Fiscal Federalism and Lobbying

Massimo Bordignon[a], *Luca Colombo*[a], *Umberto Galmarini*[b,a]

[a]Istituto di Economia e finanza, Università Cattolica, Milano, Italy
[b]Dipartimento di Diritto ed Economia delle persone e delle imprese, Università dell'Insubria, Como, Italy

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Abstract

Which functions should be decentralized (resp. centralized) once lobbying behavior is taken into account? In a two-region economy, two regional firms may either lobby *in* the market, to increase regional public good provision, or *for* the (regional) market, to gain access to it. We prove that lobbies are worse off under *decentralization* in the former case, and under *centralization* in the latter. When lobbying in the market, firms' interests are aligned (both gain from an increase in regional public good supply), hence decentralization makes coordination among local lobbies more costly. On the contrary, when lobbying is for the market, firms' interests are conflicting (each one striving for monopoly power), hence centralization, by forcing more competition between lobbies, lowers the rent they can extract from policy makers. We use these results to briefly comment upon the (de)centralization process in Europe.

Keywords: Fiscal federalism, Lobbying, European Union.

JEL classification: D70, H23, H77

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Corresponding author: Luca Colombo, Università Cattolica, Largo Gemelli 1,
I-20123 Milano, Italy. Phone: +39.02.7234.2637, Fax: +39.02.7234.2781.
E-mail: lucava.colombo@unicatt.it

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. For example, 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 which can carry one some way (see for instance, Alesina, Angeloni, Schuknecht, 2001, 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.

Consider, for instance, the current debate on the role that European Union (EU) institutions should play in fields such as labor markets institutions, competition and regulation policy, education, pensions, infrastructures etc. 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 interests' groups on governments (e.g. Tabellini and Wyplosz, 2004). The important policy question, over which theoretical analysis should 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 (Besley and Coate, 2002; Lockwood, 2002). Moreover, despite the large economic literature on lobbying (e.g. Grossman and Helpman, 2001), very few studies have concentrated on the relationship between interest groups and decentralization. And when they have done so, they only focussed on the higher heterogeneity of preferences under centralization as the main discriminating factor (e.g. De Melo *et al.,* 1993, and Redoano, 2002). But, again, this is not the crucial difference that most policy oriented observers seem to have in mind.

For example, in a very influential policy paper, Prud'homme (1994) severely warned against "the dangers of decentralization", the main danger exactly being the (presumed) stronger influence of local interest groups on local governments. Prud'homme's argument has nothing to do with preferences heterogeneity. It relies instead on a greater "disposition" by local governments to "accept" pressures from local interests, presumably due to the fact that supporting a local interest may generate additional benefits for the local politicians than supporting a foreign one.[1] This is exactly the same idea that continuously surfaces in the political debate, both at the national and at the international level. Is this idea correct? If the answer is yes, then there are additional reasons for, say, supporting centralization at the EU level in the above mentioned fields. If the answer is no, then there are additional reasons to maintain these functions at the level of member states.[2] And clearly, the EU is only an example, albeit an important one. Given the current process of decentralization in most countries, an answer to this question could be helpful in many other cases.[3]

To discuss this issue, we focus on a simple framework. In our model, there are two regions, one resident firm, and a large mass of consumers in each region owning the local firm. The two regional firms may serve both local markets, and in all cases they have an incentive to lobby the governments in charge either to gain access to local markets or to increase the production of a local public good which is complementary in consumption to the good they sell. As an interpretation, one could think of the former as an example of regulation policy, and of the latter as an example of infrastructure policy, both items over which there is some debate in Europe about which level of government should be in charge of these policies, whether the European Commission or the member countries. For simplicity, and also because these effects are well understood, we abstract entirely from "common pool" effects which may arise out of transfers from the central level to local ones (Persson, 1998), as well as from "fiscal competition" effects which may arise out of the mobility of the tax base (Wilson, 1999), or by "spillover effects" in taxation (Keen and Kotsogiannis, 2002). In our model, nobody moves, there is no need for intergovernmental transfers (as regions are identical), and each local government finances its supply of local public good out of resident taxation, so that there is no tax competition. However, there are spillover effects from regional public goods supply, as the latter affects firms' profits. Hence, when deciding about public good supply, while the central government internalizes as components of social welfare the profits that both firms make in both markets, under decentralization a local government is

[1] We are not aware of any 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).

[2] For instance, contrary to Prud'homme's claim, Shleifer and Vishny (1993), discussing corruption, argue that competition among local jurisdictions to attract businesses leads to a fall in corruption activity.

[3] Spain, Italy, France, Belgium, to consider only some of the main European countries, have recently changed their Constitution in the direction of more decentralization. The UK, which has not a formal Constitution, has however launched the devolution process in Wales and Scotland.

only interested in the profits that are made everywhere by its own resident firm. This captures in the simplest way Prud'homme's idea that local interests may have a larger weight on local governments' welfare function.

In this setting, we ask what are the effects of lobbying on economic outcomes and social welfare in the two cases of decentralization and centralization. We consider two forms of lobbying. In the first one, firms lobby *in* the market; that is, both firms have already gained access to both markets and have an incentive to lobby politicians to increase local public good production. In this case, firms have *aligned interests* in increasing local public good production. In the second one, firms lobby *for* the market; that is, they lobby politicians to gain access to local markets, so that local firms have *conflicting interests*; each one wishes to be the only one to serve the market, as it could then raise monopoly profits.

We get very sharp results. When lobbying is in the market, lobbying behavior under centralization is always as bad for social welfare as under decentralization. In fact, under decentralization, local public goods supply is as distorted as under centralization (and so is social welfare), but lobbies pay higher contributions and so are worse off. The intuition is that decentralization increases the bribes they have to pay to force local governments to internalize spillover effects on profits; as a result, lobbying is less effective (i.e. more costly).

Results are reversed when lobbying is for the market. Under decentralization lobbying always leads the local politicians to give market access to the resident firm only, as the local firm can always outbid the foreign one, although a duopoly may be better for social welfare. This is so because only the local firm's profits enter into the social welfare function of the local government. Under centralization, this effect is absent, which makes the central politician more resilient to lobbying. Finally, we also show that in this case the most effective institutional structure against lobbying distortions may be an intermediate one between centralization and decentralization (i.e. one in which competencies are split between local and central governments).

The model we discuss in this paper is simple, but it offers far reaching insights. The basic message of the paper is that the answer to the question above depends on the function under consideration; if the interests of local lobbies are aligned, then decentralization is better than centralization because decentralization introduces competition across lobbies where there is none; vice-versa, if the interests of national lobbies are in conflict, then centralization is better than decentralization because, as Prud'homme rightly suggested, local governments are more easily captured by local interests. We will discuss some extensions and applications of these ideas for institutional design in the concluding section.

We model lobbying using the "reduced form" illustrated by Grossman and Helpman (2001) (see also Grossman and Helpman, 1994, and Dixit *et al.*, 1997). However, in the analysis of lobbying under decentralization, we go beyond the Common Agency approach of Bernheim and Whinston (1986a), by considering a case with multiple principals and multiple agents. Although we do not break new theoretical grounds on this issue, some of our findings can be taken as an illustration of the recent literature (e.g. Prat and Rustichini, 2003, Segal, 1999).

The rest of the paper is organized as follows. In Section 2 we set up the model. In Section 3 we examine the policy makers' choices in the situation of no lobbying. In Section 4 we examine lobbying behavior when both firms compete and lobby in the market. In Section 5 we study lobbying for the market. Section 6 concludes by summarizing the results and suggesting avenues for further research. Most proofs and technical details are in two appendices.

2 The model

The economy is composed of two identical regions indexed by $r \in \{a, b\}$. There are four goods: two private consumption goods, x and z, a production factor, y, and a public investment good, g. The latter is purely local, meaning that there is a distinct provision in each region with no spillover effects across regions. In each region lives a continuum of immobile identical consumers with a mass of unity, and there is a firm producing good x, indexed by $\rho \in \{\alpha, \beta\}$, where α and β are the firms located in regions a and b, respectively. In both regions consumers are endowed with a fixed quantity $\bar{y} > 0$ of the production factor and have identical preferences represented by the quasi-linear utility function

$$u(x_r, z_r, g_r) = x_r - \frac{x_r^2}{2g_r} + z_r. \tag{1}$$

We take good z to be the *numeraire* and its (local) market to be perfectly competitive. Technology is linear and units are normalized so that the production of one unit of z requires one unit of input y. These assumptions imply that at the market equilibrium profits in the production of good z are zero, that its supply is perfectly elastic, and that the market price of factor y is equal to one.

Firms α and β are entirely owned by consumers living in regions a and b, respectively, and their profits are entirely distributed to shareholders.[4] Hence, consumers'

[4]Notice that given the quasi-linearity of the utility function, all income effects fall on the demand for good z, and therefore the equilibrium of the economy is independent of the distribution of profits across consumers and across regions. Also note that profit maximization by firms may be in conflict

income is made up of two terms: the market value of the fixed endowment of good y, and the distributed firms' profits (net of contributions to the politicians, if any). Consumers' income in region r is subject to a proportional income tax at rate t_r, $t_r \in [0, 1)$. We let p_r be the price of good x in region r, $\Pi_{\rho r}$ be the profits (gross of contributions) earned by firm ρ in region r, and $s_{\rho r}$ be the contributions to politicians by firm ρ for public good g_r. Without loss of generality (given symmetry between regions), in what follows we only focus on region a. Let $\pi_\alpha = \Pi_{\alpha a} - s_{\alpha a} + \Pi_{\alpha b} - s_{\alpha b}$ be the profits distributed by firm α. Taking g_a and π_α as given, each consumer in region a solves:

$$\max_{x_a, z_a} \quad x_a - \frac{x_a^2}{2g_a} + z_a,$$
$$\text{s.t.} \quad p_a x_a + z_a \leq (1 - t_a)(\bar{y} + \pi_\alpha),$$

from which we immediately obtain the inverse demand function for good x_a as

$$p_a(x_a, g_a) = 1 - \frac{x_a}{g_a}. \tag{2}$$

From (2) it is clear that for any given quantity $x_a > 0$ an increase in g_a increases the marginal willingness to pay for good x_a.

2.1 The markets for good x

In each region good x is traded in a local duopoly, with one of the firms located within the region and the other one outside it. Firms maximize profits and compete *à la* Cournot. Good y is the only input in production and technology is linear, so that marginal costs are constant. We allow, however, for a source of asymmetry between firms. When a firm supplies to its own regional market (at "home"), the production function is $x = y/c$ (the marginal cost is $c > 0$), while when a firm supplies "abroad" the production function is $x = y/(\delta c)$, $\delta \geq 1$ (the marginal cost is δc), so that the home firm has a cost advantage over its competitor. This assumption allows us to make explicit the effects of market structure on lobbying.[5]

Let $x_{\rho r}$ be the quantity sold by firm ρ in region r; hence aggregate sales in regions a and b can be written as $x_a = x_{\alpha a} + x_{\beta a}$ and $x_b = x_{\alpha b} + x_{\beta b}$. Using (2), firm α then

with shareholders' interests in their role as consumers, a standard problem in modelling the objectives of not competitive firms. We assume the existence of some un-modelled agency problem that justifies profit maximization by firms.

[5] For instance, the parameter δ (strictly speaking, $\delta - 1$) can be interpreted as representing the transport costs needed to transfer one unit of good x across regions. Notice that our assumption of a given industrial structure (one resident firm in each region) could be justified by introducing fixed costs, which make unprofitable for a firm located in one region to open a new plant in the other region in spite of transportation costs. To keep the analysis simple, however, we do not model them explicitly.

solves:

$$\max_{x_{\alpha a}, x_{\alpha b}} \quad \Pi_{\alpha a} + \Pi_{\alpha b} =$$
$$= \left(1 - \frac{x_{\alpha a} + x_{\beta a}}{g_a} - c\right) x_{\alpha a} + \left(1 - \frac{x_{\alpha b} + x_{\beta b}}{g_b} - \delta c\right) x_{\alpha b}. \tag{3}$$

Solving this problem and the symmetric one for firm β, we obtain the equilibrium quantities

$$x^*_{\alpha a} = hg_a, \quad x^*_{\beta b} = hg_b, \quad x^*_{\beta a} = fg_a, \quad x^*_{\alpha b} = fg_b,$$
$$x^*_a = (h+f)g_a, \quad x^*_b = (h+f)g_b, \tag{4}$$

and the equilibrium prices

$$p^*_a = p^*_b = p^*, \quad p^* = 1 - (h+f),$$

where

$$h = \frac{1 + \delta c - 2c}{3}, \qquad f = \frac{1 + c - 2\delta c}{3}. \tag{5}$$

To ensure that the quantities (and the respective prices) supplied by each firm in each region are non-negative, we impose the following restrictions on parameters:

Assumption 1 $0 < c < 1$ *and* $1 \leq \delta \leq \delta_{\max} = \dfrac{1+c}{2c}$.

This framework allows for a wide range of market structures. When $\delta = 1$, $h = f = (1-c)/3$, and there is a *symmetric duopoly* in each region, since the "home" firm has no cost advantage over its "foreign" rival. At the other extreme, when $\delta = \delta_{\max}$, $h = (1-c)/2$ and $f = 0$. The cost advantage of the "home" firm is so high that the "foreign" firm does not enter the market, and thus there is a *monopoly* in each region. A continuum of intermediate cases is obtained for $\delta \in (1, \delta_{\max})$.

Notice finally that the equilibrium gross profits are linearly increasing in public good provision, so that firms' managers have an incentive to lobby the policy maker(s) for an expansion in the provision of the public goods:

$$\Pi^*_\alpha = \Pi^*_{\alpha a} + \Pi^*_{\alpha b} = h^2 g_a + f^2 g_b, \quad \Pi^*_\beta = \Pi^*_{\beta a} + \Pi^*_{\beta b} = f^2 g_a + h^2 g_b. \tag{6}$$

2.2 The public sector

We consider two institutional settings. One is a *centralized system*, in which a single policy maker chooses the supply of public goods in both regions. The other is a *decentralized* one, in which each region is characterized by an independent policy maker choosing the local level of the public good. In both cases we assume public goods production to be financed by a residence-based income-tax. Technology for public good production shows decreasing returns, with factor y used as the only input. The corresponding cost function is assumed to be of the form ϕg_r^2, $\phi > 0$. To ease notation, and without loss of generality, we let $\phi = 1/4$.

Under a centralized system, a single decision maker chooses g_a and g_b and sets a uniform tax rate across regions, $t_a = t_b = t$.[6] The budget constraint is then:

$$\frac{g_a^2 + g_b^2}{4} = t(\pi_\alpha^* + \pi_\beta^* + 2\bar{y}), \tag{7}$$

where $\pi_\rho^* = \Pi_\rho^* - s_{\rho a} - s_{\rho b}$.

Under a decentralized system, each regional policy maker independently and simultaneously chooses public good provision in her own region, and public expenditure is financed through the local income tax. The regional budget constraints are then:

$$\frac{g_a^2}{4} = t_a(\pi_\alpha^* + \bar{y}), \quad \frac{g_b^2}{4} = t_b(\pi_\beta^* + \bar{y}). \tag{8}$$

Notice that by Walras' law, satisfaction of the relevant government budget constraints implies that the markets for good z and factor y also clear, under both centralization and decentralization.[7]

2.3 Social welfare

To compare the alternative institutional arrangements, we need a normative criteria. We define social welfare as the sum of consumers' surplus, distributed profits, and the contributions raised by the government.[8] Substituting the equilibrium values for x_a^*

[6] Under centralization, uniformity of regional income tax rates is a natural assumption. Furthermore, in many countries, discrimination of the income tax on territorial bases is forbidden by the Constitution.

[7] The supply of good z is perfectly elastic and thus its equilibrium quantity is determined by national demand, z^d, from consumers. As for factor y, national supply from consumers is inelastic, $y^s = 2\bar{y}$. The demand for y comes from three sources: the public sector (y_{PS}^d), the firms producing good z (y_Z^d), and the firms α and β ($y_{\alpha+\beta}^d$). By Walras' law, given that the centralized public sector's budget constraint balances, it follows that $y_Z^d + y_{PS}^d + y_{\alpha+\beta}^d = y^s$, where $y_{PS}^d = (g_a^2 + g_b^2)/4$, $y_Z^d = z^d = 2\bar{y} + \pi_\alpha^* + \pi_\beta^* - p^*(x_a^* + x_b^*)$, $y_{\alpha+\beta}^d = c(x_{\alpha a}^* + \delta x_{\alpha b}^* + x_{\beta b}^* + \delta x_{\beta a}^*)$. The same holds under decentralization.

[8] This definition makes contributions from the home firm to the local politician a pure transfer, with no effects on social welfare. As an alternative, we could have excluded contributions from social welfare, and then let them enter the choice function of the politician (see Eq. 18 below) as a separate component only. The main qualitative results concerning lobbying behavior in the two institutional settings would remain unchanged under this alternative definition, as it would still be true that under decentralization and lobbying local politicians assign different weights to the contributions by the home and the foreign firm. Details are available by the authors on request.

and $z_a^* = -p^* x_a^* + (1 - t_a)(\bar{y} + \pi_\alpha^*)$ into the utility function of consumers (1), social welfare in region a is

$$\mathcal{W}_a = x_a^* - \frac{(x_a^*)^2}{2g_a} - p^* x_a^* + (1 - t_a)(\bar{y} + \Pi_{\alpha a}^* - s_{\alpha a} + \Pi_{\alpha b}^* - s_{\alpha b}) + s_{\alpha a} + s_{\beta a}, \quad (9)$$

which using (4), (6), and (8), can be rewritten as

$$\mathcal{W}_a(g_a, g_b) = W_a(g_a, g_b) - s_{\alpha b} + s_{\beta a}, \quad (10)$$

where

$$W_a(g_a, g_b) = \frac{(h+f)^2 g_a + 2(h^2 g_a + f^2 g_b)}{2} - \frac{g_a^2}{4} + \bar{y}. \quad (11)$$

National social welfare, $\mathcal{W} = \mathcal{W}_a + \mathcal{W}_b$, is then

$$\mathcal{W}(g_a, g_b) = \frac{(h+f)^2 + 2(h^2 + f^2)}{2}(g_a + g_b) - \frac{g_a^2 + g_b^2}{4} + 2\bar{y}. \quad (12)$$

Notice that the net effect of lobbyists' contributions on *national* social welfare is nil, since they are a pure transfer from lobbyists to politicians. This is no longer true under decentralization. In this case, see Eq. (10), a contribution of firm α to the policy maker of region b counts as a welfare loss in region a, whereas a contribution of firm β to the policy maker of region a counts as a welfare gain in region a.

3 Public good provision without lobbying

Let us begin our analysis by examining policy choices in the case of no lobbying. Under centralization, the policy maker would choose public goods supply by maximizing (12), giving for both g_a and g_b:[9]

$$\hat{g}^C = (h+f)^2 + 2(h^2 + f^2). \quad (13)$$

Under decentralization, the policy maker of region a would maximize (11) with respect to g_a, taking g_b as given (and an analogous problem is solved by the policy maker in region b), obtaining the symmetric solution

$$\hat{g}^D = (h+f)^2 + 2h^2. \quad (14)$$

[9] To ease notation, throughout the paper, we suppress pedices for regions (a, b) and for firms (α, β) whenever by symmetry the corresponding magnitudes are identical.

By using (6), (13) and (14), equilibrium profits of each firm under centralization and decentralization are:

$$\hat{\pi}^C = (h^2 + f^2)\hat{g}^C, \tag{15}$$

$$\hat{\pi}^D = (h^2 + f^2)\hat{g}^D. \tag{16}$$

It follows:

Proposition 1 *Suppose there is no lobbying. Then if $\delta \in [1, \delta_{\max})$ public good supply, national social welfare and firms' profits are higher under centralization than under decentralization. In the limiting case $\delta = \delta_{\max}$, the two regimes are equivalent.*

Proof. The part on public good supply and firms' profits follows from $f^2 > 0$ if $\delta \in [1, \delta_{\max})$ and $f^2 = 0$ if $\delta = \delta_{\max}$, and by comparison of (13)–(14) and of (15)–(16), respectively. As for aggregate social welfare, since $g_a = g_b = \hat{g}^C$ is a global maximum of (12), the latter is not maximized for $g_a = g_b = \hat{g}^D < \hat{g}^C$. ■

The intuition is simple. Without lobbying, when the regional policy maker decides about local public good supply, she does not internalize as social welfare gains the profits made by the non-resident firm. Hence, when both firms sell in both regions, local public good supply is lower under decentralization and so are profits and national welfare. On the contrary, a centralized policy maker internalizes both firms' profit gains, and hence she has a greater incentive to expand public good supply. These incentives are the same when the resident firm is a monopoly within its own region, and hence $\hat{g}^C = \hat{g}^D$.[10]

4 Lobbying in the market

We now consider the effect of introducing lobbying into the model. We examine two different cases, lobbying *in* the market and lobbying *for* the market. In the first case, firms are already present in the market and have an incentive to lobby politicians to increase public good supply as this increases their profits. In the second case, firms compete to acquire the right to enter the market. In both cases, we derive equilibrium contributions and public goods supply under centralization and decentralization, and compare the results on normative grounds.

[10] One might wonder whether the fact that, without lobbying, centralization performs better than decentralization impairs our comparison in the context of lobbying. This does not occur since in our model the benchmark case is the one in which there is lobbying activity *and* policy makers are fully benevolent, a situation in which centralization and decentralization are indeed equivalent regimes, as it will be discussed below.

In this section we analyze the case of lobbying in the market, studying lobbying behavior in the *common agency* framework developed by Bernheim and Whinston (1986b). Notice, however, that under decentralization, as there are two principals (firms α and β) lobbying two agents (policy makers a and b), our model falls into the more general category of the so called *games played through agents*, recently investigated by Prat and Rustichini (2003). We begin with the centralized system.

4.1 Centralization

We assume that the policy maker maximizes a weighted average of social welfare and lobbyists' contributions. This is clearly a "reduced form" of a more complex (and unmodelled) political behavior. Politicians care for social welfare (presumably, because they want to be re-elected), but they also care for lobbyists' contributions, either because the latter increase their chances of being re-elected, or simply because these are bribes which increase the policy maker's private consumption. Each lobby maximizes profits net of the contributions to the policy maker. As for the timing, firms move first, by independently and simultaneously offering the policy maker a contribution schedule defining a monetary contribution as a function of public good provision. Upon acceptance of the lobbies contributions, the policy maker chooses public goods supply.

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 contribution schedule*, shaped along its iso-profit curve. Firms α and β compensating contribution schedules are then defined, respectively, as

$$S_\alpha(g_a, g_b, \pi_\alpha) = \max\left\{h^2 g_a + f^2 g_b - \pi_\alpha, 0\right\}, \tag{17a}$$
$$S_\beta(g_a, g_b, \pi_\beta) = \max\left\{f^2 g_a + h^2 g_b - \pi_\beta, 0\right\}. \tag{17b}$$

Firm ρ defines its strategy by choosing its net profits, π_ρ, which in turn determine the "position" of its contribution schedule in the (s_ρ, g_a, g_b) hyperplane. Obviously, it must hold in equilibrium that $\pi_\rho \geq \hat{\pi}^C$, since otherwise the firm would prefer not to lobby.

Using (12) and (17a)–(17b), the policy maker's objective function is

$$V^C(g_a, g_b, \pi_\alpha, \pi_\beta) = \mu \mathcal{W}(g_a, g_b) + (1-\mu)\left[S_\alpha(g_a, g_b, \pi_\alpha) + S_\beta(g_a, g_b, \pi_\beta)\right]. \tag{18}$$

The parameter μ, $0 < \mu \leq 1$, captures the degree of "benevolence" of the policy maker. By assuming $\mu \neq 0$, we rule out the unrealistic case in which the politician cares about contributions only.

We illustrate here the outcome of the lobbying game under centralization, leaving to the Appendix A.1 the analytical details. The game is solved by backward induction. In

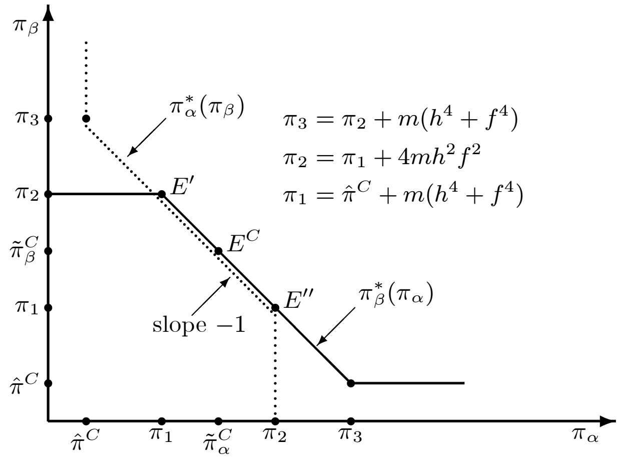

Figure 1: Nash equilibria under centralization

the second stage, given $S_\alpha(.)$ and $S_\beta(.)$, the policy maker chooses g_a and g_b to maximize (18). The optimal public good supply, both for g_a and g_b, is[11]

$$\tilde{g}^C = \hat{g}^C + 2m(h^2 + f^2), \tag{19}$$

where

$$m = \frac{1-\mu}{\mu}. \tag{20}$$

Unsurprisingly, lobbying induces an upward distortion in public good supply, and hence a social welfare loss, unless the policy maker is fully benevolent ($\mu = 1$). Notice also that $\tilde{g}^C$ is invariant to the choice of π_α and π_β by firms in stage one. This is so because contributions enter linearly into the policy maker preferences (18), and therefore π_α and π_β have no income effects on the choice of g_a and g_b.

At stage one, each firm ρ, given the strategy of the other firm, maximizes its net profits π_ρ subject to the politician's participation constraint. As we show in Appendix A.1, the lobbying game under centralization admits a multiplicity of Nash equilibria, which are illustrated in Figure 1. The solid curve depicts firm β best response function, $\pi^*_\beta(\pi_\alpha)$, whereas the dotted curve represents firm α best response function, $\pi^*_\alpha(\pi_\beta)$. The set of Nash equilibria lies along the segment E'–E''. Notice, however, that since the slope of the best response functions is equal to -1 along E'–E'', all Nash equilibria are equivalent in terms of aggregate profits (and contributions). The multiplicity of Nash equilibria is due to the linearity of firms profits and politician's preferences in contributions. Hence, given the aggregate rent that lobbies can extract from the policy

[11] Throughout the paper a "hat" denotes the solutions obtained without lobbying, whereas a "tilde" denotes the corresponding solutions under lobbying in the market.

maker, there exist several ways to allocate this amount between the two players, as an increase of the contribution by one firm, matched with a corresponding reduction of the contribution by the other firm, bears no income effects on all players.

Since aggregate profits are constant and firms are identical, in the following we restrict our attention to the symmetric equilibrium E^C in Figure 1, in which $\tilde{\pi}^C_\alpha = \tilde{\pi}^C_\beta = \tilde{\pi}^C$. As shown in Appendix A.1, in the symmetric equilibrium, net profits and contributions are

$$\tilde{\pi}^C = \hat{\pi}^C + m(h^2 + f^2)^2, \tag{21}$$

$$\tilde{s}^C = m(h^2 + f^2)^2. \tag{22}$$

Eq. (21) shows that profits under lobbying are equal to the profits without it, $\hat{\pi}^C$, plus a profit gain from lobbying. As expected, if the policy maker does not care for lobbyists' contributions (i.e. $m = 0$), $\tilde{\pi}^C = \hat{\pi}^C$ and $\tilde{s}^C = 0$.

The lobbying game we have considered above, in which both firms lobby for both public goods, is not the only conceivable one. In principle, each firm has four different options — lobby for both public goods, lobby for one public good only, and no lobby. However, we do not need to examine all the corresponding games, since each firm's profits are larger if it lobbies for both public goods, no matter what the other firm does. This follows directly from the definition of truthful strategy and the associated compensating contribution function. From Proposition 2 in Dixit *et al.* (1997), a truthful strategy is weakly dominant, and in our setting truthful strategies always involve non-negative contributions by both firms on both public goods.

4.2 Decentralization

Under decentralization, firms face one politician in each region. As in the previous section, lobbies simultaneously and independently present the policy maker a truthful contribution schedule as a function of public good choices, and then the policy makers, given the contribution schedules, simultaneously and independently choose public good supply in their own region.

Let $S_{\rho r}(g_r, \pi_{\rho r})$ be the compensating contribution schedule that firm ρ offers the policy maker of region r, where $S_{\alpha a} = \max\left\{h^2 g_a - \pi_{\alpha a}, 0\right\}$, $S_{\beta a} = \max\left\{f^2 g_a - \pi_{\beta a}, 0\right\}$, $S_{\alpha b} = \max\left\{f^2 g_b - \pi_{\alpha b}, 0\right\}$ and $S_{\beta b} = \max\left\{h^2 g_b - \pi_{\beta b}, 0\right\}$. Given the contribution schedules $S_{\alpha a}(.)$, $S_{\beta a}(.)$, $S_{\alpha b}(.)$ and $S_{\beta b}(.)$, the policy makers a and b solve, respectively,[12]

$$\tilde{g}_a^D = \underset{g_a}{\text{argmax}}\ V_a^D(g_a, g_b, \pi_{\alpha a}, \pi_{\beta a}, \pi_{\alpha b}), \tag{23a}$$

$$\tilde{g}_b^D = \underset{g_b}{\text{argmax}}\ V_b^D(g_a, g_b, \pi_{\beta b}, \pi_{\alpha b}, \pi_{\beta a}), \tag{23b}$$

where

$$V_a^D(.) \equiv \mu(W_a - S_{\alpha b} + S_{\beta a}) + (1-\mu)(S_{\alpha a} + S_{\beta a}),$$
$$V_b^D(.) \equiv \mu(W_b - S_{\beta a} + S_{\alpha b}) + (1-\mu)(S_{\beta b} + S_{\alpha b}),$$
$$\tilde{V}_a^D \equiv V_a^D(\tilde{g}_a^D, \tilde{g}_b^D, \pi_{\alpha a}, \pi_{\beta a}, \pi_{\alpha b}),\ \tilde{V}_b^D \equiv V_b^D(\tilde{g}_a^D, \tilde{g}_b^D, \pi_{\beta b}, \pi_{\alpha b}, \pi_{\beta a}).$$

As already noted, under decentralization different lobbies' contributions do not have the same weight into the local politicians' preferences. One unit of contribution a firm makes abroad counts as $-\mu$ in the home region but as 1 in the recipient region, while one unit of contribution a firm makes at home counts as $1-\mu$ in the home region and nothing abroad.

Solving the problem, the optimal public good supply in each region is (see Appendix A.2)[13]

$$\tilde{g}^D = \hat{g}^D + 2f^2 + 2m(h^2 + f^2). \tag{25}$$

Notice that in a decentralized system the lobbies influence public policy even when the social planner is fully benevolent (i.e. $m = 0$, since $\mu = 1$), as can be seen by the second term in (25). Moreover, in this case public good supply is the same as under centralization ($\tilde{g}^D = \tilde{g}^C$), which in turn equals the supply under centralization without lobbying ($\hat{g}^C$). The reason is simple. Under decentralization, the lobbies, by offering truthful contribution schedules to benevolent policy makers, induce them to internalize the spillover effects on profits of public good supply, thus providing the proper incentives to set the same (optimal) level of public good provision that occurs under centralization.[14] This also implies that the case of lobbying a fully benevolent planner can be taken as the benchmark in our context, allowing us to meaningfully compare the two institutional settings when governments are not fully benevolent.

Each firm, given the strategies of the other firm, maximizes its net profits subject to the politicians' participation constraints. As we show in Appendix A.2, the lobbying

[12] We assume that the degree of benevolence of regional policy makers is the same as that of the central policy maker.

[13] As under centralization, $\tilde{g}^D$ is independent of $\pi_{\alpha a}$, $\pi_{\alpha b}$, $\pi_{\beta b}$ and $\pi_{\beta a}$, as a consequence of the linearity of politicians' preferences in contributions.

[14] Truthful contribution schedules work as a standard *Pigouvian* subsidy scheme.

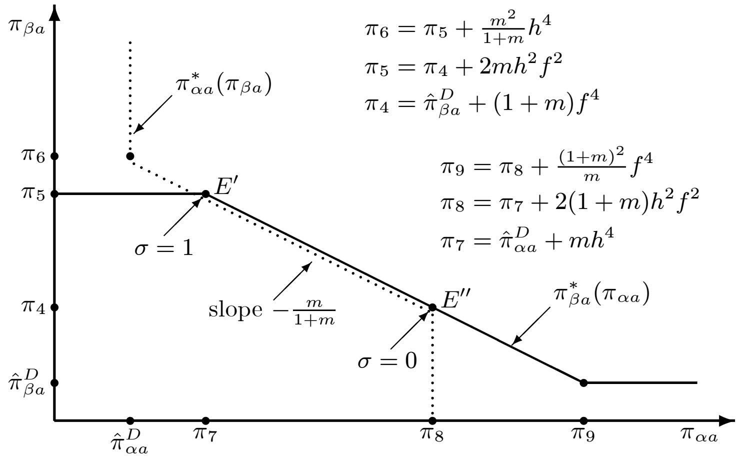

Figure 2: Nash equilibria when both firms lobby in region a under decentralization

game under decentralization admits a multiplicity of Nash equilibria in each region.[15] Segment E'–E'' in Figure 2 represents the set of Nash equilibria occurring in region a; the solid curve is firm β best response function, $\pi^*_{\beta a}(\pi_{\alpha a})$; the dotted curve is firm α best response function, $\pi^*_{\alpha a}(\pi_{\beta a})$. An identical (symmetric) set of Nash equilibria is obtained in region b for net profits $\pi_{\beta b}$ and $\pi_{\alpha b}$. Notice also that firms play a "separate" game in each region: the best response function of firm ρ in region r does not depend on its own and the other firm best response in the other region. This result comes again from the linearity of firms profits and politicians' preferences in contributions. Formally, by symmetry between regions, the set of Nash equilibria in terms of firms net profits can be characterized by the parameter $\sigma \in [0, 1]$, such that

$$\tilde{\pi}^D_{\beta a} = \tilde{\pi}^D_{\alpha b} = f^2 \hat{g}^D + (1+m) f^4 + 2mh^2 f^2 \sigma, \tag{26}$$
$$\tilde{\pi}^D_{\alpha a} = \tilde{\pi}^D_{\beta b} = h^2 \hat{g}^D + mh^4 + 2(1+m)h^2 f^2 (1-\sigma), \tag{27}$$

from which equilibrium contributions are obtained as

$$\tilde{s}^D_{\beta a} = \tilde{s}^D_{\alpha b} = (1+m) f^4 + 2mh^2 f^2 (1-\sigma), \tag{28}$$
$$\tilde{s}^D_{\alpha a} = \tilde{s}^D_{\beta b} = mh^4 + 2(1+m)h^2 f^2 \sigma. \tag{29}$$

Clearly, lobbies have a distributive conflict in each region. They both gain from an increase in public good production in each region, but each one would prefer the other firm to pay the contributions to the local politician. This conflict is formally captured by the parameter σ characterizing the set of Nash equilibria. At one end, when $\sigma = 1$,

[15] As under centralization, multiplicity of equilibria is due to linearity of firms net profits and politicians' preferences in contributions.

the equilibrium is E', the one preferred by the foreign lobby; at the other end, when $\sigma = 0$, the equilibrium is E'', the one preferred by the home lobby.[16] This conflict was present even under centralization (see the previous section), but there is now an important difference. Under decentralization, the slope of the best response functions is less than one, so that aggregate profits in each region are decreasing in σ. Figure 2 illustrates the point, by showing that aggregate profits in region a, $\pi_{\alpha a} + \pi_{\beta a}$, increase as one moves from E' to E''. This is due to the different value regional policy makers attach to contributions from the foreign and the home lobby. Consider for instance the equilibrium E'. Starting from this point, it is possible to select another equilibrium by increasing the contributions of the foreign firm (β) by m euros while reducing those of the home firm (α) by $1 + m$ euros; hence, in the new equilibrium aggregate profits are higher than in E'. The policy maker in region a, although "losing" one euro of contributions, is indifferent, for she values m euros from the foreign firm as $1+m$ euros from the home firm.

This fact brings about another important property of the game under decentralization. Adding (26)–(27), the total (home plus abroad) net profits of each firm, defined as $\tilde{\pi}^D \equiv \tilde{\pi}^D_{\alpha a} + \tilde{\pi}^D_{\alpha b} \equiv \tilde{\pi}^D_{\beta b} + \tilde{\pi}^D_{\beta a}$, and adding (28)–(29), the total contributions paid by each firm, $\tilde{s}^D = \tilde{s}^D_{\alpha a} + \tilde{s}^D_{\alpha b} = \tilde{s}^D_{\beta b} + \tilde{s}^D_{\beta a}$, are equal to, respectively,

$$\tilde{\pi}^D = \hat{\pi}^D + m\left(h^2 + f^2\right)^2 + f^4 + 2h^2 f^2 (1 - \sigma), \tag{30}$$

$$\tilde{s}^D = m\left(h^2 + f^2\right)^2 + f^4 + 2h^2 f^2 \sigma. \tag{31}$$

Hence, total profits of both firms increase as σ becomes lower. Hence, if firms succeed in coordinating their lobbying activity so as to play the equilibrium $\sigma = 0$ in each region, they attain an outcome that maximizes aggregate profits. At this equilibrium, firm α pays most part of the contributions in region b, and β does the same in region a. This is a crucial difference with the game under centralization examined in Section 4.1. In the latter, since the policy maker perceives the two lobbies as identical, the resulting Nash equilibria are all equivalent in terms of aggregate firms profits and contributions. On the contrary, under decentralization, there emerges a Pareto ranking of Nash equilibria in terms of firms' net profits. As σ becomes lower, both firms profits increase, contributions decrease (thus making the policy makers worse off), whereas public good supply is fixed at the level shown in (25).

[16] Since firms are identical, we have assumed that the parameter σ is the same in both regions. By assuming a different σ_r in each region, the support of the set of Nash equilibria would expand from $\mathbb{R}$ to $\mathbb{R}^2$.

4.3 Centralization versus Decentralization

Using the results of the previous sections, we can compare centralization and decentralization under lobbying behavior along various dimensions: social welfare, public good supply, firms' net profits, and contributions to politicians. In a centralized system, for $\mu < 1$, since both firms always lobby for both public goods, the resulting upward distortion in public good supply reduces social welfare. The same distortion occurs and the supply of public goods is the same under centralization and decentralization. In the latter regime the joint lobbying effort exerted by firms on both regional policy makers induces the latter to account for the regional profit-spillovers. However, lobbies always prefer a centralized system over a decentralized one, since net profits are higher. This follows immediately since gross profits are the same under the two regimes whereas contributions are higher under decentralization than under centralization. The proposition summarizes.

Proposition 2 *Firms' net profits are always higher under centralization than decentralization. Contributions to politicians are higher under decentralization, while public good supply and aggregate social welfare are the same under the two regimes.*

Proof. As for the comparison of net profits, using (21) and (30), it is $\tilde{\pi}^C - \tilde{\pi}^D = f^4 + 2h^2 f^2 \sigma \geq 0$, which shows that profits are higher under centralization. As for contributions, from (22) and (31) it is $\tilde{s}^D - \tilde{s}^C = f^4 + 2h^2 f^2 \sigma \geq 0$. As for public good provision and social welfare, from (19) and (25) it is $\tilde{g}^C = \tilde{g}^D$, which implies that aggregate social welfare is the same under centralization and decentralization. ■

5 Lobbying for the market

In the previous section, we discussed the case in which both firms are already operating in both markets and have a common interest in lobbying politicians to increase public good supply. We now consider a different scenario, one in which firms have conflicting interests and lobby to acquire the *right to enter* the local markets, instead of lobbying for public good provision. For reasons of analytical tractability, we assume in this section that decisions about public goods (once the firms are allowed in the markets) are taken efficiently by politicians.

We study the lobbying problem by assuming the following timing. At stage 1, the government (central or regional, depending on the case) decides on the *number* of firms that are allowed to sell in the local market for good x, if one or two firms.[17] If both

[17] The timing considered in this section is reversed with respect to that assumed in the previous one,

firms are allowed to enter, there is clearly no need to lobby and the game goes directly to stage 4. On the other hand, if the government decides to allow for one entrant only at stage 1, at stage 2 each firm competing for the market makes a credible commitment to offer the politician a positive contribution if it is the only firm allowed to enter in the market for good x. At stage 3, the politician, knowing the offers made by firms at stage 2, assigns the monopoly right to the firm that guarantees her the highest payoff (i.e. the weighted average of social welfare and lobbies' contributions) and cashes the relevant contribution. At stage 4, the government chooses public good supply by maximizing social welfare. Finally, at stage 5, market equilibrium is determined along the lines of Section 2. The model is solved by backward induction.

Notice that, although our main goal is that of comparing centralization and decentralization, the more complex structure of this case allows us to consider a richer institutional structure. We can still consider a case of *full centralization*, when the central government chooses both the number of firms entering each regional market and local public good supplies, and a case of *full decentralization,* where each regional government chooses both the number of firms entering its market and public good supply. But we may also have a case of *split competencies,* where the central government establishes the number of firms that are allowed to operate in each regional market but regional public good supply is decided at the regional level. This case mimics the situation in many countries (and the EU), where regulation policy is centralized but decisions about local public goods (infrastructures in our case) are decentralized. We ask if lobbying may provide a rationale for these arrangements.

To investigate these three cases, we need first to compute market equilibrium and welfare under monopoly (stage 5), thus extending the duopoly analysis already provided in Section 2. Letting

$$H = \frac{1-c}{2} \quad \text{and} \quad F = \frac{1-\delta c}{2}, \tag{32}$$

we obtain, by standard profit maximization, that when the regional markets are monopolized the equilibrium quantities are $x_a^* = Hg_a$ and $x_b^* = Hg_b$ ($x_a^* = Fg_a$ and $x_b^* = Fg_b$) if it is the home (foreign) firm that supplies the market. The corresponding equilibrium profits are $\Pi_\alpha^* = H^2 g_a$ and $\Pi_\beta^* = H^2 g_b$ ($\Pi_\alpha^* = F^2 g_b$ and $\Pi_\beta^* = F^2 g_a$) when the home (foreign) firm supplies the market.

as it is now the politician to move first and decide how many firms to allow in the market. This is done for analytical simplicity: the corresponding game with lobbies moving first, in fact, turns out to be too complex to allow for analytic solutions. However, as it will become clear in the next pages, since local politicians care for the profits of their home firms only, the main results of this section should remain unchanged also under the original timing, regardless of the fact that with the new timing all bargaining power rests with the politician.

Focusing again on region a, and depending on which firm operates in each region, social welfare is

$$W_a^{H_aH_b} = \frac{3H^2 g_a}{2} - \frac{g_a^2}{4} + \bar{y}, \tag{33}$$

$$W_a^{F_aF_b} = \frac{F^2 g_a + 2F^2 g_b}{2} - \frac{g_a^2}{4} + \bar{y}, \tag{34}$$

$$W_a^{H_aF_b} = \frac{3H^2 g_a + 2F^2 g_b}{2} - \frac{g_a^2}{4} + \bar{y}, \tag{35}$$

$$W_a^{F_aH_b} = \frac{F^2 g_a}{2} - \frac{g_a^2}{4} + \bar{y}, \tag{36}$$

where the apex H_aH_b (resp. F_aF_b) denotes that home (resp. foreign) firms are monopolists in both regions, and H_aF_b (resp. F_aH_b) that firm α (resp. β) is a monopolist in both regions. We begin the analysis with the full centralization case.

5.1 Full centralization

Invoking symmetry, we only consider the case in which the central government opts at stage 1 for the same policy, one or two firms, in both regions. Suppose first that the government allows for both firms supplying both regional markets. This case was already studied in Section 3, where we described the equilibrium without lobbying. Substituting the optimal public good provision given in (13) into (12), the politician's value function when both firms are allowed to enter the market is then

$$\hat{V}^{hf} = \mu \frac{[(h+f)^2 + 2(h^2+f^2)]^2}{2} + 2\mu\bar{y}. \tag{37}$$

Consider next the case in which only one firm is allowed to enter the regional markets. The government holds simultaneously an auction for each market, and firms have an incentive to compete for it, offering contributions to the government. Let S_ρ^H and S_ρ^F be the contribution offered by firm ρ for serving the home and the foreign market, respectively. The following Lemma summarizes the outcome of firms' competition for the market.

Lemma 1 *Under full centralization, if only one firm is allowed to enter the regional markets, then each firm gets the home market by paying the contribution*

$$\hat{S}_\rho^H = \max\left\{\hat{T}^H, 0\right\}, \text{ where } \hat{T}^H = -\frac{9\mu(H^4 - F^4)}{4(1-\mu)} + 3F^4. \tag{38}$$

The corresponding politician's value function is

$$\hat{V}^H = \mu\frac{9H^4}{2} + 2(1-\mu)\hat{S}_\rho^H + 2\mu\bar{y}. \tag{39}$$

Proof. See Appendix B.1. ■

The intuition is simple. A local monopoly is always more profitable than a foreign one, since the home firm has a cost advantage over the foreign one ($H \geq F$), and the optimal public good supply is higher when the home firm serves the market (for the same reason). Hence, each firm wins the home market by outbidding the foreign firm, whose offer $\hat{S}_\rho^F$ at most equals the profits it would make by serving the foreign market in a monopolistic regime, $3F^4$. Notice, however, from (38) that the home firm does not need to offer that much, and in some cases it does not even need to make a positive offer, to win the market. The reason is that if the foreign firm gets the market, then a welfare loss is observed compared to a home-monopoly. Thus, in order to win the market, the home firm can always offer the politician a lower contribution than the one offered by the foreign firm. Quite intuitively, the higher are μ and δ the more likely is that the home firm does not need to make a positive offer to win the market.

By comparing (37) and (39), we can then characterize the central government's choice in stage 1.

Proposition 3 *Under full centralization, for $\delta \in [1, \delta_1]$, $\delta_1(c) = \frac{5+17c}{22c}$, there exists a $\mu_1(\delta; c)$, decreasing in δ, such that for all $\mu \leq \mu_1$ one firm only is allowed to enter each regional market; by Lemma 1, the home firm obtains a monopoly upon the payment of a contribution. For $\delta \in [1, \delta_1]$ and $\mu > \mu_1$ both firms are allowed into both regional markets. For $\delta \in (\delta_1, \delta_{\max}]$, one firm only is allowed to enter each regional market for all μ and therefore the home firm gets a monopoly. As for contributions, there exists a $\mu_2(\delta; c)$, decreasing in δ, such that the home firm pays a contribution for all $\mu < \mu_2$ and no contribution otherwise.*

Proof. See Appendix B.2. ■

Figure 3-a. illustrates the Proposition. For $\delta \leq \delta_1$ and $\mu > \mu_1$ the policy maker opts for a duopoly in both markets ($hf_a hf_b$). In all other cases, she opts for a monopoly and, given the results in Lemma 1, each firm wins its home market ($H_a H_b$). In this latter case, positive contributions ($\hat{S}_\rho^H > 0$) are paid if and only if μ is below a given threshold (μ_1 or μ_2, depending on the value of δ); otherwise the home firm does not need to offer a contribution to gain access to the monopolized market.

To understand the intuition behind these results, suppose first that the politician simply maximizes social welfare (i.e. $\mu = 1$). The proposition then shows that there exists a threshold level of the cost advantage for the home firm, δ_1, such that for $\delta < \delta_1$ ($\delta \geq \delta_1$), social welfare is higher (lower) under a duopoly than under a monopoly. Hence, the fully benevolent politician simply lets both firms enter both markets in the former case and only the home firm in the latter one. If instead $\mu < 1$, the politician

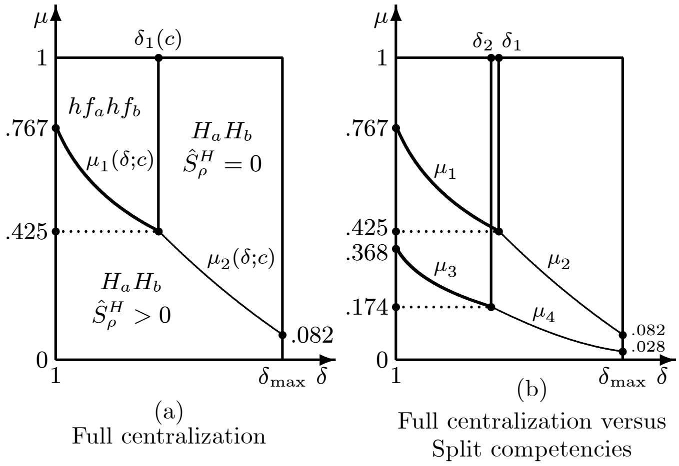

Figure 3: Lobbying for the market

faces a trade-off when $\delta < \delta_1$. By creating a monopoly, she gets a contribution from the home firm winning the contest for the market, but at the cost of the monopoly welfare loss; however, if she lets both firms in, she avoids this welfare cost but does not get any contribution. This explains why, for $\delta < \delta_1$, a sufficiently benevolent policy maker — one with preferences $\mu > \mu_1$ — makes the efficient choice, while a politician who is greedier ($\mu \leq \mu_1$) prefers a monopoly by home firms in each regional market. This trade off is absent when $\delta \geq \delta_1$, since social welfare is however higher under a home monopoly than under a duopoly. Hence, the politician always allows one firm only in each market, no matter her degree of benevolence. The latter only bears on whether contributions are paid to the central politician. If $\mu > \mu_2$, i.e. if the politician is sufficiently benevolent, then home firms would not need to bribe the politician in order to win the local monopoly, even though foreign firms made a positive offer. Instead, if the politician is greedy ($\mu \leq \mu_2$), the home firm must offer a contribution to outbid the offer made by the foreign firm. Recalling that lobbies' contributions are pure transfers and that when lobbying is for the market there are no distortions in public goods supply, we can conclude that a loss in social welfare occurs if and only if lobbying induces the central government to opt for local monopolies whenever a benevolent social planner would have opted for local duopolies. Formally:

Corollary 1 *Under full centralization lobbying causes a welfare loss if and only if* $\delta \in [1, \delta_1)$ *and* $\mu \in (0, \mu_1)$.

5.2 Split competencies

Consider next the case in which the central government chooses how many firms enter each market, but the regional governments choose public good supply. Since what differentiates split competencies and the fully centralized regimes is only the equilibrium level of public goods supply, we can directly follow the above logic to prove:

Proposition 4 *Under split competencies, for $\delta \in [1, \delta_2]$, $\delta_2(c) < \delta_1(c)$ for all $c \in (0,1)$, there exists a $\mu_3(\delta; c)$ such that for all $\mu \leq \mu_3$ one firm only is allowed to enter each regional market, and therefore the home firm obtains a monopoly upon the payment of a contribution; otherwise both firms are allowed into both regional markets. For $\delta \in (\delta_2, \delta_{\max}]$ one firm only is allowed to enter each regional market for all μ, and hence the home firm gets a monopoly. As for contributions, there exists a $\mu_4(\delta; c)$ such that the firm pays a contribution for all $\mu < \mu_4$ and no contribution otherwise.*

Split competencies and full centralization are compared in Figure 3-b. Notice that the area in which each firm obtains a monopoly at home upon the payment of a contribution is certainly *smaller* under split competencies, since the curves μ_3 and μ_4 for the latter case lie below the respective curves μ_1 and μ_2 for centralization. Hence, lobbying for the market is less effective under split competencies than under centralization.

However, the comparison in terms of social welfare depends on parameters. As $\delta_2 < \delta_1$, there is an area under split competencies — defined by $\delta \in (\delta_2, \delta_1)$ and $\mu > \mu_1$ — in which even a fully benevolent central politician ($\mu = 1$) would opt for a monopoly by the home firm instead of the more efficient duopoly. This is so because under split competencies public good provision is decided at the local level and as shown above (in Section 3) local public goods are underprovided by local governments in local duopolies. Hence, allowing for a single home producer by the center is a way to partly counteract this inefficiency at local level. On the other hand, split competencies is more efficient than centralization for $\delta < \delta_2$, as the set in which two firms are allowed in both markets (the efficient choice) is larger under split competencies than under centralization, since $\mu_3 < \mu_1$. This is again due to the fact that local governments do not consider foreign firms' profits as part of the (local) social welfare. In fact, in the event of a foreign monopoly, a local government undersupplies the public good compared to a central government. This means that under split competencies the home firms offer the politician a smaller contribution to outbid the foreign competitor, which explains why the central government is more willing to let two firms enter the market. Thus, lobbying is more effective under full centralization.

5.3 Full decentralization

We finally consider the case of full decentralization, in which regional governments (simultaneously) choose first the number of firms that are allowed to enter their market,

		region b	
		two firms	one firm
reg. a	two firms	$\hat{V}_a^{hf} = \mu \frac{[(h+f)^2+2h^2][(h+f)^2+2(h^2+f^2)]}{4}$	$\hat{V}_a^{hf_aH_b} = \mu \frac{[(h+f)^2+2h^2]^2}{4}$
	one firm	$\hat{V}_a^{hf_aH_b} = \begin{cases} \frac{4f^2[(h+f)^2+2h^2]\mu+(4+\mu)F^4}{4} \text{ if } \mu < \mu_5(\delta;c), \\ \mu\frac{9H^4+4f^2[(h+f)^2+2h^2]}{4} \text{ otherwise.} \end{cases}$	$\hat{V}_a^{H_aH_b} = \begin{cases} \frac{F^4}{4}(4+\mu) \text{ if } \mu < \mu_5(\delta;c), \\ \frac{9H^4}{4}\mu \text{ otherwise.} \end{cases}$

Table 1: Politicians' value functions under full decentralization

and then public good supply. The choice on the number of firms gives rise to a 2×2 normal form game between regional policy makers. Whenever one firm only is allowed to supply a regional market, firms compete by bribing the regional policy maker. For any strategy pair, Lemma 2 establishes the outcome of firms' competition for the market and regional payoffs, shown in Table 1, in terms of the maximum value of politicians' objective functions.[18]

Lemma 2 *Under full decentralization, whenever a region allows for one firm only to serve its local market, then it is the home firm to gain access to the market, paying the contribution*

$$\hat{S}_\rho^H = \max\left\{-\frac{\mu(9H^4 - F^4)}{4(1-\mu)} + \frac{F^4}{1-\mu}, 0\right\} \tag{40}$$

to the politician.
Depending on the number of firms allowed into each regional markets, politicians' value functions are those shown in Table 1.

Proof. See Appendix B.3. ■

As in the previous regimes and for the same reasons, it is always the home firm to gain a monopoly in its market when competing with the foreign firm. From (40) it is immediate to see that $\hat{S}_\rho^H > 0$ if and only if

$$\mu < \mu_5(\delta; c) = \frac{4F^4}{9H^4 - F^4}. \tag{41}$$

Regional politicians choose the number of firms in the market by playing the normal form game given in Table 1. The solution of such a policy game is given in the following proposition:

[18] Since the game is symmetric, the Table shows only the payoffs of region a's politician. Also, to save space, regional social welfare is net of the endowment $\bar{y}$.

Proposition 5 *Under full decentralization, it is a dominant strategy for both regional policy makers to admit one firm only in their market for all* $\mu \in (0, 1]$ *and* $\delta \in [1, \delta_{\max}]$*. Hence, by Lemma 2 the home firm gets a local monopoly upon the payment of a positive contribution for* $\mu < \mu_5(\delta; c)$ *and nothing otherwise.*

Proof. See Appendix B.4. ■

Proposition 5 shows that lobbying for the market is most effective under full decentralization, with the home firms always gaining a local monopoly in their regional market. When $\delta < \delta_1$, although a duopoly would be the efficient solution in both regions, markets turn out to be fully monopolized no matter the value of μ. This means that in the case of lobbying for the market full decentralization is the least efficient of the three regimes. Moreover, one can show that the Nash equilibrium (one-firm, one-firm) of the game in Table 1 is also Pareto inefficient in terms of politicians' aggregate value functions for all $\delta < \delta_2$. The difference between full decentralization and split competencies is that, while under the former regime regional policy makers end up in a prisoner dilemma, under the latter regime this outcome does not occur because it is the central policy maker that directly chooses the highest aggregate payoff along the diagonal cells of the game in Table 1.

6 Concluding remarks

Is decentralization more conductive to lobbying behavior? This paper offers a simple answer to this important question. When interests of local lobbies are aligned, as in our "in the market case", then decentralization is better than centralization because in the former institutional setting lobbies have to pay larger bribes to politicians to induce them to internalize profits spillover effects. Vice-versa, when interests of local lobbies are in conflict, as in our "for the market case", then centralization is better than decentralization because local governments are more easily captured by local interests. This result strongly suggests that in deciding whether a given function should be decentralized (resp. centralized) in 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, taking again the EU example cited in the Introduction, one 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. Lobbies would then be forced to pay larger contributions to induce local governments to internalize profits spillovers, which would make lobbying more costly. *Coeteris paribus*, our argument would then suggest to decentralize these functions. Vice-versa, in regulatory fields such as production subsidies to national producers, protection of market share 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, *coeteris paribus*, our argument would suggest to centralize these functions.

The paper also offers some other interesting insights. As we saw in the "for the market" case, there are situations in which the best institutional structure under lobbying is one where competencies are split between different levels of government, with the central level taking decisions about regulation policy and the lower level taking decisions about local public good supply. Indeed, we often observe in many countries that different levels of government interact, with different roles, on the same function. This is in contrast with the prescriptions of traditional normative fiscal federalism theory, which usually suggests a one-to-one assignment of functions to different levels of government. Asking if this division of tasks performs some efficiency functions, such as greater resilience to interest groups, would be an interesting avenue for further research.

Finally, there are many respects in which the above analysis calls for extensions. Our modelling of lobbying behavior is rough, as it refers to the first generation of lobbying models, which are, as we already remarked, a reduced form of a far more complex political behavior, involving elections and legislatures. Allowing for a more complex institutional structure (along the lines, for example, of Persson and Tabellini, 2000, chpt. 7, Mitra, 1999, Besley and Coate, 2001, Felli and Merlo, 2001) may highlight other channels of interaction between local interests and local policies which we have not considered here. Moreover, lobbying is not necessarily a "bad", as we have assumed here. For instance, it may provide useful information to politicians and citizens. Since better information on policies and politicians is often quoted as one of the main advantages of decentralization (e.g. Bennedsen and Feldmann, 2002 and 2004, Besley and Smart, 2003b; Bordignon *et al.*, 2004), discussing the link between informational lobbying and decentralization may offer further useful insights.

A Appendix: Lobbying for public good provision

A.1 Centralization

When both firms lobby the policy maker, from the first order conditions for maximizing (18),

$$\mu \frac{\partial \mathcal{W}}{\partial g_r} + (1-\mu)(h^2+f^2) = 0, \tag{A.1}$$

we obtain $\tilde{g}^C$ in (19) for both g_a and g_b. In deriving the first order condition (A.1), we ignore the non-negativity constraint on contributions, by letting $S_\rho = h^2 g_r + f^2 g_{-r} - \pi_\rho$ into the objective function (18), and then checking non-negativity *ex post* in the computed equilibrium. Substituting $\tilde{g}^C$ into (18) we get the politician's welfare, $V^C(\tilde{g}_a^C, \tilde{g}_b^C, \pi_\alpha, \pi_\beta)$, as a function of firms net profits. To compute the equilibrium net profits (and contributions), we derive the firms' best response functions. To get the best response function of firm β, we solve first the problem in which firm α is lobbying while β is not. In this case, the policy maker maximizes $V_{-\beta}^C(g_a, g_b, \pi_\alpha) = \mu\mathcal{W} + (1-\mu)S_\alpha$. From the corresponding first order conditions:

$$\mu \frac{\partial \mathcal{W}}{\partial g_a} + (1-\mu)h^2 = 0, \qquad \mu \frac{\partial \mathcal{W}}{\partial g_b} + (1-\mu)f^2 = 0,$$

we obtain the optimal public good supplies:

$$\tilde{g}_{a(-\beta)}^C = \hat{g}^C + 2mh^2, \qquad \tilde{g}_{b(-\beta)}^C = \hat{g}^C + 2mf^2.$$

For any given π_α, the maximum amount of profits that firm β can make is constrained by the politician's participation constraint, which gives rise to the following conditions:

$$V^C(\tilde{g}_a^C, \tilde{g}_b^C, \pi_\alpha, \pi_\beta) = V_{-\beta}^C(\tilde{g}_{a(-\beta)}^C, \tilde{g}_{b(-\beta)}^C, \pi_\alpha), \quad \text{if } \tilde{V}_{-\beta}^C \geq \mu\mathcal{W}(\hat{g}_a^C, \hat{g}_b^C), \tag{A.2a}$$

$$V^C(\tilde{g}_a^C, \tilde{g}_b^C, \pi_\alpha, \pi_\beta) = \mu\mathcal{W}(\hat{g}_a^C, \hat{g}_b^C), \quad \text{otherwise.} \tag{A.2b}$$

Given π_α, if the policy maker is better off under lobbying by firm α than under no lobbying, i.e. if $\tilde{V}_{-\beta}^C \geq \mu\mathcal{W}(\hat{g}_a^C, \hat{g}_b^C)$, then Eq. (A.2a) says that firm β can increase its profits (and correspondingly reduce contributions) up to the point in which the policy maker is indifferent between being lobbed by both firms and being lobbed only by firm α. On the contrary, if the policy maker is better off under no lobbying than under lobbying by firm α, then (A.2b) says that firm β can increase its profits up to the point in which the policy maker is indifferent between being lobbed by both firms and not being lobbed.

It is immediate to show that condition $\tilde{V}_{-\beta}^C \geq \mu\mathcal{W}(\hat{g}_a^C, \hat{g}_b^C)$ in (A.2a) can be written as $\pi_\alpha \leq \pi_1 \equiv \hat{\pi}^C + m(h^4+f^4)$. Thus, solving the equations in (A.2a) and (A.2b) for π_β, we get the best response function of firm β as

$$\pi_\beta^*(\pi_\alpha) = \begin{cases} \pi_2 & \text{if } \pi_\alpha \leq \pi_1, \\ \hat{\pi}^C + \pi_3 - \pi_\alpha & \text{if } \pi_1 < \pi_\alpha \leq \pi_3, \\ \hat{\pi}^C & \text{if } \pi_\alpha > \pi_3, \end{cases} \tag{A.3}$$

where $\pi_2 \equiv \pi_1 + 4mh^2f^2$ and $\pi_3 \equiv \pi_2 + m(h^4+f^4)$. The graph of $\pi_\beta^*(\pi_\alpha)$ is shown in Figure 1 in the text as the solid curve. For $\pi_\alpha \leq \pi_1$, the best response of firm β is to offer the policy maker a contribution schedule such that $\pi_\beta = \pi_2$, since this is the minimum amount of contributions (maximum amount of profits) that keeps the policy maker on its participation constraint. For $\pi_\alpha > \pi_1$, as firm α reduces its contributions, the best response of β is to correspondingly increase its contributions (the slope of the best response function is -1). However, firm β is not willing to see its profits to go below $\hat{\pi}^C$, the amount it would earn without lobbying; hence the best response function is flat at $\pi^*_\beta = \hat{\pi}^C$ for $\pi_\alpha > \pi_3$.

By symmetry, we get the best response function, $\pi^*_\alpha(\pi_\beta)$, of firm α, also shown in Figure 1 as the dotted curve. It is then immediate to see that the lobbying game admits a set of Nash equilibria, defined by the profit pairs (π_α, π_β) such that

$$\pi_\beta = \hat{\pi}^C + \pi_3 - \pi_\alpha, \quad \pi_1 \leq \pi_\alpha \leq \pi_2. \tag{A.4}$$

It is immediate to check that contributions are non-negative in all Nash equilibria, ranging from the minimum level of $s_\rho = m(h^4 + f^4)$, when firm ρ earns the highest amount of profits $\pi_\rho = \hat{\pi}^C + \pi_3 - \pi_1$, to the maximum level of $s_\rho = m(h^4 + f^4) + 4mh^2 f^2$, when firm ρ earns the lowest amount of profits $\pi_\rho = \hat{\pi}^C + \pi_3 - \pi_2$. Finally, setting $\pi_\beta = \pi_\alpha$, we obtain from (A.4) the symmetric Nash equilibrium $\tilde{\pi}^C = \tilde{\pi}^C_\alpha = \tilde{\pi}^C_\beta$ shown in (21), and by substituting (19) and (21) into (17a)–(17b), we get the contributions $\tilde{s}^C = \tilde{s}^C_\alpha = \tilde{s}^C_\beta$ in (22).

A.2 Decentralization

We solve the lobby game ignoring the non-negativity constraint on contributions, letting $S_{\alpha a} = h^2 g_a - \pi_{\alpha a}$, $S_{\beta a} = f^2 g_a - \pi_{\beta a}$, $S_{\alpha b} = f^2 g_b - \pi_{\alpha b}$ and $S_{\beta b} = h^2 g_b - \pi_{\beta b}$. We check *ex post* that equilibrium contributions are non-negative. V^D_r denotes the preferences of policy maker r, $r \in \{a, b\}$.

Policy makers' solve problems (23a)–(23b) in Section 4.2, obtaining, from the corresponding first order conditions, the symmetric solution $\tilde{g}^D$ in (25). To derive the equilibrium net profits (and contributions), we compute the firms' best response functions. Focusing first on lobbying in region a, to obtain the best response function of firm β, we need to solve the problem in which firm α lobbies in both regions (α^{ab}) while β no longer lobbies in region a (β^b), that is

$$\tilde{g}_a^{\alpha^{ab}\beta^b} = \underset{g_a}{\text{argmax}} \ V_a^{\alpha^{ab}\beta^b}(g_a, g_b, \pi_{\alpha a}, \pi_{\alpha b}), \tag{A.5a}$$

$$V_a^{\alpha^{ab}\beta^b}(.) \equiv \mu(W_a - S_{\alpha b}) + (1-\mu)S_{\alpha a}, \ \tilde{V}_a^{\alpha^{ab}\beta^b} \equiv V_a^{\alpha^{ab}\beta^b}(\tilde{g}_a^{\alpha^{ab}\beta^b}, \tilde{g}_b^{\alpha^{ab}\beta^b}, \pi_{\alpha a}, \pi_{\alpha b}),$$

$$\tilde{g}_b^{\alpha^{ab}\beta^b} = \underset{g_b}{\text{argmax}} \ V_b^{\alpha^{ab}\beta^b}(g_a, g_b, \pi_{\beta b}, \pi_{\alpha b}), \tag{A.5b}$$

$$V_b^{\alpha^{ab}\beta^b}(.) \equiv \mu(W_b + S_{\alpha b}) + (1-\mu)(S_{\alpha b} + S_{\beta b}), \ \tilde{V}_b^{\alpha^{ab}\beta^b} \equiv V_b^{\alpha^{ab}\beta^b}(\tilde{g}_a^{\alpha^{ab}\beta^b}, \tilde{g}_b^{\alpha^{ab}\beta^b}, \pi_{\beta b}, \pi_{\alpha b}).$$

For any given $\pi_{\alpha a}$ and $\pi_{\alpha b}$, the maximum amount of profits that firm β can make in region a $(\pi_{\beta a})$ is constrained by the politician's participation constraint, which amounts to the following conditions:

$$V_a^D\left(\tilde{g}_a^D, \tilde{g}_b^D, \pi_{\alpha a}, \pi_{\beta a}, \pi_{\alpha b}\right) = V_a^{\alpha^{ab}\beta^b}(\tilde{g}_a^{\alpha^{ab}\beta^b}, \tilde{g}_b^{\alpha^{ab}\beta^b}, \pi_{\alpha a}, \pi_{\alpha b}), \quad \text{if } \tilde{V}_a^{\alpha^{ab}\beta^b} \geq \tilde{V}_a^{\alpha^b\beta^b}, \tag{A.6a}$$

$$V_a^D\left(\tilde{g}_a^D, \tilde{g}_b^D, \pi_{\alpha a}, \pi_{\beta a}, \pi_{\alpha b}\right) = V_a^{\alpha^b\beta^b}(\tilde{g}_a^{\alpha^b\beta^b}, \tilde{g}_b^{\alpha^b\beta^b}, \pi_{\alpha b}), \quad \text{otherwise}, \tag{A.6b}$$

where $\tilde{V}_a^{\alpha^b\beta^b}$ is politician a maximum value function in the game in which both firms lobby only in region b, that is the game

$$\tilde{g}_a^{\alpha^b\beta^b} = \underset{g_a}{\operatorname{argmax}}\ V_a^{\alpha^b\beta^b}(g_a, g_b, \pi_{\alpha b}), \tag{A.7a}$$

$$V_a^{\alpha^b\beta^b}(.) \equiv \mu(W_a - S_{\alpha b}),\ \tilde{V}_a^{\alpha^b\beta^b} \equiv V_a^{\alpha^b\beta^b}(\tilde{g}_a^{\alpha^b\beta^b}, \tilde{g}_b^{\alpha^b\beta^b}, \pi_{\alpha b})$$

$$\tilde{g}_b^{\alpha^b\beta^b} = \underset{g_b}{\operatorname{argmax}}\ V_b^{\alpha^b\beta^b}(g_a, g_b, \pi_{\beta b}, \pi_{\alpha b}), \tag{A.7b}$$

$$V_b^{\alpha^b\beta^b}(.) \equiv \mu(W_b + S_{\alpha b}) + (1-\mu)(S_{\alpha b} + S_{\beta b}),\ \tilde{V}_b^{\alpha^b\beta^b} \equiv V_b^{\alpha^b\beta^b}(\tilde{g}_a^{\alpha^b\beta^b}, \tilde{g}_b^{\alpha^b\beta^b}, \pi_{\beta b}, \pi_{\alpha b}).$$

Given $\pi_{\alpha a}$ and $\pi_{\alpha b}$, if policy maker a is better off under lobbying by firm α than under no lobbying, i.e. if $\tilde{V}_a^{\alpha^{ab}\beta^b} \geq \tilde{V}_a^{\alpha^b\beta^b}$, then Eq. (A.6a) says that firm β can increase its profits (and correspondingly reduce contributions) up to the point in which the policy maker is indifferent between being lobbed by both firms and being lobbed only by firm α. On the contrary, if the policy maker is better off under no lobbying than under lobbying by firm α, then (A.6b) says that firm β can increase its profits up to the point in which the policy maker is indifferent between being lobbed by both firms and not being lobbed, which is problem $\alpha^b\beta^b$ in (A.7a)–(A.7b). Routine algebra shows that $\tilde{V}_a^{\alpha^{ab}\beta^b} \geq \tilde{V}_a^{\alpha^b\beta^b}$ in (A.6a) can be written as $\pi_{\alpha a} \leq \pi_7 \equiv \hat{\pi}_{\alpha a}^D + mh^4$, where $\hat{\pi}_{\alpha a}^D = h^2\hat{g}^D$ is the amount of profits that a firm earns at home under decentralization and no lobbying (notice that π_7 is independent of $\pi_{\alpha b}$). Solving the equations in (A.6a) and (A.6b) for $\pi_{\beta a}$, we thus get, after some algebra, the best response function of firm β in region a:

$$\pi_{\beta a}^*(\pi_{\alpha a}) = \begin{cases} \pi_5 & \text{if } \pi_{\alpha a} \leq \pi_7, \\ \pi_6 + \frac{m}{1+m}(\hat{\pi}_{\alpha a}^D - \pi_{\alpha a}) & \text{if } \pi_7 < \pi_{\alpha a} \leq \pi_9, \\ \hat{\pi}_{\beta a}^D & \text{if } \pi_{\alpha a} > \pi_9, \end{cases} \tag{A.8}$$

where $\hat{\pi}_{\beta a}^D = f^2\hat{g}^D$ are the profits that a firm earns abroad under decentralization and no lobbying (the reservation utility of firm β in region a); π_5, π_6 and π_9 are defined in Figure 2 in the text, in which the graph of $\pi_{\beta a}^*(\pi_{\alpha a})$ is shown as the solid curve. Notice that the best response function is independent of $\pi_{\alpha b}$.

In a similar manner, to obtain the best response function of firm α in region a, we need to solve problem $\alpha^b\beta^{ab}$ defined in (A.9a)–(A.9b), in which firm β lobbies in both regions while α no longer lobbies in its region. For any given $\pi_{\beta a}$ and $\pi_{\alpha b}$, the maximum $\pi_{\alpha a}$ that firm α can make is constrained by the following conditions on politician's welfare in region a:

$$V_a^D\left(\tilde{g}_a^D, \tilde{g}_b^D, \pi_{\alpha a}, \pi_{\beta a}, \pi_{\alpha b}\right) = V_a^{\alpha^b\beta^{ab}}(\tilde{g}_a^{\alpha^b\beta^{ab}}, \tilde{g}_b^{\alpha^b\beta^{ab}}, \pi_{\beta a}, \pi_{\alpha b}), \quad \text{if } \tilde{V}_a^{\alpha^b\beta^{ab}} \geq \tilde{V}_a^{\alpha^b\beta^b}, \tag{A.9a}$$

$$V_a^D\left(\tilde{g}_a^D, \tilde{g}_b^D, \pi_{\alpha a}, \pi_{\beta a}, \pi_{\alpha b}\right) = V_a^{\alpha^b\beta^b}(\tilde{g}_a^{\alpha^b\beta^b}, \tilde{g}_b^{\alpha^b\beta^b}, \pi_{\alpha b}), \quad \text{otherwise}, \tag{A.9b}$$

where

$$\tilde{g}_a^{\alpha^b\beta^{ab}} = \underset{g_a}{\text{argmax}}\ V_a^{\alpha^b\beta^{ab}}(g_a, g_b, \pi_{\beta a}, \pi_{\alpha b}), \tag{A.10a}$$

$$V_a^{\alpha^b\beta^{ab}}(.) \equiv \mu(W_a - S_{\alpha b} + S_{\beta a}) + (1-\mu)S_{\beta a},$$

$$\tilde{V}_a^{\alpha^b\beta^{ab}} \equiv V_a^{\alpha^b\beta^{ab}}(\tilde{g}_a^{\alpha^b\beta^{ab}}, \tilde{g}_b^{\alpha^b\beta^{ab}}, \pi_{\beta a}, \pi_{\alpha b})$$

$$\tilde{g}_b^{\alpha^b\beta^{ab}} = \underset{g_b}{\text{argmax}}\ V_b^{\alpha^b\beta^{ab}}(g_a, g_b, \pi_{\beta b}, \pi_{\beta a}, \pi_{\alpha b}), \tag{A.10b}$$

$$V_b^{\alpha^b\beta^{ab}}(.) \equiv \mu(W_b - S_{\beta a} + S_{\alpha b}) + (1-\mu)(S_{\alpha b} + S_{\beta b}),$$

$$\tilde{V}_b^{\alpha^b\beta^{ab}} \equiv V_b^{\alpha^b\beta^{ab}}(\tilde{g}_a^{\alpha^b\beta^{ab}}, \tilde{g}_b^{\alpha^b\beta^{ab}}, \pi_{\beta b}, \pi_{\beta a}, \pi_{\alpha b}).$$

The interpretation of these conditions is similar to the one given for conditions (A.6a)–(A.6b). Inequality $\tilde{V}_a^{\alpha^b\beta^{ab}} \geq \tilde{V}_a^{\alpha^b\beta^b}$ in (A.9a) can be written as $\pi_{\beta a} \leq \pi_4 \equiv \hat{\pi}_{\beta a}^D + (1+m)f^4$. Solving the equations in (A.9a) and (A.9b) for $\pi_{\alpha a}$, we finally get the best response function of firm α in region a:

$$\pi_{\alpha a}^*(\pi_{\beta a}) = \begin{cases} \pi_8 & \text{if } \pi_{\beta a} \leq \pi_4, \\ \pi_9 + \frac{1+m}{m}(\hat{\pi}_{\beta a}^D - \pi_{\beta a}) & \text{if } \pi_4 < \pi_{\beta a} \leq \pi_6, \\ \hat{\pi}_{\alpha a}^D & \text{if } \pi_{\beta a} > \pi_6, \end{cases} \tag{A.11}$$

where π_8 is defined in Figure 2, in which the graph of $\pi_{\alpha a}^*(\pi_{\beta \alpha})$ is shown as the dotted curve.

From (A.8) and (A.11), it is then immediate to see that lobbying by both firms in region a admits a set of Nash equilibria, defined by the profit pairs $(\pi_{\alpha a}, \pi_{\beta a})$ such that

$$\pi_{\beta a} = \pi_6 + \frac{m}{1+m}(\hat{\pi}_{\alpha a}^D - \pi_{\alpha a}), \quad \pi_7 \leq \pi_{\alpha a} \leq \pi_8. \tag{A.12}$$

By symmetry, the same set of Nash equilibria, this time in the profit pairs $(\pi_{\beta b}, \pi_{\alpha b})$, arises from lobbying by both firms in region b. Introducing a profit-distribution parameter $\sigma \in [0,1]$, the set of Nash equilibria (A.12) can thus be expressed as in (26) and (27) in the text. Finally, equilibrium contributions of the game D, shown in (28)–(29), are obtained from substitution of optimal public good supplies and profits into the contribution functions.

B Appendix: Lobbying for the market

B.1 Proof of Lemma 1

We first derive the optimal public goods levels by maximizing $W^{J_a K_b} = W_a^{J_a K_b} + W_b^{J_a K_b}$, $J, K = \{H, F\}$, as defined in (33)–(36), with respect to g_a and g_b. This gives

$$\hat{g}_a^{H_a H_b} = \hat{g}_b^{H_a H_b} = \hat{g}_a^{H_a F_b} = \hat{g}_b^{F_a H_b} = 3H^2,\ \hat{g}_a^{F_a F_b} = \hat{g}_b^{F_a F_b} = \hat{g}_b^{H_a F_b} = \hat{g}_a^{F_a H_b} = 3F^2.$$

Monopoly profits when supplying the home and the foreign region are $3H^4$ and $3F^4$, respectively. Thus, given S_ρ^H and S_ρ^F, with $0 \leq S_\rho^H \leq 3H^4$ and $0 \leq S_\rho^F \leq 3F^4$, the politician's value functions in the four possible cases are

$$V^{H_aH_b} = \mu\frac{9H^4}{2} + (1-\mu)(S_\alpha^H + S_\beta^H) + 2\mu\bar{y},$$
$$V^{H_aF_b} = \mu\frac{9(H^4+F^4)}{4} + (1-\mu)(S_\alpha^H + S_\alpha^F) + 2\mu\bar{y},$$
$$V^{F_aH_b} = \mu\frac{9(H^4+F^4)}{4} + (1-\mu)(S_\beta^H + S_\beta^F) + 2\mu\bar{y},$$
$$V^{F_aF_b} = \mu\frac{9F^4}{2} + (1-\mu)(S_\alpha^F + S_\beta^F) + 2\mu\bar{y}.$$

Consider firm α (the same argument holds true for firm β). Given S_β^H and S_β^F the government chooses H_aH_b if and only if $V^{H_aH_b} \geq V^{H_aF_b}$, $V^{H_aH_b} \geq V^{F_aH_b}$, $V^{H_aH_b} \geq V^{F_aF_b}$; after some algebra these inequalities reduce to $S_\alpha^H \geq T^H(S_\beta^F)$ and $S_\alpha^F \leq T^F(S_\beta^H)$, where

$$T^H(S_\beta^F) = \max\left\{-\frac{9\mu(H^4-F^4)}{4(1-\mu)} + S_\beta^F,\ 0\right\},$$
$$T^F(S_\beta^H) = \min\left\{\frac{9\mu(H^4-F^4)}{4(1-\mu)} + S_\beta^H,\ 3F^4\right\}.$$

Analogously one gets that the government chooses F_aF_b if and only if $S_\alpha^H \leq T^H(S_\beta^F)$ and $S_\alpha^F \geq T^F(S_\beta^H)$, H_aF_b if and only if $S_\alpha^H > T^H(S_\beta^F)$ and $S_\alpha^F > T^F(S_\beta^H)$, and F_aH_b if and only if $S_\alpha^H < T^H(S_\beta^F)$ and $S_\alpha^F < T^F(S_\beta^H)$. The profit function of the firm is then defined as

$$\Pi_\alpha(S_\alpha^H, S_\alpha^F; S_\beta^H, S_\beta^F) = \begin{cases} 3H^4 - S_\alpha^H & \text{if } S_\alpha^H \geq T^H(S_\beta^F) \text{ and } S_\alpha^F \leq T^F(S_\beta^H), \\ 3F^4 - S_\alpha^F & \text{if } S_\alpha^H \leq T^H(S_\beta^F) \text{ and } S_\alpha^F \geq T^F(S_\beta^H), \\ 3(H^4+F^4) - S_\alpha^H - S_\alpha^F & \text{if } S_\alpha^H > T^H(S_\beta^F) \text{ and } S_\alpha^F > T^F(S_\beta^H), \\ 0 & \text{if } S_\alpha^H < T^H(S_\beta^F) \text{ and } S_\alpha^F < T^F(S_\beta^H). \end{cases}$$

Profit maximization requires the firm to set $S_\alpha^H = T^H(S_\beta^F) + \varepsilon$ and $S_\alpha^F = T^F(S_\beta^H) + \varepsilon$, with $\varepsilon > 0$ as close as possible to zero. Since the same profit maximizing behavior holds true for firm β, the two firms will engage in a Bertrand-type competition in contributions, leading to the unique Nash equilibrium (pure) strategy profile: $\hat{S}_\rho^F = 3F^4$ and $\hat{S}_\rho^H = \max\left\{\hat{T}^H, 0\right\}$, with $\hat{T}^H = T^H(\hat{S}_\rho^F)$ as defined in (38). The corresponding politician's value function (39) follows immediately by substituting $\hat{S}_\rho^H$ into the expression for $V^{H_aH_b}$ above. ■

B.2 Proof of Proposition 3

From $\hat{T}^H = 0$, with $\hat{T}^H$ defined in (38), one gets

$$\mu_2(\delta; c) = \frac{4F^4}{F^4 + 3H^4}, \tag{B.1}$$

where H and F are defined in (32). Eq. (B.1) divides the closed set $S = (\mu, \delta) \in [0,1] \times [1, \delta_{\max}]$ in two regions (see Figure B.1): $\hat{S}^H > 0$ for $\mu < \mu_2$, and $\hat{S}^H = 0$ otherwise. $\mu_2(\delta; c) \in C^2$ is monotonically decreasing in δ, with $\mu_2(1; c) = 1$ and $\mu_2(\delta_{\max}; c) = \frac{4}{49} = .082$.
From

$$\hat{V}^{hf} - \mu\frac{9H^4}{2} - 2(1-\mu)\hat{T}^H - 2\mu\bar{y} = 0$$

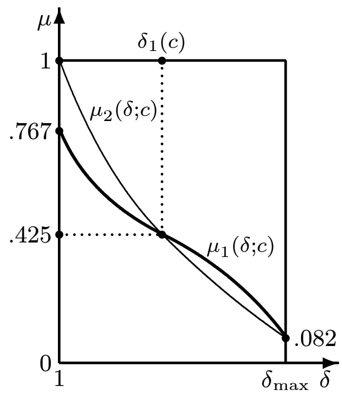

Figure B.1: An illustration of Proposition 6

it is

$$\mu_1(\delta;c) = \frac{12F^4}{3F^4 + [(h+f)^2 + 2(h^2+f^2)]^2}, \tag{B.2}$$

where h and f are defined in (5). One can see that $\mu_1(\delta;c) \in C^2$, $\mu_1(1;c) = \frac{972}{1267} \cong .767$, $\mu_1(\delta_{\max};c) = \frac{4}{49}$, and that $\mu_1(\delta;c)$ and $\mu_2(\delta;c)$ have a unique intersection at $\delta = \delta_1(c) \equiv \frac{5+17c}{22c}$ for $\delta \in [1, \delta_{\max})$, for which $\mu = \frac{334084}{786289} \cong .425$. Thus, for $\delta \in [1, \delta_1]$, the locus defined by Eq. (B.2) separates the subset of S in which $\hat{S}^H > 0$ into two subsets such that: $\hat{V}^{hf} > \hat{V}^H$ for $\mu > \mu_1$ and $\hat{V}^{hf} \leq \hat{V}^H$ otherwise, proving the first part of the proposition. For $\delta \in (\delta_1, \delta_{\max})$, if $\mu \leq \mu_1$ then $\hat{V}^{hf} < \hat{V}^H$ since $\mu_1 > \mu_2$. If $\mu \geq \mu_2$ then $\hat{S}^H = 0$, while if $\mu < \mu_2$ then $\hat{S}^H > 0$. Define $\Psi(\mu, \delta; c) = \hat{V}^{hf} - \mu\frac{9H^4}{4}$, $\Psi \in C^2$. Since $\Psi(\mu, 1; c) > 0$, $\Psi(\mu, \delta_{\max}; c) = 0$ and there is a unique root at $\delta = \delta_1$ for $\delta \in [1, \delta_{\max})$, then $\Psi < 0$ for all $\delta \in (\delta_1, \delta_{\max})$, proving that only the home firm enters the market without paying any contribution. ■

B.3 Proof of Lemma 2

The proof is conducted in three steps.

Step 1. Both regional governments admit one firm only. By deriving the optimal public goods levels through the maximization in g_a and g_b, respectively, of $W_a^{J_a K_b}$ and $W_b^{J_a K_b}$, $J, K = \{H, F\}$, as defined in (33)–(36), and given S_ρ^H and S_ρ^F, $\rho = \{\alpha, \beta\}$, with $0 \leq S_\rho^H \leq 3H^4$ and $0 \leq S_\rho^F \leq 3F^4$, we obtain region a politician's value functions in the four possible cases

$$\begin{aligned}
V_a^{H_a H_b} &= \mu\frac{9H^4}{4} + (1-\mu)S_\alpha^H + \mu\bar{y}, \\
V_a^{H_a F_b} &= \mu\left(\frac{9H^4}{4} + F^4\right) - \mu S_\alpha^F + (1-\mu)S_\alpha^H + \mu\bar{y}, \\
V_a^{F_a H_b} &= \mu\frac{F^4}{4} + S_\beta^F + \mu\bar{y}, \\
V_a^{F_a F_b} &= \mu\frac{5F^4}{4} - \mu S_\alpha^F + S_\beta^F + \mu\bar{y}.
\end{aligned}$$

Given S_β^F, it is a (weakly) dominant strategy for region a (and symmetrically the same holds true for region b) to choose the home firm if and only if $V_a^{H_aH_b} \geq V_a^{F_aH_b}$ and $V_a^{H_aF_b} \geq V_a^{F_aF_b}$. These two inequalities are satisfied for the same condition, i.e.

$$S_\alpha^H(S_\beta^F) \geq \max\left\{-\frac{\mu(9H^4 - F^4)}{4(1-\mu)} + \frac{S_\beta^F}{1-\mu}, 0\right\}.$$

Bertrand competition in contributions implies that $\hat{S}_\rho^F = F^4$ and thus it is

$$\hat{S}_\rho^H = \max\left\{-\frac{\mu(9H^4 - F^4)}{4(1-\mu)} + \frac{F^4}{1-\mu}, 0\right\},$$

proving Equation (40) in the lemma. One needs to check that $\hat{S}_\rho^H \leq 3H^4$. For $\mu \neq 1$, this requires $\mu(\delta) \leq \mu^T(\delta) \equiv 4\frac{3H^4-F^4}{3H^4+F^4}$. By recalling (32), it is immediate to show that it is $\mu^T(1) = 2$ and $\frac{\partial \mu^T(\delta)}{\partial \delta} > 0$. Hence $\hat{S}_\rho^H$ is always smaller than the profits realized in the home region.

Thus, when one firm only is allowed to enter a regional market, the home firm wins the contest for the market and the politician's value function (in each region) is $\hat{V}_a^{H_aH_b}$ in Table 1.

Step 2. Both regional governments allow both firms in their domestic markets. This case has been examined in Section 3, where policy without lobbying has been described. Using the optimal public good provision given in (14) and substituting it into (11), region a politician's value function when both firms are allowed to enter their market is $\hat{V}_a^{hf_ahf_b}$, shown in Table 1.

Step 3. One regional government admits one firm only and the other one admits both. Suppose, without loss of generality, that region a lets both firms in, while region b allows only one of them to enter its regional market. If firm β gets region b's market, social welfare becomes

$$\begin{aligned} W_a^{hf_aH_b} &= \mu\frac{(h+f)^2 g_a + 2h^2 g_a}{2} - \frac{g_a^2}{4}, \\ W_b^{hf_aH_b} &= \mu\frac{3H^2 g_b + 2f^2 g_a}{2} - \frac{g_b^2}{4} + (1-\mu)S_\beta^H. \end{aligned}$$

On the other hand, in the case in which firm α gets region b's market, the corresponding social welfare functions are

$$\begin{aligned} W_a^{hf_aF_b} &= \mu\frac{(h+f)^2 g_a + 2h^2 g_a + 2F^2 g_b - 2S_\alpha^F}{2} - \frac{g_a^2}{4}, \\ W_b^{hf_aF_b} &= \mu\frac{F^2 g_b + 2f^2 g_a + 2S_\alpha^F}{2} - \frac{g_b^2}{4} + (1-\mu)S_\alpha^F. \end{aligned}$$

By maximizing each regional social welfare function in the local public good supply, one obtains the corresponding politicians' value functions

$$\begin{aligned} \hat{V}_a^{hf_aH_b} &= \mu\frac{[(h+f)^2 + 2h^2]^2}{4}, \\ V_b^{hf_aH_b} &= \mu\frac{9H^4 + 4f^2[(h+f)^2 + 2h^2]}{4} + (1-\mu)S_\beta^H, \\ V_a^{hf_aF_b} &= \mu\frac{[(h+f)^2 + 2h^2]^2 + 4F^4}{4} - \mu S_\alpha^F, \\ V_b^{hf_aF_b} &= \mu\frac{F^4 + 4f^2[(h+f)^2 + 2h^2]}{4} + S_\alpha^F. \end{aligned}$$

Region b allows firm β in if and only if $V_b^{hf_aH_b} \geq V_b^{hf_aF_b}$ that requires

$$S_\beta^H(S_\alpha^F) \geq \max\left\{-\frac{\mu(9H^4 - F^4)}{4(1-\mu)} + \frac{S_\alpha^F}{1-\mu}, 0\right\}.$$

By Bertrand competition, $\hat{S}_\alpha^F = F^4$ and

$$\hat{S}_\beta^H = \max\left\{-\frac{\mu(9H^4 - F^4)}{4(1-\mu)} + \frac{F^4}{1-\mu}, 0\right\},$$

where $\hat{S}_\beta^H > 0$ for $\mu < \frac{4F^4}{9H^4 - F^4}$. Moreover, by the same argument in Step 2, $\hat{S}_\beta^H \leq 3H^4$. Thus, substituting $\hat{S}_\beta^H$ into $V_b^{hf_aH_b}$ the region b politician's value function is $\hat{V}_b^{hf_aH_b}$ in Table 1. The same applies symmetrically when region b let both firms in, while region a allows only one of them to enter its regional market. ■

B.4 Proof of Proposition 5

Considering the game in Table 1, it is a (weakly) dominant strategy for both regions to admit one firm only if and only if $\hat{V}_a^{hf_aH_b} \geq \hat{V}_a^{hf}$ and $\hat{V}_a^{H_aH_b} \geq \hat{V}_a^{hf_aH_b}$. These inequalities imply (i) $\mu \leq \mu_6(\delta; c) \equiv \frac{4F^4}{[(h+f)^2+2h^2]^2}$ for $\mu < \mu_5(\delta; c)$, where $\mu_5(\delta; c)$ is defined in (41), and (ii) $\mu\{9H^4 - [(h+f)^2 + 2h^2]^2\} \geq 0$ for $\mu \geq \mu_5(\delta; c)$. Condition (ii) is always satisfied for all $\delta \in [1, \delta_{\max}]$ and $c \in (0, 1)$; hence one-firm in each region is the unique Nash equilibrium for $\mu \geq \mu_5(\delta; c)$. As for condition (i), it is always satisfied for all $\delta \in [1, \delta_{\max}]$ and $c \in (0, 1)$, since $\mu_6(\delta; c) \geq \mu_5(\delta; c)$. The latter inequality follows by a continuity argument from $\mu_6(1; c) = \frac{36}{55} > \mu_5(1; c) = \frac{1}{2}$, $\mu_6(\delta_{\max}; c) = \mu_5(\delta_{\max}; c) = \frac{4}{143}$, and $\mu_6(\delta; c) \neq \mu_5(\delta; c)$ for all $\delta \in [1, \delta_{\max})$. Hence one-firm in each region is the unique Nash equilibrium also for $\mu < \mu_5(\delta; c)$. In both cases, by Lemma 2, it is the home firm to gain access to the market. ■

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