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ABSTRACT

How to Win a Decision in a Confederation*

This Paper deals with collective decision making within a group of independent jurisdictions. The right to choose the public policy is delegated from the central authority of one of the jurisdictions through a bidding procedure among the group members. We identify the following trade-off: competition among jurisdictions yields higher transfers to the government, but the outcome tends to be less efficient than when jurisdictions negotiate prior to the decision-making process. We extend and illustrate the model by means of a public good game involving several heterogeneous jurisdictions.

JEL Classification: D44, D62, H41 and H70
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1 Introduction

The on-going process pushing toward more economic integration among nations, on the one hand, and more political decentralization within nation-states, on the other, has led to the emergence of a large array of new institutional systems. Acting at different levels, these systems have been designed to make collective decisions that affect several nations, regions or municipalities. The setting that motivates this paper may be described as a *confederation* that brings together various independent jurisdictions (think of the European Union as an example). The government of the confederation is a non-state authority (e.g. the European Commission), which does not have the usual attributes of a government. For example, it is not elected or does not have the power of raising taxes. Nevertheless, this government has the right to make decisions regarding specific issues on which the constituting jurisdictions have agreed upon. It also has a budget given by the jurisdictions, which allows it to finance particular actions at the level of the confederation (e.g. the Politique Agricole Commune).

A lot of attention has been paid to the working of federations such as the United States, Canada or Germany. In the canonical model of public economics, the federal government maximizes some global welfare function involving the well-being of all members of the federation. In the public choice literature, the decision within the federation is typically made according to some voting schemes (Mueller, 1989).[1] In modern fiscal federalism, it is recognized that the federation members often have conflicting interests that lead them to compete in taxes and subsidies, very much as firms compete in oligopolistic markets (Wildasin, 1988; Wilson, 1999).[2] In a different (but related) context, local public goods may be supplied by land developers competing to attract residents (Pines, 1991; Henderson and Thisse, 2001) or by private governments that supplement services provided by the public sector (Helsley and Strange, 1998). More recently, the lobbying approach has been used to explain how some jurisdictions manage to finance local public goods through federal subsidies at the expense of other jurisdictions (Persson and Tabellini, 1999).

In this paper, we propose a positive model that seems more suitable

[1] For example, residents are voters who, according to the median voter rule, choose the quantity of public goods and the taxation scheme to be established within the community.

[2] Jehiel (1997) analyzes the situation in which jurisdictions determine their levels of tax and of public good through bargaining.

to the working of a confederation of the type described above.[3] First, we view the government as being a two-sided Janus. On the one hand, it is a benevolent dictator in that it cares about the overall level of welfare within the confederation. On the other, the government has a Leviathan side, which may reflect the influence of its bureaucracy: it aims at increasing its budget.[4] As a result, the government is modeled as an agent whose preferences are defined on these two variables. Second, quite a few decisions made by the government cannot be cast under the form of a compromise between the members of the confederation - think of the decision of launching a GPS satellite program by the EU, the choice of a common standard to be imposed across the whole territory of the Union, or of some trade agreements that may favor particular jurisdictions at the expense of the others.[5] In such a context, it is critical to account for the likely existence of a conflict between jurisdictions regarding the choice of the policy as well as the fact that this policy may affect differently the jurisdictions through various channels. In other words, we are in a setting in which jurisdictions compete for the right of implementing their most preferred policy, which in turn generate spillover effects across the confederation members.

Given these provisos, we then assume that *the right to choose the public policy is delegated from the government to one of the jurisdictions through a bidding procedure among the confederation members*. As said in the foregoing, our motivation for this modeling strategy is based on the idea that the government may not be able or allowed to find a compromise between jurisdictions, or to enforce it, or both. This may be so because the public policy involves some strong indivisibilities or because reaching such a compromise appears to be a very hard task within the political arena in which the central authority has no constitutional rights. Or it might be that if the central authority were allowed to look for compromises, it would be the subject of heavy lobbying activities, which a number of jurisdictions might not be willing to see. In such a context, it might be more effective to "delegate"

[3]Our model may also describe decision making within federations with lose ties, such as Nigeria or Russia.

[4]**This may also be because the central authority is free to use its own budget at will while making a decision that requires the funding of jurisdictions generally must follow heavier procedures.**

[5]This feature is explicitly accounted for by King *et al.* (1993) who consider a bidding procedure among jurisdictions in order to attract a firm's investment. In their model, the firm is the auctioneer.

the decision to one of the group members through a competitive procedure in which each jurisdiction has the potential right to win the decision. Of course, in order to participate to the bidding, a jurisdiction must be a member of the confederation, which therefore provide jurisdictions with the reason for being a member of the confederation. Moreover, the bidding procedure considered here is less "squared" than what it might look at first sight, for at least two reasons. First, the winning jurisdiction must compensate the government, hence the whole confederation, for the right of deciding. Second, the central authority may bias the procedure (in a way that will be made clear below) to favor jurisdictions that are not able to really compete with the others, possibly because of their limited means. Clearly, in doing so, the government helps keeping the stability of the confederation.

Formally, the decision procedure is modeled as a second price auction in which the winning jurisdiction - the one who has offered the highest contribution - gets the right of implementing its most-preferred policy in exchange for the second highest contribution (to be transferred to the central authority budget).[6,7] Several reasons justify this choice. First, as is well known, in simple contexts without externalities, the second price auction leads agents to reveal (through their bids) the private (monetary) value they attach to a particular decision. In this case, the auction mechanism leads to the efficient decisions, namely the ones for which agents are ready to pay most.[8] Second, the second price auction is simple to design and is easy to implement. It is thus a fairly transparent decision procedure. Last, by modeling the bidding process as an auction, we allow the jurisdictions to compete a priori on equal footing while allowing the jurisdiction for which the decision is most valuable to win the right to decide.[9]

[6]In the complete information setup considered in this paper, first price auctions would yield the same analysis as second price auctions.

[7]An alternative interpretation of the timing of the game is that the jurisdiction's most-preferred policy as the outcome of a (possibly long) bargaining process within the jurisdiction itself to which it is (more or less) committed (and agents contributing to the choice of the decision are very small, hence non-strategic).

[8]This holds true even if agents have private information on their valuations as shown by Vickrey (1961).

[9]This is appealing to us because we consider a jurisdiction's most-preferred action as the outcome of a bargaining process within the jurisdiction itself. The fact that the agreement of the jurisdiction's members is required prevents the jurisdiction from offering a schedule specifying an offer that would vary with the action taken by the government, as in Bernheim and Whinston (1986). Indeed, such a fine-tuning policy would generate

A key feature of our framework is that we allow for the case in which *all the members of the confederation are affected by the policy effectively chosen by the winning jurisdiction.* This implies that the collective decision process is modeled as an auction with externalities (Jehiel and Moldovanu, 1996). Our approach is nevertheless broader in that it can deal with more sophisticated institutional arrangements. In particular, we will see how cooperation between jurisdictions may affect the outcome of the procedure. We also allow the government to influence the collective decision making process itself by "biasing" the bidding among jurisdictions.[10]

It remains to clarify what the bid paid by the winner means in the present context. Clearly, it may be interpreted as a rebate on the transfers that occur from the central authority to the jurisdictions. In the political arena, this bid may also be viewed as a reduced form for all the indirect benefits generated by the activities of the winning jurisdiction at the global level. For example, France may act as an intermediary in some negotiation between the EU and some African countries that were former colonies.

In the first part of the paper, we describe the delegation game. In the two jurisdiction case, we observe that competition leads to the efficient decision from the global standpoint when the choice is restricted to the sole most-preferred policies of the two regions. Besides, the government receives a positive transfer from the winning jurisdiction through the bidding procedure. When jurisdictions negotiate before the decision process, the door is being open to the possible implementation of alternative decisions that may be more efficient. But the cost is that the government receives no transfer anymore. This leads to the following trade-off: *competition between jurisdictions is good for the central authority budget, but it may induce a less efficient outcome at the global level than cooperation.*

When there are three (or more) jurisdictions, things get much more complicated, but richer phenomena may arise. For example, it may be that jurisdictions A and B are better off when all jurisdictions, say A, B, C,

many practical difficulties within the jurisdiction that seem to be out of reach in practice.

[10]Here different interpretations may be retained. In one of them, the government chooses biases in order to account for the general interest of the federation, an approach which agrees with the canonical model of public economics. However, other interpretations are also possible: for example, as argued in the public choice literature, the federal government could bias the auction in favor of its constituency. Hence, it seems fair to say that our modeling strategy leads to a richer set of possible interactions between jurisdictions than the one encountered in standard auctioning models.

compete than when A and B negotiate first while competing with C. This echoes a phenomenon referred to as the merger paradox in the industrial organization literature (Salant *et al.*, 1983), although the channel through which this occurs here is quite different. When only two jurisdictions, say A and B, can possibly win the decision while the others have absolutely no chance whatsoever, we characterize the optimal bias the central authority should use in the delegation game to maximize aggregate welfare. We observe that the bias should be solely determined by the comparison between how the left aside jurisdictions value the most preferred policies of A and B. That is, even when the government cares about the welfare of jurisdictions A and B, the bias should not take them into account, as they are already accounted for in the bidding procedure.

Although simple, our model is fairly general and may be used to address various specific issues, and so at different levels of decisions (from the international to the local). In order to illustrate this potential, we highlight its working in the second part of the paper by considering a more structured setting. More precisely, we focus on the case where the public decision is given by the quantity of a public good to be supplied to an arbitrary number of jurisdictions, whereas its cost is shared among them according to a pre-specified rule. The indivisibility associated with the public decision mentioned above is reflected in the fact that the *same* quantity of the public good has to be chosen for *all* the confederation members, although jurisdictions are heterogenous in both the benefit they receive from and the share they pay for this public good.[11] We show that there always exists an equilibrium in which the winner is the jurisdiction with the largest financing share. We also study how the distribution of the most-preferred quantity of public good affects the outcome of the game, and show that it may vastly differ from the (simple majority) voting outcome. When the jurisdictions with the highest financing shares lie at the extremes of the distribution, the winning jurisdiction is typically far from the median one.

[11]Hence, we differ from the standard setting in which the public good is specific to each interest group (Persson and Tabellini, 1999).

2 An Auction Model of Delegation in a Confederation

2.1 The model

We consider an institutional setting formed by $n+1$ agents, i.e. one (central) *government* and n *jurisdictions* (also called locales). In accord with what we said in the introduction, we take the view that the central authority is nonstrategic in that the jurisdictions are the only players in the game. However, the government is not indifferent about the outcome of the game among jurisdictions because it is endowed with a utility which increases in the welfare level within the confederation as well as in the amount of resources available that allow it to implement policies at the global level.[12] Such a setting is designed to capture the role of a central authority which has no constitutional rights, such as the European Commission within the EU, but which is able to take some actions through delegation as well as to make some transfers to the jurisdictions.[13]

A public policy must be chosen and which policy is selected affects differently the various jurisdictions. Formally, the choice space is described by a set S of policies. Each jurisdiction i has a utility $u_i(s, m_i)$ defined over $S \times R$ where $s \in S$ and $m_i \in R$ stands for the numéraire held by i. For simplicity, it is assumed that each utility is quasi-linear

$$u_i(s, m) = v_i(s) + m_i$$

and that each jurisdiction has a single most-preferred policy denoted

$$s_i^* = \arg\max_{s \in S} v_i(s) \qquad i = 1, ..., n$$

If jurisdiction i gets the right of choosing the public policy, it should be clear that it will choose to implement s_i^* since this policy corresponds to its most-preferred choice. Indeed, it may be argued that the locale has to choose s_i^* because this policy is precisely the outcome of a process of negotiation within the locale itself and has the nature of a compromise between the various interest groups in this locale.

[12]Observe that most of our results hold true if the government is replaced by an abstract auctioneer.

[13]Think of the Structural Funds within the EU (Martin, 1999).

Since utility is transferable, the total welfare in the confederation is given by the sum of the jurisdictions' utilities. Finally, we assume that the jurisdictions' utilities are commonly known to all of them.

We now describe the delegation game, which we call *bidding for deciding* (in short BD), as an *auction* among locales. Formally, locales simultaneously submit a nonnegative *bid*, where the bid of the jurisdiction i is denoted by $b_i \geq 0$.

The locale with the highest bid then has the right of choosing the public policy. If jurisdiction i is the winner, it must pay to the central government the second highest bid to get the right of deciding.[14] This payment may take the form of a rebate on transfers from the government to i.

The outcome of the game is described as follows. Locales submit $b_1, ..., b_n$. Without loss of generality, we may re-index them such that $b_1 \geq b_2 \geq ... \geq b_n$. If W is the set of jurisdictions with the highest bid, one locale w in W is selected with probability $1/\#(W)$ and it pays the amount b_2 to the government. The structure of payoffs is then as follows. The jurisdiction w has a payoff given by $v_w(s_w^*) - b_2$, whereas any locale $i \neq w$ receives $v_i(s_w^*)$. In this case, the central government receives a positive transfer from the winning jurisdiction equal to b_2.

2.2 The two-jurisdiction case

We start by studying the case of two locales and then show how the outcome described in the foregoing is affected when the two locales may negotiate before playing BD. The two locales are denoted $i = A, B$ and their most-preferred policy by s_A^* and s_B^*, respectively.

2.2.1 The case of competition

We assume for the moment that jurisdictions behave noncooperatively in BD.[15]

[14] Hence, we consider a second price auction and it is readily verified that our results equally hold in the case of a first price auction in which the winner has to pay its own bid with a standard tie breaking rule.

[15] We restrict ourselves to weakly undominated strategies because such a feature would emerge as an equilibrium outcome when information among players tends to be complete.

Proposition 1 *When there are two locales, there exists a unique (undominated) pure strategy equilibrium. The equilibrium bids are respectively* $b_A^* = v_A(s_A^*) - v_A(s_B^*) > 0$ *and* $b_B^* = v_B(s_B^*) - v_B(s_A^*) > 0$*. If*

$$v_A(s_A^*) - v_A(s_B^*) \geq v_B(s_B^*) - v_B(s_A^*) \quad (1)$$

then A's payoff is given by

$$v_A(s_A^*) - [v_B(s_B^*) - v_B(s_A^*)]$$

whereas B's payoff is equal to $v_B(s_A^*)$*.*

Proof. See Jehiel and Moldovanu (1996, Proposition 2).

The intuition behind this result is fairly straightforward. The net value of winning BD for, say, locale A is nonnegative and given by the difference of locale A's payoffs when A decides and when B decides. Since A (resp. B) chooses s_A^* (resp. s_B^*) when it is the winner, the expressions for the equilibrium effective bids follow immediately.. From these expressions, the equilibrium bids as given in the proposition may then be obtained.

In fact, condition (1) means that the winner has a differential surplus between the two policies s_A^* and s_B^* that (weakly) exceeds the surplus of the other locale. When the inequality is strict in (1), A is the winner. By contrast, when $s_A^* = s_B^*$ the two equilibrium bids are zero because the jurisdictions have no incentives to compete.

Observe that condition (1) implies that

$$v_A(s_A^*) + v_B(s_A^*) \geq v_A(s_B^*) + v_B(s_B^*)$$

This proposition has the following interesting implication.

Corollary 2 *In the two-jurisdiction case, the equilibrium of* BD *is efficient from the viewpoint of the confederation when the choice space is confined to the pair* $\{s_A^*, s_B^*\}$*.*

2.2.2 The case of cooperation

Once the two locales are allowed to negotiate prior to BD, the outcome may be welfare-superior because they may implement a policy other than s_A^* and s_B^*. For example, they may guarantee to themselves a (weakly) higher surplus by maximizing the sum of their payoffs and by agreeing on the corresponding policy.[16] However, for the federal government, the situation may be worse off because its revenues will be lower.

Let us elaborate on this point. Suppose there is a pre-play stage in which the two jurisdictions freely negotiate on the public policy to implement and on the bids to submit at the BD game. Since utility is transferable, any efficient mechanism will yield an outcome that maximizes $v_A(s) + v_B(s)$. Let

$$s^* \in \arg\max_{s \in S}[v_A(s) + v_B(s)]$$

be such a solution. It then follows immediately that:

Proposition 3 *Assume there is a pre-play negotiation between the two locales. Then, in equilibrium both locales agree on pursuing the same objective s^* and the federal government receives no transfer from them.*

Since there is a priori no reason for s^* to coincide with s_A^* or s_B^*, this proposition means that *negotiation will in general generate higher total welfare but lower revenues for the federal government.*

2.2.3 The strategic choice of policy by jurisdictions

So far, we have assumed that each locale was committed in implementing its ideal policy s_i^*. However, strategic considerations may induce jurisdictions to move away from their ideal policies and to choose others, depending on when players take action (the timing of the game). In fact, the BD-game assumes that each locale chooses its best policy after having gained the right of deciding. One could think of the reverse order and assume that each locale must declare the policy it wishes to implement before playing the corresponding auction subgame. Such a game may be described as follows. In the first stage, locales choose simultaneously the policies $s_1 ... s_n$ that each would implement if it were the winner of the auction; the second stage is then identical to our BD game under the proviso that jurisdiction i is committed to choose s_i, which may now differ from its utility-maximizing policy. In the two-locale case, we have:

[16] Observe that cooperation does not necessarily imply monetary transfers from one jurisdiction to the other. Very much like the bids paid by the winning jurisdiction, the benefits of cooperation may be shared between jurisdictions according to much more sophisticated means.

Proposition 4 *In the two-locale case, there exists a unique subgame perfect Nash equilibrium in (undominated) pure strategies. This equilibrium is such that*

$$s_A = s_B = s^*$$

while the equilibrium transfer is zero.

Proof. Assume that B chooses s_B. If A chooses s in the first stage, its payoff is equal to

$$\max\{v_A(s_B), v_A(s) - [v_B(s_B) - v_B(s)]\}$$

Since $v_A(s_B)$ is constant, a (weakly) dominant strategy for A is to select the policy that maximizes

$$v_A(s) - [v_B(s_B) - v_B(s)]$$

that is, the policy s^{opt} maximizing $v_A(s) + v_B(s)$, and so regardless of s_B. ■

It is worth noting that the outcome of this two-stage game is the one that maximizes total welfare.[17]

2.3 Bidding with more than two locales

2.3.1 The case of three locales

We come to the case of three locales A, B and C. We start with an existence result.[18] For $i, j = A, B, C$ and $i \neq j$, let

$$b_i^{ij} \equiv v_i(s_i^*) - v_j(s_j^*)$$

be the bid of locale i if it were to compete with jurisdiction j only. Without loss of generality, let b_C^{CB} be the minimum of all b_i^{ij}. The following bids define an equilibrium of BD: (i) locale A: b_A^{AB}; (ii) locale B: b_B^{BA}; (iii) locale C: b_C^{CB}.[19] In this case, the winner is A (resp. B) if $b_A^{AB} > b_B^{BA}$ (resp. $b_B^{BA} > b_A^{AB}$). Thus, we have shown:

[17]Unfortunately, the optimality property of this game holds only in the case of two jurisdictions. Indeed, the choice of s_i rests only upon pairwise comparisons and will not involve the maximization of the sum of all utilities.

[18]Observe that, unlike the case of two regions, there may exist several equilibria when there are three regions (see Jehiel and Moldovanu (1996)).

[19]This configuration is such that region C expects to compete with region B, whereas region A (resp. B) expects with B (resp. A).

Proposition 5 *In the case of three locales, there always exists an equilibrium in pure (undominated) strategies.*

One of the most interesting issues when there are several locales involved in BD is the possibility for some jurisdictions to negotiate prior to BD without negotiating with others. In this perspective, we find it instructive to focus on the case in which jurisdictions A and B negotiate while jurisdiction C stays away. Although in the case of two locales, A and B are always better off when they cooperate, they may be worse off when there is a third locale C which is not involved in the negotiation. In order to show it, consider the following example. Assume that the set S is given by a compact interval $[a, b]$ and that the jurisdictions' most-preferred policies s_i^* are such that $s_B^* < s_A^* < s_C^*$ while $b_A^{AB} > b_B^{BA}$, $b_A^{AC} > b_C^{CA}$ and $b_C^{CA} > b_B^{BA}$. When the three locales compete, A is the winning jurisdiction and pays b_C^{CA} to the government. As a result, the payoff of locales A and B are respectively equal to $v_A(s_A^*) - b_C^{CA}$ and $v_B(s_A^*)$.

By contrast, when locales A and B negotiate (maybe because they are neighboring jurisdictions in the space-economy), they choose a policy s_{AB}^* which maximizes $v_{AB}(s) \equiv v_A(s) + v_B(s)$. Assuming that utilities $v_i(s)$ are single-peaked, it follows that $s_B^* \leq s_{AB}^* \leq s_A^*$. In this case, the joint payoff of A and B is given by $v_{AB}(s_{AB}^*) - b_C^*$, where $b_C^* = v_C(s_C^*) - v_C(s_{AB}^*)$, if they win against locale C, or by $v_{AB}(s_C^*)$ if C wins. Thus, whenever the two inequalities

$$\begin{aligned} v_{AB}(s_A^*) - v_{AB}(s_C^*) &> v_C(s_C^*) - v_C(s_A^*) \\ v_C(s_A^*) - v_C(s_{AB}^*) &> v_{AB}(s_{AB}^*) - v_{AB}(s_A^*) \end{aligned}$$

hold, *locales A and B are worse off when they cooperate.* This is because cooperation between them makes competition with C fiercer. We face here a phenomenon of "negotiation curse".

On the other hand, when $s_A^* < s_B^* < s_C^*$ and A is still the winner in the noncooperative case, cooperation between locales A and B is always beneficial to them.

2.3.2 The case when only two jurisdictions may win the game

Consider now a political environment involving several jurisdictions but in which only two of them, A and B, have enough influence to be the winner of the bidding game. In other words, the remaining jurisdictions have no chance of winning the decision under consideration and the central government is aware of it. The preferences of the inhabitants of these jurisdictions are subsumed in the utility

$$u_0(s, m_0) = v_0(s) + m_0$$

where m_0 is the amount of the numéraire owned by those people. Because the government cares about the welfare of all jurisdictions, the auction is modified according to the following rescaling. For each jurisdiction $i = A, B$ submitting bid b_i, let

$$\widehat{b}_i = b_i + \beta_i$$

be the *effective bid* of locale i where $\beta_i \geq 0$ is the *bias* imposed by the government on locale i's bid. The jurisdiction with the higher effective bid then has the right of choosing the public policy s. If locale $i = A, B$ is the winner, it must pay to the government the second higher effective bid net of its own bias β_i to get the right of deciding. In other words, one must deduct β_i because the auction is based on effective bids $\widehat{b}_i$ that differ from the submitted bids b_i.

To fix ideas, assume that $\widehat{b}_A > \widehat{b}_B$. Jurisdiction A wins the decision and has a payoff given by $v_A(s_A^*) - \widehat{b}_B + \beta_A$, whereas jurisdiction B receives $v_B(s_A^*)$. In this case, the government obtains a transfer equal to

$$\widehat{b}_B - \beta_A = b_B + \beta_B - \beta_A$$

Observe that this payment corresponds to a subsidy to locale A when $\beta_B - \beta_A < 0$ and to a tax in the opposite case. If the government is free to choose the bias, then it will choose $\beta_A > \beta_B$ whenever the objective of A agrees more than the objective of B with the interests of the confederation.

It is readily verified that Proposition 1 can be restated as follows: the equilibrium bids are respectively $b_A^* = v_A(s_A^*) - v_A(s_B^*) > 0$ and $b_B^* = v_B(s_B^*) - v_B(s_A^*) > 0$. If

$$v_A(s_A^*) - v_A(s_B^*) + \beta_A \geq v_B(s_B^*) - v_B(s_A^*) + \beta_B \tag{2}$$

then A's payoff is given by

$$v_A(s_A^*) - [v_B(s_B^*) - v_B(s_A^*) + \beta_B] + \beta_A$$

whereas B's payoff is equal to $v_B(s_A^*)$. Observe that condition (2) implies that

$$v_A(s_A^*) + v_B(s_A^*) + \beta_A \geq v_A(s_B^*) + v_B(s_B^*) + \beta_B$$

This has the following interesting implication. If the government cares about *total* welfare, it will choose biases equal (up to a constant) to $\beta_i = v_0(s_i^*)$ because by so doing the equilibrium of BD is efficient from the viewpoint of the *whole* confederation when the choice of policies is confined to the pair $\{s_A^*, s_B^*\}$.

It is worth investigating what the role of the biases β_A and β_B becomes once locales A and B are allowed to negotiate on the choice of the public policy prior to BD. Then, in equilibrium both locales agree on pursuing the policy s^* that maximizes $v_A(s)+v_B(s)$, whereas the government pays a global subsidy equal to $|\beta_A - \beta_B|$ to locales A and B. For example, if $\beta_A > \beta_B$, then jurisdiction A will submit a positive but arbitrarily small bid while B will submit a zero bid. Given the rules of the game, these two jurisdictions will then receive $|\beta_A - \beta_B|$ from the government, thus showing that cooperation allow the two jurisdictions in question to manipulate the rules of the game to their advantage. Clearly, in such a case, the government has no incentive to bias the game between them because the policy chosen is unaffected while the transfer to the government is negative. This is to be contrasted with what we have just seen in the noncooperative case.

Since the government's budget is lower under cooperation between A and B than under competition, it does not necessarily prefer cooperation to competition. In addition, the policy s^* might well result in a much lower level of total welfare whenever the interests of the two jurisdictions diverge from those of the remaining ones, thus showing in this case the importance of biasing the delegation procedure for the stability of the confederation.

3 The Choice of Public Good through Delegation

The purpose of this section is to add more structure to the foregoing model and to apply it to a standard problem of public good provision. Specifically, we are interested in the problem in which the public policy is a pure public good supplied by the government to all jurisdictions. To do so, we consider a fairly popular model used in industrial organization and describing heterogeneous agents.

Consider an economy formed by n jurisdictions. The government must choose the amount of a pure public good z whose cost $C(z)$ is covered by the jurisdictions. Each of them has a utility function given by

$$v_i(z) = \theta_i z - \alpha_i C(z) \qquad i = 1, ..., n$$

where θ_i is the valuation of the public good in i and α_i its share in the cost of providing the public good. Therefore, jurisdictions are heterogeneous in two respects: (i) they do not equally value the public good (θ_i) and (ii) they must contribute differently to the cost of the public good according to some prespecified weights (α_i) whose sum equal one. For simplicity, we assume that $C(z) = z^2$ so that the most-preferred quantity of public good by i is uniquely defined by

$$z_i = \frac{\theta_i}{2\alpha_i}$$

We first re-state our foregoing results for two jurisdictions A and B. Proposition 1 yields the following equilibrium bids:

$$b_A^* = \alpha_A (z_A - z_B)^2 \qquad \text{and} \qquad b_B^* = \alpha_B (z_A - z_B)^2$$

so that

Proposition 6 *When there are two jurisdictions, the winning jurisdiction is the one with the larger share in financing the public good.*

Intuitively, the reason is that the jurisdiction with the larger share is more concerned with the policy effectively implemented. It is also interesting to observe that, in the present setting, the intensity of preferences for the public good has no influence on the determination of the winning jurisdiction. We find this simple result to be fairly plausible in that the most influential jurisdictions involved in the choice of the level of a public good are often those with the largest contributions to the global budget.[20]

It remains to investigate how the outcome changes when the two jurisdictions negotiate before playing BD. In this case, both jurisdictions will choose

[20]When $\alpha_A = \alpha_B = 1/2$, the winner is undetermined but the structure of payoffs is uniquely determined.

to implement the socially optimal quantity $z^* = (\theta_A + \theta_B)/2$ regardless of the way the cost of the public good is shared between them. In the special case where both jurisdictions have identical preferences ($\theta_A = \theta_B$), the BD game leads to underprovision in the public good since $\theta_i/2\alpha_i < \theta_i$, i being the winning jurisdiction with α_i exceeding 1/2. In general, the comparison between the equilibrium and optimum outcomes depends on a fairly subtle interplay between the four parameters α_i and θ_i, so that under- and over-provision of the public good may arise.

This conclusion is similar to that investigated in the fiscal competition literature that similarly asked whether decentralization in the provision of local public goods leads to under-provision. In particular, we concur with Williams' (1966) for whom whether under- or oversupply holds depends on the shape of the reaction curves. We must stress the fact, however, that our setting is quite different from the mechanism of fiscal competition developed since the work of Williams.

3.1 Existence of an equilibrium

We now return to the case of n jurisdictions and show that an equilibrium always exists. Let

$$\Delta_{ij} \equiv (z_i - z_j)^2 = \frac{1}{4}\left(\frac{\theta_i}{\alpha_i} - \frac{\theta_j}{\alpha_j}\right)^2$$

so that $\Delta_{ij} = \Delta_{ji}$.

Proposition 7 *In the BD game with n jurisdictions, there always exists a (undominated) pure strategy equilibrium. Furthermore, there is an equilibrium such that the winner is a jurisdiction with the highest share in financing the public good.*

Proof. Let

$$w \in \arg\max_{i=1,\ldots,n} \alpha_i$$

and

$$l \in \arg\max_{i \neq w} \alpha_i \Delta_{iw}$$

An equilibrium is then as follows: (i) w bids $\alpha_w \Delta_{wl}$, (ii) l bids $\alpha_l \Delta_{wl}$ and (iii) all $k \neq l, w$ bid $\alpha_k \Delta_{kw}$. Indeed, jurisdiction w is the winner because it has the highest bid so that every jurisdiction $j \neq w$ bids $\alpha_j \Delta_{jw}$; by definition of l, any jurisdiction k different from jurisdictions w and l bids below jurisdiction l so that it is optimal for jurisdiction w to bid $\alpha_w \Delta_{wl}$. The corresponding payoff structure is: w is the winner and pays $\alpha_l \Delta_{lw}$ to the government for having the right of implementing its most-preferred quantity, notwithstanding its share in the public good cost; the remaining jurisdictions only contributes to the cost $C(z_w^*)$. ■

This proof exhibits an equilibrium that has the same features as the equilibrium obtained in the two-jurisdiction case: *the winning jurisdiction is the one with the largest contribution*. However, with more than two locales, there may exist other equilibria in which the winning jurisdiction is not the one with the largest share. To show this, consider the following example.

Example 8 *There are three jurisdictions in which* $\alpha_1 > \alpha_2 > \alpha_3$ *and* $\theta_1/\alpha_1 \approx \theta_2/\alpha_2 \neq \theta_3/\alpha_3$.

Applying Proposition 7, there is an equilibrium in which jurisdiction 1 is the winner and pays $\alpha_3 \Delta_{31}$. Another equilibrium arises when jurisdiction 1 bids $\alpha_1 \Delta_{12}$ which is very small, while jurisdiction 2 (resp. 3) bids $\alpha_2 \Delta_{23}$ (resp. $\alpha_3 \Delta_{23}$). The locale 2 wins and pays $\alpha_3 \Delta_{23}$ to the government. Hence, the two equilibria differ in all respects.

In this example, locales 1 and 2 are very similar in their most-preferred policies. The two equilibria we have exhibited are such that either of these two locales free rides on the other, explaining the existence of two equilibria depending on the identity of the free rider. Clearly, there exists a third equilibrium in mixed strategies that resembles a war of attrition between jurisdictions 1 and 2, the winner of which may sometimes be jurisdiction 3.[21] We believe that such a characterization of our equilibria provides a good description of the opportunistic behavior displayed by some jurisdictions inside (con)federations.

We now provide a general characterization of the equilibria of the n-jurisdiction case. To this end, let

$$j(i) \in \arg\max_j \alpha_j (z_j - z_i)^2$$

[21] A similar war of attrition is discussed in a dynamic bargaining context by Jehiel and Moldovanu (1995) who consider a reduced form analogous to ours.

We assume from now on that the jurisdiction $j(i)$ is uniquely defined. Hence, if i is the winning jurisdiction, then $j(i)$ is the one that incurs the largest loss from not being the winner.

Proposition 9 *In any (undominated) pure strategy equilibrium of the BD game, the winning jurisdiction i is such that*

$$\alpha_i \geq \alpha_{j(i)}$$

Furthermore, when this inequality holds, there exists an equilibrium in (undominated) pure strategies in which i is the winner.

Proof. Consider first an undominated pure strategy equilibrium in which i is the winner. Every bidder $j \neq i$ has a single best reply in undominated strategies which is given by $b_j = \alpha_j(z_j - z_i)^2$. Thus, bidder $j(i)$ makes the highest bid among the competing jurisdictions and the unique best reply of i against these bids is to bid

$$b_i = \alpha_i(z_i - z_{j(i)})^2$$

This defines an equilibrium to the extent that, given these bids, i is indeed the winner, implying that $b_i \geq b_{j(i)}$ or $\alpha_i \geq \alpha_{j(i)}$.

Conversely, assume that $\alpha_i \geq \alpha_{j(i)}$. Then, the bids as just defined constitute an undominated pure strategies equilibrium in which i is the winner. ■

3.2 A characterization of the winning jurisdiction

In order to gain more insights about what the equilibria might be when there are several jurisdictions, we now explore particular, but relevant, classes of examples. Without loss of generality, the n jurisdictions can be ranked in increasing order of their most-preferred quantity of public good $z_i = \theta_i/2\alpha_i$ along a linear segment. In the first class of examples, we assume that the distribution of the α_i's is single-peaked and we re-label the locales for the one with the largest share to be jurisdiction 0, so that the others are re-indexed in a way such as those on the left (right) of 0 have a negative (positive) index, a locale with a larger (smaller) index being more distant from locale 0 on the right (left) side.

Assume that $-i < 0$ is the winning jurisdiction and let $j(-i)$ be the jurisdiction that incurs the largest loss from not being the winner, namely

$$j(-i) = \arg\max_j \alpha_j(z_j - z_{-i})^2$$

Then, it must be that $j(-i) > 0$ since we have

$$\alpha_0(z_0 - z_{-i})^2 > \alpha_{-j}(z_{-j} - z_{-i})^2 \qquad \text{for all } j > 0$$

A symmetric property holds when $i > 0$ is the winning jurisdiction, yielding $j(i) < 0$.

Proposition 10 *Assume that the distribution of the α_i's is single-peaked with a maximum reached at z_0. There exist two nonnegative numbers i^* and i^{**} such that set of possible winners of the BD-game is given by*

$$\{i; -i^* \leq i \leq i^{**}\}$$

Proof. Let

$$I^- \equiv \left\{-i; \alpha_{j(-i)} \leq \alpha_{-i}\right\}$$

By Proposition 9, I^- is the set of jurisdictions with a negative index that can win in equilibrium. Let $-i \in I^-$ and $-i^{'} > -i$. Then, we show that $-i^{'} \in I^-$. To ease the burden of notation, set $j = j(-i)$ and $j^{'} = j(-i^{'})$. By definition of $j(i)$, we have

$$\alpha_j(z_j - z_{-i})^2 \geq \alpha_{j'}(z_{j'} - z_{-i})^2 \tag{3}$$

Similarly,

$$\alpha_{j'}(z_{j'} - z_{-i'})^2 \geq \alpha_j(z_j - z_{-i'})^2 \tag{4}$$

Taking the square root of each side of (3) and (4) and adding the resulting inequalities, we obtain

$$\left(\sqrt{\alpha_j} - \sqrt{\alpha_{j'}}\right)(z_{-i'} - z_{-i}) \geq 0$$

Since $-i^{'} > -i$, it follows that $z_{-i'} - z_{-i} > 0$. Consequently, by the previous inequality we have

$$\alpha_{j'} \leq \alpha_j$$

Since $-i \in I^-$, we have

$$\alpha_j \leq \alpha_{-i}$$

Moreover, using the single-peakness of the distribution implies that

$$\alpha_{-i} \leq \alpha_{-i'}$$

Adding these three inequalities, we get

$$\alpha_{j'} \leq \alpha_{-i'}$$

thus implying that $-i^{'} \in I^{-}$.

A symmetric argument holds for the set

$$I^{+} \equiv \left\{i; \alpha_{j(i)} \leq \alpha_i\right\}$$

■

When the α-distribution is single-peaked, the winning jurisdiction must be in the vicinity of the peak, thus suggesting that *locales with very large or very low demand for public goods cannot win the right to decide.*

Let us now consider our second class of examples in which the distribution of the α_i's is ∪–shaped. We re-label the jurisdictions for the one with the smallest share to be jurisdiction 0, so that the others are re-indexed in a way such as those on the left (right) of 0 have a negative (positive) index, a jurisdiction with a larger (smaller) index being more distant from locale 0 on the right (left) side. The first and the last jurisdiction are respectively denoted $-m$ and r. If i is the winning jurisdiction, then the ∪–shaped property implies that the locale that incurs the largest loss from not being the winner is either r or $-m$:

$$j(i) \in \{-m, r\}$$

Proposition 11 *Assume that the distribution of the α_i's is ∪–shaped and that $\alpha_r > \alpha_{-m}$. There exists a nonnegative number i^*such that set of possible winners of the BD-game is given by*

$$\{i; i^* \leq i \leq r\}$$

Proof. First, any $-i$ cannot be a winner because $j(-i) = r$ and $\alpha_r > \alpha_{-i}$. Second, consider the case of $i \geq 0$. Let

$$I^{+} \equiv \left\{i \geq 0; \alpha_{j(i)} \leq \alpha_r\right\}$$

By Proposition 9, I^+ is the set of possible winners. We now show that $i \in I^+$ and $i^{'} > i$ imply that $i^{'} \in I^+$. Since $i \in I^+$ and the α-distribution is $\cup$-shaped, it must be that $j(i) = -m$. Both $i^{'} > i$ and $j(i) = -m$ imply that $j(i^{'}) = -m$. Indeed

$$\alpha_m(z_i - z_{-m})^2 \geq \alpha_r(z_i - z_r)^2$$

implies that

$$\alpha_m(z_{i'} - z_{-m})^2 \geq \alpha_r(z_{i'} - z_r)^2$$

since $z_{i'} > z_i$. Finally, $\alpha_{-m} < \alpha_{i'}$ because $\alpha_i < \alpha_{i'}$ (by the $\cup$-shaped assumption) and $\alpha_{-m} < \alpha_i$ (since $i \in I^+$). ■

A symmetric result holds when $\alpha_{-m} > \alpha_r$. It thus appears that, in the case of $\cup$-shaped distribution, *the BD game yields an outcome corresponding to the ideal policy of one the two jurisdictions with most extreme interests in the provision of public good.* Jurisdictions with intermediate demand for the public good are therefore excluded from the decision process, showing that the outcome of BD critically depends on the distribution of the α_i's.

By contrast, it is interesting to observe that, in a similar context, voting would yield the same result regardless of the distributions of the α_i's, provided that they have the same median. Consequently, it is fair to conclude that *bidding and voting tend to generate very different social outcomes.*

3.3 The formation of regional coalitions

We want discuss here the possibility for different jurisdictions to join efforts and to form a single region. Hence, here again, we supplement the BD-game by adding a region formation stage, prior to BD. We start with the case in which homogeneous locales, with the same most-preferred public good to, form a region. To illustrate, consider the special, but relevant, case in which there are two groups of jurisdictions I and J that wish the same amount of public good:

$$I = \left\{ i : \frac{\theta_i}{2\alpha_i} = z_I \right\}$$

$$J = \left\{ j : \frac{\theta_j}{2\alpha_j} = z_J \right\}$$

with $z_I \neq z_J$. However, within I (J) the locales i (j) may have different shares α_i (α_j); for simplicity, we assume that the α_i and α_j are such that the equality never holds between any two sums of these coefficients. In such a context, the relevant question is to determine which locales will belong to region A_I (A_J) since locales differ in their contributions. Of course, for a locale i to decide to join A_i, it must know what will be its contribution to the equilibrium payment when A_i is the winner of BD. To fix ideas, consider the following *proportional rule*: if P is the payment, then the share of locale $i \in A_I$ is given by

$$\frac{\alpha_i}{\sum_{k \in A_I} \alpha_k} P$$

and similarly for j. Thus, all the constitutive elements of the game are described.

Let

$$\alpha_I \equiv \sum_{i \in I} \alpha_i$$

and

$$\alpha_J \equiv \sum_{j \in J} \alpha_j$$

Proposition 12 *Assume that $\alpha_I > \alpha_J$. Then, there exists several (undominated) pure strategy equilibria but all of them are such the region A_I is winner. Furthermore, in all equilibria we have $A_J = J$ and A_I is such that*

$$\sum_{i \in A_I} \alpha_i > \alpha_J \qquad \text{and} \qquad \sum_{i \in A_I - \{k\}} \alpha_i < \alpha_J \quad \text{for any } k \in A_I \tag{5}$$

Since $\alpha_I > \alpha_J$, the members of I have the potential to form a winning region by Proposition 1. Thus, (5) means that any member of the winning region A_I is *essential* in that taking her away from the region would change the outcome of BD in favor of J.

Proof. Members of A_J are indifferent between being in the region or staying out (however, staying out is a weakly dominated strategy). By contrast, the winning region A_I contains only essential members since an inessential member would be strictly better off by dropping out, the public good being the same while her contribution would be zero. Conversely, given our payment sharing rule, the payoff of each member of A_I is proportional to α_i, which guarantees that each member of A_I is better off by being in the region than dropping out that would result in the failure of region A_I. ■

A few remarks are in order. First, the essentiality of the members of the winning region is independent of the payment sharing rule chosen and holds as long as the payment of each participant is positive. This reflects the idea that an inessential member participating to the winning region would be strictly better off by being outside of the region since the same public policy would be implemented (because it is inessential) while avoiding any payment. Second, even though there are several equilibria, the quantity of public good supplied is the same for all equilibria and equal to z_I, while the revenue of the government is also the same and equal to $\alpha_J \Delta_{ij}$ where $i \in I$ and $j \in J$. Third, the essentiality of the members of each A_I implies that the total contributions of two regions A_I and A_J to the financing of the public good are similar enough.

Another interesting question to investigate is the desirability of such large regions formed by locales with identical (similar) tastes. If they do not form, all the i and j compete within the BD game.

Proposition 13 *Whatever the equilibrium, the revenue of the government and the total welfare are never lower when two homogeneous regions are formed than when all jurisdictions play the BD game separately.*

Proof. Without loss of generality, assume that $\alpha_I > \alpha_J$. Then, the revenue of the government is

$$\alpha_J (z_I - z_J)^2 \tag{6}$$

when the two regions are formed and the quantity of public good is z_I. Consider now the BD-game in which all jurisdictions play independently. If the winner $w \in I$, the government's revenue is

$$\max_{j \in J} \alpha_j (z_I - z_J)^2$$

which is strictly smaller than (6). If the winner $w \in J$, the revenue is

$$\max_{i \in I} \alpha_i (z_I - z_J)^2$$

Furthermore, it must be that

$$\alpha_w \geq \max_{i \in I} \alpha_i$$

and, since

$$\alpha_w < \alpha_J$$

the revenue is again smaller than (6).

Regarding efficiency, the outcome when the two large regions are formed is the same as if the two complete regions were formed. So, by Proposition 1, the outcome is efficient between $\{z_I, z_J\}$ so that the game in which all jurisdictions play separately cannot be more efficient. ■

To conclude, consider the case in which there are (at least) two very heterogeneous jurisdictions. As discussed in Section 2.1, allowing these jurisdictions to negotiate is equivalent to assuming that they merge into a single region. In this case, Proposition 13 no longer holds because there is now a trade-off between the transfer the government receives from the winning region and the welfare level. Indeed, if there is a single region the welfare level is maximized across all participating jurisdictions but the government does not receive any payment. This suggests an interesting institutional recommendations that supplement those made in the foregoing: *the central authority should foster the formation of homogeneous regional coalitions but prevent that of very heterogeneous ones.*

4 Concluding Remarks

We believe that our model permits to capture some basic ingredients of collective decision making within a confederation in which the central authority does not have the powers of a standard government. Delegation also allows for a possible analysis of collective decision making each time a public decision involves some indivisible features that prevent the design of a compromise, while involving spillover effects across jurisdictions. However, as discussed throughout the paper, the transfer from the winning region as well as the biases the government may use allow one for a substantial amount of flexibility within the procedure that may lead to a rich set of outcomes. To our knowledge, this is the first time that some insights about the trade-off between competition and cooperation between jurisdictions are provided within a unified framework. Furthermore, it is worth noting that our model opens the door to a new approach regarding the formation of regional coalitions.

The model presented in this paper allows for several extensions that are left for further research. First, the cost sharing rule used in section 3 should be endogenized. Second, when the government has limited information about jurisdictions' preferences, the trade-off between competition and cooperation is likely to be affected in ways to be determined. Last, the biases used by the government should themselves be subject to external influence and be, therefore, the outcome of a game played prior to bidding for deciding.

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