centralization, a benevolent policy maker maximizes national social welfare W. Therefore, policy choices by a benevolent policy maker under centralization correspond by definition to the utilitarian optimum. Under decentralization, the policy maker in region r, $r = \alpha, \beta$, independently from the policy maker in region j, $j = \alpha, \beta$, $j \neq r$, maximizes regional social welfare

[3] Also cash transfer programs financed through general taxation on the entire population, but mainly targeted to members of groups a and b, can fit into the model. In this case, the utility functions (3)–(4) for members of groups A and B can be interpreted as a reduced form representation of the welfare loss incurred for having to pay the tax bill while receiving no direct benefits from public expenditure. The parameter σ could capture the structure of the tax system. For instance, $\sigma = 0$ may be appropriate if members of groups A and B pay residence-based taxes, while a positive value for σ may represent the case when regional public expenditure is financed out of a common pool of national taxes.

W_r. In contrast with centralization, benevolent local policy makers do not necessarily implement the utilitarian optimum, as they do not internalize spillover effects of their policies on residents living in the other region. In the present setting, however, both regimes deliver the utilitarian optimum when policy makers are benevolent, provided that the following assumption concerning the parameters h and θ is made:

Assumption 1 $2\theta h < 1$.

We discuss this assumption after presenting Proposition 1 below. A second assumption is introduced to characterize the choices taken by policy makers. Linearity in the assumed pay-off functions imply that in many cases there is a continuum of policies that maximize the objective function of the policy makers. We thus assume:

Assumption 2 *If the policy maker is indifferent among policies belonging to a set $\mathcal{P}$, and if $\mathcal{P}$ contains a symmetric policy choice, i.e. one with equal policies in regions α and β, then the policy maker chooses the symmetric policy.*

We are now ready to characterize the normative benchmark in which policies are set by benevolent policy makers.[4]

Proposition 1 *In the utilitarian optimum, $p_r^* = 0$, $q_r^* = 0$, $r = \alpha, \beta$. Social welfare is $W^* = 0$. Groups' per capita welfare is $U_I^* = 0$, $I = A, B$, $U_i^* = 0$, $i = a, b$. Benevolent policy makers implement the utilitarian optimum, under both Centralization and Decentralization.*

Proof. To characterize the utilitarian optimum, differentiate (8) with respect to the policy instruments,

$$\frac{\partial W}{\partial p_\alpha} = \theta h(1 + \lambda\delta) - (1 + p_\alpha + q_\alpha),$$
$$\frac{\partial W}{\partial q_\alpha} = \theta h(\lambda + \delta) - (1 + p_\alpha + q_\alpha),$$
$$\frac{\partial W}{\partial q_\beta} = \theta h(1 + \lambda\delta) - (1 + p_\beta + q_\beta),$$
$$\frac{\partial W}{\partial p_\beta} = \theta h(\lambda + \delta) - (1 + p_\beta + q_\beta).$$

Assumption 1 implies $\theta h(1+\lambda\delta) < 1$ and $\theta h(\lambda+\delta) < 1$, since $1+\lambda\delta \leq 2$ and $\lambda+\delta \leq 2$ for all $\delta \in (-1, 1]$, $\lambda \in [0, 1]$. Hence $\left.\frac{\partial W}{\partial p_\alpha}\right|_{p_\alpha=0} < 0$ for all $q_\alpha \geq 0$, $\left.\frac{\partial W}{\partial q_\alpha}\right|_{q_\alpha=0} < 0$ for all

[4] We use an asterisk to denote the allocation in the utilitarian optimum.

$p_\alpha \geq 0$, $\left.\frac{\partial W}{\partial q_\beta}\right|_{q_\beta=0} < 0$ for all $p_\beta \geq 0$, $\left.\frac{\partial W}{\partial p_\beta}\right|_{p_\beta=0} < 0$ for all $q_\beta \geq 0$. Therefore $p_r^* = 0$, $q_r^* = 0$, $r = \alpha, \beta$, $W^* = 0$, $U_I^* = 0$, $I = A, B$, $U_i^* = 0$, $i = a, b$ at the optimum. Under centralization, a benevolent policy maker maximizes W in (8) and therefore implements the utilitarian optimum. Under decentralization, the policy maker of region α sets p_α and q_α that maximize W_α. By differentiating (6),

$$\frac{\partial W_\alpha}{\partial p_\alpha} = \theta h - (1-\sigma)(1 + p_\alpha + q_\alpha),$$
$$\frac{\partial W_\alpha}{\partial q_\alpha} = \theta h \delta - (1-\sigma)(1 + p_\alpha + q_\alpha).$$

Assumption 1 implies $(\theta h)/(1-\sigma) < 1$ and $(\theta h \delta)/(1-\sigma) < 1$ for all $\delta \in (-1, 1]$, $\sigma \in [0, \frac{1}{2}]$. Hence $\left.\frac{\partial W_\alpha}{\partial p_\alpha}\right|_{p_\alpha=0} < 0$ for all $q_\alpha \geq 0$, $\left.\frac{\partial W_\alpha}{\partial q_\alpha}\right|_{q_\alpha=0} < 0$ for all $p_\alpha \geq 0$. Therefore $p_\alpha^* = 0$, $q_\alpha^* = 0$. By symmetry, the solution of the problem solved by the policy maker in region β is $p_\beta^* = 0$, $q_\beta^* = 0$. Therefore, benevolent policy makers implement the utilitarian optimum under decentralization. ■

In the utilitarian optimum both policies are set equal to zero, and the same choices are made both under centralization and under decentralization, thus providing a common benchmark for analyzing the effects of lobbying in the two regimes. To analyze lobbying, we now assume that in each region the minority group is organized as a lobby, whereas the majority group is not organized.[5] Notice that in this model organized and non-organized groups have conflicting interests. While each minority group i values a positive level of at least one policy instrument, each majority group I prefers that both policies are set to zero. By Proposition 1, any policy distortion (i.e. positive levels of policies) that the minority groups may win by lobbying the policy makers involves a social welfare loss. Indeed, the corner solution with zero policy levels of the utilitarian optimum captures in a simple way the common idea that the lobbying groups, if successful in distorting public policy, typically obtain gains that are smaller than the costs imposed on the rest of the population. Note that this is precisely the content of Assumption 1. At zero policy levels, the aggregate marginal gains accruing to the lobbies as a result of a policy distortion are equal to $(1 + \delta)\theta h$, whereas the aggregate marginal loss for non-organized groups is equal to 1. Therefore, Assumption 1 ensures that, given the mass θ of the organized groups, the size of the parameter h is sufficiently small so that the marginal benefits for the lobbies are *strictly* lower than the marginal

[5] As customarily in this type of models, we take as exogenously given the decision of some groups to organize themselves as lobbies. This is certainly a limitation of this literature. We refer to Mitra (1999) for a preliminary analysis on the endogenous formation of lobbies.

losses for the other groups, no matter the value of δ.[6] Assumption 1 also implies, as shown in Propositions 2 and 3 below, that in our model lobbying can be successful only if policy makers are 'sufficiently greedy' (in a sense defined more precisely below), which constitutes another realistic feature of our model.

Notice that while there is always a conflict of interest between organized and non-organized groups, the interests pursued by the two lobbying groups may interact in different ways, depending on the value taken by the parameter δ. Lobbies have *aligned* interests when $\delta \in (0, 1]$ and have *conflicting* interests when $\delta \in (-1, 0)$. In the former case, if (say) lobby a successfully induces the (national or regional) policy maker(s) to set a positive level of either policy p or q, then the benefits of the lobbying effort also accrue to members of group b. On the contrary, in the latter case, lobby a (resp. b) desires a positive level of policy p (resp. q) but a zero level of policy q (resp. p). In what follows, we will emphasize the impact of this difference on the results of the lobbying game under decentralization and centralization. To aid the interpretation of the results below, notice also that in the model there are two cases in which the interests of the two lobbying groups are independent. One is when $\delta = 0$ implying that lobby a cares only about type p policies, while lobby b cares only about type q policies. The other is when $\lambda = 0$, implying that each lobby cares only about policies set in the home region.

As anticipated in the Introduction we model lobbying behavior using the *common agency* framework developed by Bernheim and Whinston (1986a,b), Grossman and Helpman (1994, 2001) and Dixit *et al.* (1997), in which a set of principals (the lobbies) try to influence the actions of *one* agent (the policy maker). The case of policy centralization we consider below falls into this category. However, the case of policy decentralization, in which there are two principals (lobbies a and b) lobbying *two* agents (local policy makers in α and β), falls into the more general category of the so called *Games Played Through Agents*, investigated by Prat and Rustichini (2003). We begin with the centralized system.

[6] The fact that the lobbying groups represent a minority of the population usually implies that their members can obtain large individual gains in case of successful lobbying by causing small individual losses on the members of non-organized groups, that instead represent the majority of the population. This feature can be formally captured in our model by assuming $(1 + \delta)h > 1$. However, the relevant condition is the one made in Assumption 1, confronting aggregate, and not individual, marginal gains and losses.

4 Lobbying under Centralization

Under centralization, in both regions public policy is in the hands of a single policy maker caring both about social welfare and about contributions from the lobbies.[7] Politicians care about social welfare, presumably because they want to be re-elected, but they also care for lobbyists' contributions, either because the latter (e.g. in the form of campaign contributions) increase their chances of being re-elected, or simply because lobbies pay bribes that increase the policy maker's private consumption. Each lobbying group maximizes its welfare net of the contributions to the policy maker. As for the timing, lobbies move first, by independently and simultaneously offering the policy maker a contribution schedule defining a monetary contribution contingent on the vector of policy instruments. Upon acceptance of the lobbies contributions, the policy maker chooses public policy. The game is solved by backward induction.

Following Dixit *et al.* (1997), we focus on *truthful* subgame perfect Nash equilibria, in which each lobby offers the policy maker a non-negative *compensating (or truthful) contribution schedule*, shaped along its indifference curve. Formally, in the second stage of the game, given the per capita contribution schedules S_a and S_b collectively offered by members of groups a and b respectively, the policy maker chooses p_r and q_r, $r = \alpha, \beta$, to maximize her objective function

$$V = W + m\theta(S_a + S_b). \tag{9}$$

In (9), the parameter m, $m \geq 0$, measures the relative weight that the policy maker attaches to social welfare, W, and to contributions, S_i. The policy maker is taken to be 'benevolent' when m is close to zero, and 'greedy' when m is large.

Using (1) and (2), the per capita compensating contribution functions take the following form:

$$S_a = \max\{0, U_a - \pi_a\} = \max\{0, h[p_\alpha + \lambda p_\beta + \delta(q_\alpha + \lambda q_\beta)] - \pi_a\}, \tag{10}$$

$$S_b = \max\{0, U_b - \pi_b\} = \max\{0, h[q_\beta + \lambda q_\alpha + \delta(p_\beta + \lambda p_\alpha)] - \pi_b\}. \tag{11}$$

The contribution function S_i presented by lobby i is said to be truthful relative to the constant π_i since, given the *net* welfare level π_i (gross welfare U_i net of the contributions

[7] We focus exclusively on lobbying activities aimed at buying influence by means of some sort of contributions offered to the policy maker. However, lobbying activities may be directed at a variety of goals, such as providing information to policy makers. See Grossman and Helpman (2001) and Spiller and Liao (2006) for comprehensive surveys.

s_i paid), the change in the compensation offered to the policy maker for any change of policy is equal to the welfare change for lobby i.

Since common agency games typically present multiple equilibria, truthful equilibria are a useful refinement. Bernheim and Whinston (1986b, Theorem 1) and Dixit *et al.* (1997, Proposition 2) show that the set of best reply strategies of a principal to the contribution functions of the other principals (truthful or not) always contains a truthful contribution function. Moreover, truthful equilibria are easier to characterize than other types of equilibria, since truthful equilibria can be computed by solving a set of simultaneous equations in terms of the equilibrium welfare numbers π_i (see Proposition 3 in Dixit *et al.*, 1997). To solve our lobbying game, we rely on Corollary 1 to Proposition 4 in Dixit *et al.* (1997), that applies to cases (like ours) in which the utility functions of both the lobbies and the policy maker are linear in the contributions.

In terms of our game, the Corollary states that, given a truthful equilibrium with policy choices p_r^C and q_r^C, $r = \alpha, \beta$, and with positive contributions s_i^C, $i = a, b$, then the equilibrium policy choices are obtained by maximizing[8]

$$\mathcal{V} = W + m\theta(U_a + U_b) = (\theta + m\theta)h[(1 + \lambda\delta)(p_\alpha + q_\beta) + (\lambda + \delta)(p_\beta + q_\alpha)] + \\ -L(p_\alpha, q_\alpha) - L(p_\beta, q_\beta). \quad (12)$$

Clearly, maximizing (12) is an easier task than maximizing (9), since the former 'ignores' the non-negativity constraints on contributions. We thus derive the optimal choices of the policy maker in the second stage of the lobbying game, assuming that contributions are positive. We then check *ex post* for the non-negativity of the equilibrium contributions in the Appendix, where we solve for the first stage of the game. By maximizing (12) with respect to p_r and q_r, $r = \alpha, \beta$, we can state the following:

Proposition 2 *Let* $m^C \equiv \dfrac{1 - \theta h(1 + \lambda\delta)}{\theta h(1 + \lambda\delta)} > 0$. *Under Centralization, in the truthful equilibrium of the lobbying game, policy choices in region* r*,* $r = \alpha, \beta$*, are:*

- *If* $m \leq m^C$ *then* $p_r^C = q_r^C = 0$.
  Social welfare is $W^C = W^*$.
  Per capita groups' welfare is $U_I^C = U_I^*$, $I = A, B$, $U_i^C = U_i^*$, $i = a, b$.
- *If* $m > m^C$ *then* $p_\alpha^C = q_\beta^C = (\theta + m\theta)h(1 + \lambda\delta) - 1 > 0$, $p_\beta^C = q_\alpha^C = 0$ *for any* $(\delta, \lambda) \in (-1, 1) \times [0, 1)$;

[8] We use the superscript C to denote the allocation under centralization. In the next section, superscript D denotes the allocation under decentralization.

$p_r^C = q_r^C = [(\theta + m\theta)h(1 + \lambda\delta) - 1]/2 > 0$ for $\delta = 1$ or $\lambda = 1$.
Social welfare is $W^C < W^*$.
Per capita groups' welfare is $U_I^C < U_I^*$, $I = A, B$, $U_i^C > U_i^*$, $i = a, b$.

Proof. By differentiating (12) with respect to the policy instruments,

$$\frac{\partial \mathcal{V}}{\partial p_\alpha} = (\theta + m\theta)h(1 + \lambda\delta) - (1 + p_\alpha + q_\alpha), \tag{13}$$

$$\frac{\partial \mathcal{V}}{\partial q_\alpha} = (\theta + m\theta)h(\lambda + \delta) - (1 + p_\alpha + q_\alpha), \tag{14}$$

$$\frac{\partial \mathcal{V}}{\partial q_\beta} = (\theta + m\theta)h(1 + \lambda\delta) - (1 + p_\beta + q_\beta), \tag{15}$$

$$\frac{\partial \mathcal{V}}{\partial p_\beta} = (\theta + m\theta)h(\lambda + \delta) - (1 + p_\beta + q_\beta). \tag{16}$$

$\delta \in (-1, 1]$ and $\lambda \in [0, 1]$ imply that $1 + \lambda\delta = \lambda + \delta$ if $\lambda = 1$ or $\delta = 1$, and $1 + \lambda\delta > \lambda + \delta$ if $(\delta, \lambda) \in (-1, 1) \times [0, 1)$. Therefore $\frac{\partial \mathcal{V}}{\partial p_\alpha} > \frac{\partial \mathcal{V}}{\partial q_\alpha}$, $\frac{\partial \mathcal{V}}{\partial q_\beta} > \frac{\partial \mathcal{V}}{\partial p_\beta}$ for all $p_r \geq 0$, $q_r \geq 0$ if $(\delta, \lambda) \in (-1, 1) \times [0, 1)$, which implies $q_\alpha^C = p_\beta^C = 0$. Evaluating (13) at $p_\alpha = q_\alpha^C = 0$, and (15) at $p_\beta^C = q_\beta = 0$, one obtains

$$\left.\frac{\partial \mathcal{V}}{\partial p_\alpha}\right|_{p_\alpha = q_\alpha^C = 0} = \left.\frac{\partial \mathcal{V}}{\partial q_\beta}\right|_{p_\beta^C = q_\beta = 0} = (\theta + m\theta)h(1 + \lambda\delta) - 1 \equiv \Phi^C.$$

If $\Phi^C \leq 0$, i.e. if $m \leq m^C$ with m^C solving $\Phi^C = 0$, then $p_\alpha^C = q_\beta^C = 0$. Assumption 1 implies $m^C > 0$ for all $(\delta, \lambda) \in (-1, 1) \times [0, 1)$. Otherwise, if $\Phi^C > 0$, i.e. if $m > m^C$, then $p_\alpha^C > 0$ solves $\left.\frac{\partial \mathcal{V}}{\partial p_\alpha}\right|_{q_\alpha^C = 0} = 0$ and $q_\beta^C > 0$ solves $\left.\frac{\partial \mathcal{V}}{\partial q_\beta}\right|_{p_\beta^C = 0} = 0$, that is $p_\alpha^C = q_\beta^C = (\theta + m\theta)h(1 + \lambda\delta) - 1$. If $\lambda = 1$ or $\delta = 1$, then $1 + \lambda\delta = \lambda + \delta$ and hence the two policies set in region r, p_r and q_r, are perfect substitutes in the policy maker objective function. Let $z_r = p_r + q_r$. Then equations (13) and (16) reduce to

$$\frac{\partial \mathcal{V}}{\partial z_r} = (\theta + m\theta)h(1 + \lambda\delta) - (1 + z_r), \quad r = \alpha, \beta. \tag{17}$$

Evaluating (17) at $z_r = 0$, $\left.\frac{\partial \mathcal{V}}{\partial z_r}\right|_{z_r = 0} = \Phi^C$. Therefore, as in the previous case, if $\Phi^C \leq 0$, i.e. if $m \leq m^C$, then $z_r^C = p_r^C = q_r^C = 0$. Assumption 1 implies $m^C > 0$ for $\lambda = 1$ or $\delta = 1$. Otherwise, if $\Phi^C > 0$, i.e. if $m > m^C$, then $z_r^C > 0$ solves $\frac{\partial \mathcal{V}}{\partial z_r} = 0$, that is $z_r^C = (\theta + m\theta)h(1 + \lambda\delta) - 1$. Assumption 2 then implies $p_r^C = q_r^C = z_r^C/2$. When $p_r^C = q_r^C = 0$, the equilibrium allocation, social welfare and groups' welfare are the same as in the normative benchmark (see Proposition 1). Instead, when $p_\alpha^C = q_\beta^C > 0$, $p_\beta^C = q_\alpha^C = 0$, or when $p_r^C = q_r^C > 0$, social welfare and groups I welfare are lower, whereas groups i welfare is higher, than in the normative optimum, since the latter involves zero policy levels. ■

Proposition 2 shows that if the policy maker is 'sufficiently' *benevolent*, that is if $m \leq m^C$, then the minority lobbying groups are unable to distort the policy maker choices, so that the resulting allocation is socially optimal with zero levels of the policy instruments. On the contrary, if the policy maker is 'sufficiently' *greedy*, that is if $m > m^C$, then the lobbies are able to induce the policy maker to set policies p_α and q_β at a positive level if $(\delta, \lambda) \in (-1, 1) \times [0, 1)$, and all policies at a positive level if $\delta = 1$ or $\lambda = 1$, upon the payment of contributions. This increases lobbyists' welfare but reduces aggregate social welfare as the gain for the lobbies does not compensate for the loss suffered by non-organized citizens.

5 Lobbying under Decentralization

The game under decentralization is identical to the one considered in Section 4 but for the important fact that the lobbies face a distinct policy maker in each region. In stage one, the lobbies simultaneously and independently present to each local policy maker a truthful contribution schedule contingent on policy choices and then, in stage two, the policy makers, given the contribution schedules, simultaneously and independently choose public policy in their own region. To ensure comparability between institutional settings, we assume that the preferences of the politicians are the same (i.e. m is the same) both at the decentralized and at the centralized level.[9]

As already noticed above, while the lobbying game under centralization falls into the *common agency* framework (many principals, one agent), the corresponding game under decentralization falls into the more general one of *Games Played Through Agents*, or GPTA (many principals, many agents). To deal with this case, we follow Prat and Rustichini (2003). In particular, we assume that the contribution from a lobby to a local policy maker is *action-contingent* in the sense that it depends only on the policy choices taken by that policy maker.[10]

[9] See Seabright (1996) and Bardhan and Mookherjee (2000) for opposite arguments suggesting different values of m at the two levels.

[10] Prat and Rustichini (2003) consider also the more general case of *outcome-contingent* contributions, in which the contribution to an agent depends also on the actions taken by other agents. However, in the latter case no general characterization of the equilibrium outcomes of the game is available. Notice that our GPTA is slightly more general than the one examined by Prat and Rustichini (2003), although

In the second stage of the game, given the contribution function offered by the 'home' lobby, $S_{a,\alpha}$, and that offered by the 'foreign' lobby, $S_{b,\alpha}$,[11] the policy maker of region α, independently from the other policy maker β, chooses p_α and q_α to maximize her objective function

$$V_\alpha = W_\alpha + m\theta(S_{a,\alpha} + S_{b,\alpha}). \tag{18}$$

The problem of policy maker β is defined in a similar way. She maximizes the objective function $V_\beta = W_\beta + m\theta(S_{a,\beta} + S_{b,\beta})$.

Using equation (1), the per capita compensating contribution functions offered by lobby a to the policy makers of regions α and β are respectively defined as

$$S_{a,\alpha}(p_\alpha, q_\alpha) = \max\{0, h(p_\alpha + \delta q_\alpha) - \pi_{a,\alpha}\}, \tag{19}$$

$$S_{a,\beta}(p_\beta, q_\beta) = \max\{0, h\lambda(p_\beta + \delta q_\beta) - \pi_{a,\beta}\}. \tag{20}$$

Notice that the contribution (19) offered to the 'home' policy maker is truthful relative to the net welfare level (gross welfare minus contributions) achieved in region α, $\pi_{a,\alpha}$, and depends only on the policies chosen by that policy maker. By the same token, the contribution (20) offered to the policy maker of the other region is truthful relative to the net welfare level achieved in region β, $\pi_{a,\beta}$, and depends only on the policies chosen by that policy maker.[12]

In a similar manner, the per capita compensating contribution functions offered by

their results fully apply to our framework as well. They consider the case in which the utility function of each agent depends only on her actions. In our case, the utility (regional social welfare) of an agent (local policy maker) depends also on the actions (policies p and q) of the other agent.

[11] In denoting contributions under decentralization, the first subscript, a or b, denotes the group offering the contribution, whereas the second subscript, α or β, denotes the policy maker to which the contribution is offered.

[12] In general, as argued by Prat and Rustichini (2003, p. 1008), truthful contributions like those defined in common agency games "would impose too many equality restrictions on the transfer matrix" of the GPTA. They therefore introduce the weaker condition of *weakly truthful contributions*, that in terms of our model would substitute conditions (19)–(20) with the condition

$$S_{a,\alpha}(p_\alpha, q_\alpha) + S_{a,\beta}(p_\beta, q_\beta) \geq \max\{0, h[p_\alpha + \lambda p_\beta + \delta(q_\alpha + \lambda q_\beta)] - \pi_a\}.$$

In our setting, however, given the linearity and separability of the utility functions of the principals, the games played in each region are independent of each other, which allows us to apply the condition of truthful contributions defined in (19)–(20).

lobby b to the policy makers of regions β and α are respectively defined as

$$S_{b,\beta}(p_\beta, q_\beta) = \max\{0, h(q_\beta + \delta p_\beta) - \pi_{b,\beta}\}, \tag{21}$$

$$S_{b,\alpha}(p_\alpha, q_\alpha) = \max\{0, h\lambda(q_\alpha + \delta p_\alpha) - \pi_{b,\alpha}\}. \tag{22}$$

To characterize the equilibrium policy choices in the second stage of the game, we proceed as in Section 4, by maximizing the objective function of the policy maker while ignoring the non-negativity constraints on contributions. *Ex-post*, in the Appendix, we verify that in the given equilibrium the contributions are non-negative. In what follows, we focus on region α only, as the problem for region β is symmetric. Given the contributions (19) and (22), the problem of the policy maker of region α is that of choosing p_α and q_α to maximize her objective function

$$\begin{aligned}\mathcal{V}_\alpha = W_\alpha + m\theta[h(p_\alpha + \delta q_\alpha) + h\lambda(q_\alpha + \delta p_\alpha)] = \\ = \theta h[p_\alpha + \lambda p_\beta + \delta(q_\alpha + \lambda q_\beta)] + m\theta h[(1+\lambda\delta)p_\alpha + (\lambda+\delta)q_\alpha] + \\ -(1-\sigma)L(p_\alpha, q_\alpha) - \sigma L(p_\beta, q_\beta),\end{aligned} \tag{23}$$

where we have substituted W_α from (6).

Proposition 3 *Let* $m^D \equiv \dfrac{1-\sigma-\theta h}{\theta h(1+\lambda\delta)} > 0$. *Under Decentralization, in the truthful equilibrium of the lobbying game, policy choices in region* r, $r = \alpha, \beta$, *are:*

- *If* $m \leq m^D$ *then* $p_r^D = q_r^D = 0$.
  Social welfare is $W^D = W^*$.
  Per capita groups' welfare is $U_I^D = U_I^*$, $I = A, B$, $U_i^D = U_i^*$, $i = a, b$.
- *If* $m > m^D$ *then* $p_\alpha^D = q_\beta^D = \theta h - (1-\sigma) + m\theta h(1+\lambda\delta) > 0$, $p_\beta^D = q_\alpha^D = 0$, *for any* $\delta \in (-1, 1)$.
  $p_r^D = q_r^D = [\theta h - (1-\sigma) + m\theta h(1+\lambda\delta)]/2 > 0$, *for* $\delta = 1$.
  Social welfare is $W^D < W^*$.
  Per capita groups' welfare is $U_I^D < U_I^*$, $I = A, B$, $U_i^D > U_i^*$, $i = a, b$.

Proof. By differentiating $\mathcal{V}_\alpha$ with respect to p_α and q_α one has

$$\frac{\partial \mathcal{V}_a}{\partial p_\alpha} = \theta h + m\theta h(1+\lambda\delta) - (1-\sigma)(1 + p_\alpha + q_\alpha), \tag{24}$$

$$\frac{\partial \mathcal{V}_a}{\partial q_\alpha} = \theta h\delta + m\theta h(\lambda+\delta) - (1-\sigma)(1 + p_\alpha + q_\alpha). \tag{25}$$

If $\delta \in (-1, 1)$, equations (24)–(25) imply $q_\alpha^D = 0$ at the optimum, since $\frac{\partial \mathcal{V}_a}{\partial p_\alpha} > \frac{\partial \mathcal{V}_a}{\partial q_\alpha}$ for all $p_\alpha \geq 0$, $q_\alpha \geq 0$. Evaluating (24) at $p_\alpha = q_\alpha^D = 0$, one obtains

$$\left.\frac{\partial \mathcal{V}_a}{\partial p_\alpha}\right|_{p_\alpha = q_\alpha^D = 0} = \theta h - (1 - \sigma) + m\theta h(1 + \lambda\delta) \equiv \Phi^D.$$

If $\Phi^D \leq 0$, i.e if $m \leq m^D$, with m^D that solves $\Phi^D = 0$, then $p_\alpha^D = 0$. Assumption 1 implies that $m^D > 0$. Otherwise, if $\Phi^D > 0$, i.e. if $m > m^D$, then $p_\alpha^D > 0$ solves $\frac{\partial \mathcal{V}_a}{\partial p_\alpha} = 0$. If $\delta = 1$, then $\frac{\partial \mathcal{V}_a}{\partial p_\alpha} = \frac{\partial \mathcal{V}_a}{\partial q_\alpha}$, hence p_α and q_α are perfect substitutes in the policy maker objective function. Hence, substituting $z_\alpha = p_\alpha + q_\alpha$ into equations (24)–(25), Assumptions 2 and 1 imply that $z_\alpha^D = p_\alpha^D = q_\alpha^D = 0$ if $m \leq m^D$, and $z_\alpha^D > 0$ that solves $\frac{\partial \mathcal{V}_a}{\partial p_\alpha} = 0$ if $m > m^D$, with $p_\alpha^D = q_\alpha^D = z_\alpha^D/2$. By symmetry, the same solutions are obtained for the policies p_β and q_β from the problem of policy maker β. When $p_r^D = q_r^D = 0$, the equilibrium allocation, social welfare and groups' welfare are the same as in the normative benchmark. Both when $p_\alpha^D = q_\beta^D > 0$, $p_\beta^D = q_\alpha^D = 0$ and when $p_r^D = q_r^D > 0$, social welfare and groups I welfare are lower, whereas groups i welfare is higher, than in the normative optimum in which all policies are set to zero. ■

The results of Proposition 3 are similar to those obtained in Proposition 2 under centralization. Lobbying is not effective if policy makers are 'sufficiently' benevolent, while it succeeds in distorting public policy when the policy makers are greedy. There are however some important differences, that we address in the next Section.

6 Centralization vs Decentralization

The comparison between the two institutional regimes comes immediately by contrasting Proposition 2 with Proposition 3. As shown in the following proposition, the ranking in terms of social welfare depends on the relative magnitudes of four parameters:

$\delta \in (-1, 1]$, indicating whether the interests of the two lobbies for policies p and q are *aligned* ($\delta > 0$) or *conflicting* ($\delta < 0$);

$\lambda \in [0, 1]$, measuring the size of the spillover of local policies on the non-resident lobby;

$\sigma \in [0, \frac{1}{2}]$, measuring the size of the spillover of local policies on non-resident non-organized groups;

$m \geq 0$, representing the weight that policy makers attach to contributions from the lobbies.

Proposition 4 *Let* $\tilde{\sigma} \equiv \theta h \lambda \delta < \frac{1}{2}$*. If* $\delta \in (0, 1]$*,* $\lambda \in (0, 1]$*,* $\sigma \in [0, \tilde{\sigma})$*, social welfare is no lower under Decentralization than under Centralization. In fact:*

- *If* $m \in [0, m^C]$ *lobbying is ineffective under both regimes:* $W^C = W^D = W^*$*,* $p_r^C = q_r^C = p_r^D = q_r^D = 0$*,* $r = \alpha, \beta$*.*
- *If* $m \in (m^C, m^D]$ *lobbying induces a policy distortion under Centralization, but not under Decentralization:* $W^C < W^D = W^*$*,* $p_\alpha^C = q_\beta^C > 0$*,* $p_\beta^C = q_\alpha^C \geq 0$*,* $p_r^D = q_r^D = 0$*,* $r = \alpha, \beta$*.*
- *If* $m \in (m^D, \infty)$ *lobbying determines a larger distortion under Centralization than under Decentralization:* $W^C < W^D < W^*$*,* $p_\alpha^C = q_\beta^C > p_\alpha^D = q_\beta^D > 0$*,* $p_\beta^C = q_\alpha^C \geq p_\beta^D = q_\alpha^D \geq 0$ *.*

If (a) $\delta \in (0, 1]$*,* $\lambda \in (0, 1]$*,* $\sigma \in (\tilde{\sigma}, \frac{1}{2}]$*, or (b)* $\delta \in (-1, 0)$*,* $\lambda \in [0, 1]$*,* $\sigma \in [0, \frac{1}{2}]$*,* $\lambda\sigma \neq 0$*, social welfare is no lower under Centralization than under Decentralization. In fact:*

- *If* $m \in [0, m^D]$ *lobbying is ineffective under both regimes:* $W^D = W^C = W^*$*,* $p_r^D = q_r^D = p_r^C = q_r^C = 0$*,* $r = \alpha, \beta$*.*
- *If* $m \in (m^D, m^C]$ *lobbying induces a policy distortion under Decentralization, but not under Centralization:* $W^D < W^C = W^*$*,* $p_\alpha^D = q_\beta^D > 0$*,* $p_\beta^D = q_\alpha^D \geq 0$*,* $p_r^C = q_r^C = 0$*,* $r = \alpha, \beta$*.*
- *If* $m \in (m^C, \infty)$ *lobbying determines a larger distortion under Decentralization than under Centralization:* $W^D < W^C < W^*$*,* $p_\alpha^D = q_\beta^D > p_\alpha^C = q_\beta^C > 0$*,* $p_\beta^D = q_\alpha^D \geq p_\beta^C = q_\alpha^C \geq 0$ *.*

If (a) $\delta \in [0, 1]$*,* $\lambda \in [0, 1]$*,* $\sigma = \tilde{\sigma}$*, or (b)* $\delta \in (-1, 0)$*,* $\lambda = \sigma = 0$*, Centralization and Decentralization are equivalent regimes.*

Proof. The proof follows immediately from the definitions of m^C, m^D, p_r^C, q_r^C, p_r^D, q_r^D, in Propositions 2 and 3, given that $\sigma \lesseqgtr \tilde{\sigma}$ implies $m^C \lesseqgtr m^D$ and that, by Assumption 1, $\tilde{\sigma} < \frac{1}{2}$ for all λ and δ. ■

Proposition 4 shows that decentralization is a better regime when lobbies interests are *aligned*, provided that $\sigma < \tilde{\sigma}$, which means that decentralization is more likely to be welfare superior when policy spillovers on non-organized groups are sufficiently weak. Notice also that the threshold $\tilde{\sigma}$ is increasing in λ, the size of policy spillovers on organized groups; therefore, decentralization is more likely to be welfare superior the larger is λ, since strong policy spillovers reinforce the alignment of interests between the two lobbying groups. The specific outcome of the welfare comparison depends obviously on policy makers' preferences. If policy makers are 'sufficiently' greedy ($m^C < m \leq m^D$), the lobbies distort public policy under centralization but not under decentralization. Lobbying is effective under both regimes only if policy makers are 'very' greedy ($m > m^D$), but in this case the size of the distortions (and the associated social welfare loss) are greater under centralization. The two regimes are equivalent only when policy makers are 'sufficiently' benevolent ($m \leq m^C$), in which case the lobbies are unable to distort their choices. Overall, decentralization is thus a better regime on social welfare grounds. Centralization is instead a better regime when the alignment of interests ($\delta > 0$) is associated to strong policy spillovers on non-organized groups ($\sigma > \tilde{\sigma}$), as well as when the lobbies have *conflicting* interests ($\delta > 0$), no matter the size of policy spillovers σ and λ.

An even neater result, stated in Corollary 1 to Proposition 4, follows for the case in which $\sigma = 0$, that is when there are no policy spillovers on the non-organized groups, as it could be in the case in which, for example, local policies are transfers to social groups that are financed only out of resident taxation (see footnote 3). In this case, the ranking in terms of social welfare only depends on the sign of the parameter δ, that is on whether the lobbies have *aligned* or *conflicting* interests with respect to policies p and q.

Corollary 1 *Assume $\sigma = 0$. When lobbies interests are aligned ($\delta > 0$), social welfare is no lower under Decentralization than under Centralization. When lobbies interests are conflicting ($\delta < 0$), social welfare is no lower under Centralization than under Decentralization.*

The economic intuition behind our results can be better understood by looking at the incentives of the policy maker. Such incentives come from two sources: social welfare (with weight 1) and lobbies' contributions (with weight m). As for the latter, given that the lobbies offer, by assumption, *truthful* contributions, the policy maker has always the right incentives to maximize the aggregate welfare of the two lobbies, *no matter* whether the lobbies have aligned or conflicting interests and *no matter* the type of institutional setting, a centralized or a decentralized one. In particular, with aligned interests, lobbies have no incentives to free ride on each other's activity, since the actions are taken by the policy maker(s) under the incentives provided by truthful incentive schemes. With conflicting interests, the lobbies do not harm each other, since the policy maker(s), again by means of truthful incentive schemes, fully internalizes the aggregate benefits accruing to the lobbies from public policy. What makes the difference between the two regimes is thus the first component of the policy maker's objective function, i.e. social welfare. While under centralization the policy maker fully internalizes (into the aggregate social welfare) the effects that the policy variables have on the two lobbying groups, under decentralization each local policy maker takes into account only the impact of policies on the resident lobby. With *aligned* interests, since policy in one region determines a *positive externality* on the non-resident organized group, under decentralization the policy instruments are thus set at *lower* levels than under centralization. Therefore, lobbying is less harmful for social welfare under decentralization. The opposite is true with *conflicting* interests. In the latter case, policy in one region determines a *negative externality* on the non-resident organized group, and this implies that under decentralization the policy instruments are set at *higher* levels than under centralization, with the result that lobbying is more harmful for social welfare under decentralization.

In the more general case in which there are also policy spillovers on non-organized groups ($\sigma > 0$), decentralization may turn out to be welfare dominated by centralization even when lobbies' interests are aligned. This is because local policy makers cause larger distortions than those that would be caused by a central policy maker, as they do not internalize the negative externality imposed by their policy choices on the non-organized citizens of the other region. Hence, for given $\delta > 0$ and λ, centralization is a better regime in terms of welfare if policy spillovers on non-organized groups are sufficiently large, i.e. if $\sigma > \tilde{\sigma}$.

7 Concluding remarks

Is decentralization more conductive to lobbying behavior? This paper offers a simple answer to this important question. When the interests of lobbying groups are aligned, provided that policy spillovers on non-organized groups are sufficiently weak, then decentralization is better than centralization because in the former institutional setting local governments do not take into account the benefits of their policies on the non-resident lobbying groups, thus reducing the influence of lobbying. *Vice versa*, when the interests of local lobbies are in conflict, then centralization is better than decentralization because the central government takes into account the net benefits on all groups, while local governments only internalize the impact on their resident interest group. We find that the normative choice between decentralization and centralization is also influenced by the impact of policy makers' choices on non-organized non-resident groups. Since, under decentralization, local policy makers do not internalize the negative externality imposed by their policy choices on the non-organized group of the other region, they cause larger distortions than those that would occur under centralization. Thus if policy spillovers on non-organized groups are sufficiently strong, centralization may be better than decentralization on welfare grounds even when lobbies' interests are aligned.

Overall, our results suggest that in deciding whether a given function should be decentralized (resp. centralized) in the presence of significant lobbying behavior, one should also consider how the interests of local lobbies are positioned with respect to that particular function. For instance, consider again the EU example cited in the Introduction. One then notes that in fields such as consumer and environment protection, foreign and domestic producers would have the same interest to lobby for low consumers' protection if these policies were decided at the EU level. Of course, they would do the same if the policies remained at local level, but then each country would have no interest to internalize the effects of these policies on the profits of foreign firms. *Ceteris paribus*, our argument would then suggest to decentralize these functions. *Vice versa*, in regulatory fields such as production subsidies to national producers, or the protection of the market shares of incumbents and 'national champions', national lobbies have conflicting interests, and centralization at the EU level would force the policy maker to take into account also the interests hurt by protection policy. Hence, *ceteris paribus*, our argument would suggest to centralize these functions.

Clearly, our model focuses only on a single feature of the relationship between (de)centralization and lobbying, and we make no claim that this is the only possible channel. The literature surveyed in the Introduction already discusses alternative models of lobbying, with a richer political structure, which may produce different results. Moreover, lobbying is not necessarily a 'bad', as we have assumed here. It may provide useful information to politicians and citizens, and as better information on policies and politicians is often quoted as one of the main advantages of decentralization (e.g. Bennedsen and Feldmann, 2002 and 2006; Besley and Smart, 2007; Bordignon *et al.*, 2004), discussing the link between informational lobbying and decentralization may offer further useful insights. However, while these are all issues that should be addressed in future research, we believe that the point we raise here is general enough to deserve serious consideration.

Appendix: Contributions

In this appendix we apply Proposition 3 in Dixit *et al.* (1997) to solve the first stage of the lobbying game and to show that the equilibrium contributions are non-negative.

Consider the case of policy centralization. In the first stage of the game, the strategy space of lobby i is given by the per capita net welfare level $\pi_i \geq 0$ that determines the 'position' of its truthful contribution function S_i in the policy space. Therefore, we solve for the Nash equilibrium in the per capita net welfare levels π_a and π_b. Consider, without loss of generality, lobby b. Its best response function to any given strategy π_a chosen by lobby a is obtained by solving

$$\mathcal{V}^C - m\theta(\pi_a + \pi_b) = \tilde{\mathcal{V}}^C - m\theta\pi_a, \quad \text{if } \tilde{\mathcal{V}}^C - m\theta\pi_a \geq 0, \tag{A.1}$$

$$\mathcal{V}^C - m\theta(\pi_a + \pi_b) = 0, \quad \text{otherwise.} \tag{A.2}$$

$\mathcal{V}^C$ is equation (12) evaluated at the equilibrium policies p_r^C and q_r^C chosen in the second stage of the game by the policy maker under the influence of both lobbies offering the truthful contributions (10)–(11). $\tilde{\mathcal{V}}^C$ is defined in a similar way for the case in which only group a is lobbying by offering the truthful contribution (10), with group b abstaining from lobbying.[13] Equations (A.1)–(A.2) show that the maximum amount of per capita net welfare π_b that lobby b can get is constrained by the policy maker's participation constraint. Given π_a, if the policy maker is better off under lobbying by group a than under no lobbying, i.e. if $\tilde{\mathcal{V}}^C - m\theta\pi_a \geq 0$ (recall that, by Proposition 1, social welfare is zero in the absence of lobbying), then equation (A.1) states that group b can increase its per capita net welfare π_b (and correspondingly reduce contributions) up to the point in which the policy maker is indifferent between being lobbied by both groups and being lobbied only by group a. Otherwise, if the policy maker is better off under no lobbying than under lobbying by group a, then (A.2) states that group b can increase π_b up to the point in which the policy maker is indifferent between being lobbied by both groups and not being lobbied.

From equations (A.1)–(A.2), the best response function of lobby b can be written

[13] We use a 'tilde' to denote equilibrium variables in the lobbying games in which only one group is lobbying.

as

$$\pi_b(\pi_a) = \begin{cases} \dfrac{\mathcal{V}^C - \tilde{\mathcal{V}}^C}{m\theta}, & \text{if } \pi_a \leq \dfrac{\tilde{\mathcal{V}}^C}{m\theta}, \\ \dfrac{\mathcal{V}^C}{m\theta} - \pi_a, & \text{otherwise.} \end{cases} \tag{A.3}$$

By symmetry, the best response function of lobby a is:

$$\pi_a(\pi_b) = \begin{cases} \dfrac{\mathcal{V}^C - \tilde{\mathcal{V}}^C}{m\theta}, & \text{if } \pi_b \leq \dfrac{\tilde{\mathcal{V}}^C}{m\theta}, \\ \dfrac{\mathcal{V}^C}{m\theta} - \pi_b, & \text{otherwise.} \end{cases} \tag{A.4}$$

To characterize the Nash equilibrium, we prove the following:

Lemma 1 *Under Centralization,* $\mathcal{V}^C - \tilde{\mathcal{V}}^C \geq 0$.

Proof. To compute $\tilde{\mathcal{V}}^C$, we consider the second stage of the game in the case in which only one group is lobbying. Suppose, without loss of generality, that only group a is lobbying by offering the truthful contribution (10). The policy maker chooses public policy to maximize the objective function $\tilde{V} = W + m\theta S_a$. Ignoring the non-negativity constraint on contributions, and using (8) and (10), $\tilde{V}$ can be written as

$$\tilde{\mathcal{V}} = W + m\theta U_a = \theta h[(1+\lambda\delta)(p_\alpha + q_\beta) + (\lambda+\delta)(p_\beta + q_\alpha)] +$$
$$+ m\theta h[p_\alpha + \lambda p_\beta + \delta(q_\alpha + \lambda q_\beta)] - L(p_\alpha, q_\alpha) - L(p_\beta, q_\beta).$$

By differentiating $\tilde{\mathcal{V}}$ with respect to the policy instruments,

$$\frac{\partial \tilde{\mathcal{V}}}{\partial p_\alpha} = \theta h(1+\lambda\delta) + m\theta h - (1 + p_\alpha + q_\alpha), \tag{A.5}$$

$$\frac{\partial \tilde{\mathcal{V}}}{\partial q_\alpha} = \theta h(\lambda+\delta) + m\theta h\delta - (1 + p_\alpha + q_\alpha), \tag{A.6}$$

$$\frac{\partial \tilde{\mathcal{V}}}{\partial q_\beta} = \theta h(1+\lambda\delta) + m\theta h\lambda\delta - (1 + p_\beta + q_\beta), \tag{A.7}$$

$$\frac{\partial \tilde{\mathcal{V}}}{\partial p_\beta} = \theta h(\lambda+\delta) + m\theta h\lambda - (1 + p_\beta + q_\beta). \tag{A.8}$$

From pairwise comparison of equations (A.5)–(A.8) with equations (13)–(16) it is immediate to see that $\frac{\partial \mathcal{V}}{\partial p_\alpha} - \frac{\partial \tilde{\mathcal{V}}}{\partial p_\alpha} = m\theta h\lambda\delta \geq 0$, $\frac{\partial \mathcal{V}}{\partial q_\alpha} - \frac{\partial \tilde{\mathcal{V}}}{\partial q_\alpha} = m\theta h\lambda \geq 0$, $\frac{\partial \mathcal{V}}{\partial q_\beta} - \frac{\partial \tilde{\mathcal{V}}}{\partial q_\beta} = m\theta h \geq 0$, $\frac{\partial \mathcal{V}}{\partial p_\beta} - \frac{\partial \tilde{\mathcal{V}}}{\partial p_\beta} = m\theta h\delta \geq 0$ for all admissible values of the parameters δ, λ, m. Therefore, evaluating $\mathcal{V}$ and $\tilde{\mathcal{V}}$ at the corresponding equilibrium policies, we get $\mathcal{V}^C \geq \tilde{\mathcal{V}}^C$. ■

Since the first stage of the game may have multiple Nash equilibria that are all equivalent in terms of aggregate payoffs, we make the following:

Assumption 3 *Whenever the first stage of the lobbying game has multiple equilibria* $(\hat{\pi}_a, \hat{\pi}_b)$ *such that* $\hat{\pi}_a + \hat{\pi}_b = 2k$, $k > 0$, *it is assumed that the players select the symmetric equilibrium* $\hat{\pi}_a = \hat{\pi}_b = k$.

The first stage of the lobby game under centralization is characterized in the following:

Proposition 5 *Under Centralization, in the first stage of the lobbying game, the Nash equilibrium in the per capita net welfare levels is:*

- *If* $\mathcal{V}^C \leq 2\tilde{\mathcal{V}}^C$ *then* $\pi_i^C = \dfrac{\mathcal{V}^C - \tilde{\mathcal{V}}^C}{m\theta} \geq 0$. *Equilibrium contributions are non-negative.*
- *If* $\mathcal{V}^C > 2\tilde{\mathcal{V}}^C$ *then* $\pi_i^C = \dfrac{\mathcal{V}^C}{2m\theta} \geq 0$. *Equilibrium contributions are non-negative.*

Proof. By symmetry of the best response functions (A.3) and (A.4), the Nash equilibrium is $\pi_i^C = \frac{\mathcal{V}^C - \tilde{\mathcal{V}}^C}{m\theta}$ if $\pi_i^C \leq \frac{\tilde{\mathcal{V}}^C}{m\theta}$, i.e. if $\mathcal{V}^C \leq 2\tilde{\mathcal{V}}^C$. Per capita contributions are non-negative if $\pi_i^C \leq U_i^C$, i.e. if net welfare is no greater than gross welfare. Substituting for $\mathcal{V}^C = W^C + 2m\theta U_i^C$ and $\tilde{\mathcal{V}}^C = \tilde{W}^C + m\theta\tilde{U}_i^C$ into π_i^C, the latter inequality can be written as $\tilde{W}^C - W^C + m\theta(\tilde{U}_i^C - U_i^C) \geq 0$. The latter inequality holds true, since inequality $\mathcal{V}^C \leq 2\tilde{\mathcal{V}}^C$ implies $0 \leq -W^C \leq 2[\tilde{W}^C - W^C + m\theta(\tilde{U}_i^C - U_i^C)]$. There is instead a multiplicity of Nash equilibria, $\pi_a^C + \pi_b^C = \frac{\mathcal{V}^C}{m\theta}$, $\frac{\tilde{\mathcal{V}}^C}{m\theta} < \pi_a^C, \pi_b^C \leq \frac{\mathcal{V}^C - \tilde{\mathcal{V}}^C}{m\theta}$, if $\mathcal{V}^C > 2\tilde{\mathcal{V}}^C$. In this case, the symmetric equilibrium, $\pi_i^C = \frac{\mathcal{V}^C}{2m\theta}$, is selected by Assumption 3. Per capita contributions are non-negative if $\pi_i^C \leq U_i^C$, i.e. if $\frac{\mathcal{V}^C}{2m\theta} \leq U_i^C$. Substituting for $\mathcal{V}^C = W^C + 2m\theta U_i^C$, the latter inequality is shown to be $W^C \leq 0$, which holds because W^C is non-positive. ■

Under decentralization, the first stage of the lobbying game is solved in a similar way. Consider, without loss of generality, region α. In the first stage of the lobbying game, we solve for the Nash equilibrium in the per capita net welfare levels $\pi_{a,\alpha} \geq 0$ and $\pi_{b,\alpha} \geq 0$. Consider lobby b. Its best response function to any given strategy $\pi_{a,\alpha}$ chosen by lobby a is obtained by solving

$$\mathcal{V}_\alpha^D - m\theta(\pi_{a,\alpha} + \pi_{b,\alpha}) = \tilde{\mathcal{V}}_\alpha^{D(a)} - m\theta\pi_{a,\alpha}, \quad \text{if } \tilde{\mathcal{V}}_\alpha^{D(a)} - m\theta\pi_{a,\alpha} \geq 0, \tag{A.9}$$

$$\mathcal{V}_\alpha^D - m\theta(\pi_{a,\alpha} + \pi_{b,\alpha}) = 0, \quad \text{otherwise.} \tag{A.10}$$

$\mathcal{V}_\alpha^D$ is equation (23) evaluated at the equilibrium policies p_r^D and q_r^D chosen in the second stage of the game by the local policy makers under the influence of both lobbies offering the truthful contributions (19)–(22). $\tilde{\mathcal{V}}_\alpha^{D(a)}$ is defined in a similar way for the case in which only group a is lobbying by offering the truthful contribution (19), with group b abstaining from lobbying. Equations (A.9)–(A.10) show that the maximum amount of per capita net welfare $\pi_{b,\alpha}$ that lobby b can get in region α is constrained by the participation constraint of the policy maker of region α.

From equations (A.9)–(A.10), the best response function of lobby b can be written as

$$\pi_{b,\alpha}(\pi_{a,\alpha}) = \begin{cases} \dfrac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(a)}}{m\theta}, & \text{if } \pi_{a,\alpha} \leq \dfrac{\tilde{\mathcal{V}}_\alpha^{D(a)}}{m\theta}, \\ \dfrac{\mathcal{V}_\alpha^D}{m\theta} - \pi_{a,\alpha}, & \text{otherwise.} \end{cases} \tag{A.11}$$

The best response function of lobby a is obtained in a similar way:

$$\pi_{a,\alpha}(\pi_{b,\alpha}) = \begin{cases} \dfrac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(b)}}{m\theta}, & \text{if } \pi_{b,\alpha} \leq \dfrac{\tilde{\mathcal{V}}_\alpha^{D(b)}}{m\theta}, \\ \dfrac{\mathcal{V}_\alpha^D}{m\theta} - \pi_{b,\alpha}, & \text{otherwise.} \end{cases} \tag{A.12}$$

To characterize the Nash equilibrium in region α, we prove the following:

Lemma 2 *Under Decentralization,* $\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(a)} \geq 0$, $\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(b)} \geq 0$.

Proof. To compute $\tilde{\mathcal{V}}_\alpha^{D(a)}$, we consider the second stage of the game in the case in which only group a is lobbying the policy maker in region α, by offering the truthful contribution (19). The policy maker maximizes the objective function $\tilde{V}_\alpha^{(a)} = W_\alpha + m\theta S_{a,\alpha}$. Ignoring the non-negativity constraint on contributions, and using (6) and (19), $\tilde{V}_\alpha^{(a)}$ can be written as

$$\tilde{\mathcal{V}}_\alpha^{(a)} = \theta h[p_\alpha + \lambda p_\beta + \delta(q_\alpha + \lambda q_\beta)] + m\theta h(p_\alpha + \delta q_\alpha) - (1-\sigma)L(p_\alpha, q_\alpha) - \sigma L(p_\beta, q_\beta). \tag{A.13}$$

By differentiating $\tilde{\mathcal{V}}_\alpha^{(a)}$ with respect to the policy instruments chosen by the policy maker in region α, one obtains

$$\frac{\partial \tilde{\mathcal{V}}_\alpha^{(a)}}{\partial p_\alpha} = \theta h(1+m) - (1-\sigma)(1 + p_\alpha + q_\alpha), \tag{A.14}$$

$$\frac{\partial \tilde{\mathcal{V}}_\alpha^{(a)}}{\partial q_\alpha} = \theta h\delta(1+m) - (1-\sigma)(1 + p_\alpha + q_\alpha). \tag{A.15}$$

From pairwise comparison of equations (A.14)–(A.15) with equations (24)–(25) it is immediate to see that $\frac{\partial \mathcal{V}_\alpha}{\partial p_\alpha} - \frac{\partial \tilde{\mathcal{V}}_\alpha^{(a)}}{\partial p_\alpha} = m\theta h\lambda\delta \geq 0$, $\frac{\partial \mathcal{V}_\alpha}{\partial q_\alpha} - \frac{\partial \tilde{\mathcal{V}}_\alpha^{(a)}}{\partial q_\alpha} = m\theta h\lambda \geq 0$ for all admissible values of the parameters δ, λ, m. Therefore, evaluating $\mathcal{V}_\alpha$ and $\tilde{\mathcal{V}}_\alpha^{(a)}$ at the corresponding equilibrium policies, we get $\mathcal{V}_\alpha^D \geq \tilde{\mathcal{V}}_\alpha^{D(a)}$.

To compute $\tilde{\mathcal{V}}_\alpha^{D(b)}$, we consider the second stage of the game in the case in which only group b is lobbying the policy maker in region α, by offering the truthful contribution (22). The policy maker maximizes the objective function $\tilde{V}_\alpha^{(a)} = W_\alpha + m\theta S_{b,\alpha}$. Ignoring the non-negativity constraint on contributions, and using (6) and (22), $\tilde{V}_\alpha^{(b)}$ can be written as

$$\tilde{\mathcal{V}}_\alpha^{(b)} = \theta h[p_\alpha + \lambda p_\beta + \delta(q_\alpha + \lambda q_\beta)] + m\theta h\lambda(\delta p_\alpha + q_\alpha) - (1-\sigma)L(p_\alpha, q_\alpha) - \sigma L(p_\beta, q_\beta). \quad \text{(A.16)}$$

By differentiating $\tilde{\mathcal{V}}_\alpha^{(b)}$ with respect to the policy instruments chosen by the policy maker in region α, one gets

$$\frac{\partial \tilde{\mathcal{V}}_\alpha^{(b)}}{\partial p_\alpha} = \theta h(1 + m\lambda\delta) - (1-\sigma)(1 + p_\alpha + q_\alpha), \quad \text{(A.17)}$$

$$\frac{\partial \tilde{\mathcal{V}}_\alpha^{(b)}}{\partial q_\alpha} = \theta h(\delta + m\lambda) - (1-\sigma)(1 + p_\alpha + q_\alpha). \quad \text{(A.18)}$$

From pairwise comparison of equations (A.17)–(A.18) with equations (24)–(25) it is immediate to see that $\frac{\partial \mathcal{V}_\alpha}{\partial p_\alpha} - \frac{\partial \tilde{\mathcal{V}}_\alpha^{(b)}}{\partial p_\alpha} = m\theta h \geq 0$, $\frac{\partial \mathcal{V}_\alpha}{\partial q_\alpha} - \frac{\partial \tilde{\mathcal{V}}_\alpha^{(b)}}{\partial q_\alpha} = m\theta h\delta \geq 0$ for all admissible values of the parameters δ, λ, m. Therefore, evaluating $\mathcal{V}_\alpha$ and $\tilde{\mathcal{V}}_\alpha^{(b)}$ at the corresponding equilibrium policies, we get $\mathcal{V}_\alpha^D \geq \tilde{\mathcal{V}}_\alpha^{D(b)}$. ∎

As one can see from the best response functions (A.11) and (A.12), and from equations (A.13) and (A.16), the lobbying game in region α is not symmetric, since $\tilde{\mathcal{V}}_\alpha^{D(a)} \neq \tilde{\mathcal{V}}_\alpha^{D(b)}$ for $\delta \neq 1$ and $\lambda \neq 1$. The game can also have multiple Nash equilibria that are all equivalent in terms of aggregate payoffs. We thus make the following:

Assumption 4 *Whenever the first stage of the lobbying game has multiple equilibria* $(\hat{\pi}_{a,\alpha}, \hat{\pi}_{b,\alpha})$ *such that* $\hat{\pi}_{a,\alpha} + \hat{\pi}_{b,\alpha} = k$, $k > 0$, *it is assumed that the players select an equilibrium with non-negative contributions, if there exists one.*

In region α, the first stage of the game under decentralization is characterized in the following:

Proposition 6 *Under Decentralization, in the first stage of the lobbying game, the Nash equilibrium in the per capita net welfare levels is:*

– *If* $\mathcal{V}_\alpha^D \leq \tilde{\mathcal{V}}_\alpha^{D(a)} + \tilde{\mathcal{V}}_\alpha^{D(b)}$ *then* $\pi_{a,\alpha}^D = \dfrac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(b)}}{m\theta} \geq 0$, $\pi_{b,\alpha}^D = \dfrac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(a)}}{m\theta} \geq 0$. *Equilibrium contributions are non-negative.*

– *If* $\mathcal{V}_\alpha^D > \tilde{\mathcal{V}}_\alpha^{D(a)} + \tilde{\mathcal{V}}_\alpha^{D(b)}$ *then* $\pi_{a,\alpha}^D = \dfrac{\mathcal{V}_\alpha^D}{2m\theta} + \dfrac{U_{a,\alpha}^D - U_{b,\alpha}^D}{2} \geq 0$,
$\pi_{b,\alpha}^D = \dfrac{\mathcal{V}_\alpha^D}{2m\theta} - \dfrac{U_{a,\alpha}^D - U_{b,\alpha}^D}{2} \geq 0$. *Equilibrium contributions are non-negative.*

Proof. From the best response functions (A.11) and (A.12), the Nash equilibrium is $\pi_{a,\alpha}^D = \frac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(b)}}{m\theta}$, $\pi_{b,\alpha}^D = \frac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(a)}}{m\theta}$ if $\frac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(b)}}{m\theta} \leq \frac{\tilde{\mathcal{V}}_\alpha^{D(a)}}{m\theta}$, $\frac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(a)}}{m\theta} \leq \frac{\tilde{\mathcal{V}}_\alpha^{D(b)}}{m\theta}$, respectively; both inequalities imply $\mathcal{V}_\alpha^D \leq \tilde{\mathcal{V}}_\alpha^{D(a)} + \tilde{\mathcal{V}}_\alpha^{D(b)}$. Let $U_{a,\alpha} = h(p_\alpha + \delta q_\alpha)$, $U_{b,\alpha} = h\lambda(\delta p_\alpha + q_\alpha)$. Per capita contributions are non-negative if $\pi_{a,\alpha}^D \leq U_{a,\alpha}^D$, $\pi_{b,\alpha}^D \leq U_{b,\alpha}^D$, i.e. if $\frac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(b)}}{m\theta} \leq U_{a,\alpha}^D$, $\frac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(a)}}{m\theta} \leq U_{b,\alpha}^D$, respectively. Substituting for $\mathcal{V}_\alpha^D = W_\alpha^D + m\theta(U_{a,\alpha}^D + U_{b,\alpha}^D)$, $\tilde{\mathcal{V}}_\alpha^{D(b)} = \tilde{W}_\alpha^{D(b)} + m\theta\tilde{U}_{b,\alpha}^{D(b)}$, $\tilde{\mathcal{V}}_\alpha^{D(a)} = \tilde{W}_\alpha^{D(a)} + m\theta\tilde{U}_{a,\alpha}^{D(a)}$ into the latter inequalities, and simplifying, one gets $\tilde{W}_\alpha^{D(b)} - W_\alpha^D + m\theta(\tilde{U}_{b,\alpha}^{D(b)} - U_{b,\alpha}^D) \geq 0$, $\tilde{W}_\alpha^{D(a)} - W_\alpha^D + m\theta(\tilde{U}_{a,\alpha}^{D(a)} - m\theta U_{a,\alpha}^D) \geq 0$, respectively. The latter inequalities can both hold true, since inequality $\mathcal{V}_\alpha^D \leq \tilde{\mathcal{V}}_\alpha^{D(a)} + \tilde{\mathcal{V}}_\alpha^{D(b)}$ implies $0 \leq -W_\alpha^D \leq \tilde{W}_\alpha^{D(a)} - W_\alpha^D + m\theta(\tilde{U}_{a,\alpha}^{D(a)} - U_{a,\alpha}^D) + \tilde{W}_\alpha^{D(b)} - W_\alpha^D + m\theta(\tilde{U}_{b,\alpha}^{D(b)} - U_{b,\alpha}^D)$. There is instead a multiplicity of Nash equilibria, $\pi_{a,\alpha}^D + \pi_{b,\alpha}^D = \frac{\mathcal{V}_\alpha^D}{m\theta}$, $\frac{\tilde{\mathcal{V}}_\alpha^{D(a)}}{m\theta} < \pi_{a,\alpha}^D \leq \frac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(b)}}{m\theta}$, $\frac{\tilde{\mathcal{V}}_\alpha^{D(b)}}{m\theta} < \pi_{b,\alpha}^D \leq \frac{\mathcal{V}_\alpha^D - \tilde{\mathcal{V}}_\alpha^{D(a)}}{m\theta}$, if $\mathcal{V}_\alpha^D > \tilde{\mathcal{V}}_\alpha^{D(a)} + \tilde{\mathcal{V}}_\alpha^{D(b)}$. In this case, an equilibrium with positive contributions is selected by Assumption 4. Per capita contributions are non-negative if $\pi_{a,\alpha}^D \leq U_{a,\alpha}^D$, $\pi_{b,\alpha}^D \leq U_{b,\alpha}^D$, i.e. if $\frac{\mathcal{V}_\alpha^D}{2m\theta} + \frac{U_{a,\alpha}^D - U_{b,\alpha}^D}{2} \leq U_{a,\alpha}^D$, $\frac{\mathcal{V}_\alpha^D}{2m\theta} - \frac{U_{a,\alpha}^D - U_{b,\alpha}^D}{2} \leq U_{b,\alpha}^D$, respectively. Substituting for $\mathcal{V}_\alpha^D = W_\alpha^D + m\theta(U_{a,\alpha}^D + U_{b,\alpha}^D)$, the latter inequalities become $W_\alpha^D \leq 0$. ■

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