

Central Governance or Subsidiarity: A Property-Rights Approach to Federalism*

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Summary

The paper reconsiders the theory of fiscal federalism in a framework inspired by property rights theory. We set up a two-period model where on a first stage a region in a federation can expend value-enhancing investments into a public project. The project can be implemented on a second stage, and causes spillovers on other regions. Under centralized as well as centralized governance, negotiations on the federal level facilitate the realization of the efficient policy. Still, non-contractibility of investments causes the overall outcome to differ across regimes. If the region with access to the public project bears the entire implementation costs of its policies, underinvestment prevails and subsidiarity (centralized governance) is superior when spillovers are weak (strong). Conversely, if linear cost sharing arrangements are feasible, decentralized authority often leads to a socially optimal outcome while centralized authority (with majority or unanimity rule) does not.

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1 Introduction

Economic theory does not offer a straightforward explanation whether authority over policy variables should be assigned to a federal or a regional level. Established federalism theories posit it as a virtue of decentralized authority that local governments are ‘closer to the people’ living in their jurisdiction and therefore perform better in catering the needs of their respective constituency. On the other hand, the merits of centralized governance are seen in its internalization of the externalities involved in public decisions [Oates (1972)]. The optimal governance structure then balances these conflicting aspects. This line of argument has an intuitive appeal, but it rests on some critical presumptions. First, policy coordination among local governments does not take place so that there is no way to account for spillovers under subsidiarity. Second, the central government maximizes overall welfare in the economy. Finally, although the center is seen as a benevolent entity, it is assumed to provide policy projects uniformly across all regions even though their preferences may be heterogenous.¹

This paper reconsiders the question of whether the decision over a public policy should be assigned to a local or the central government in a setting that is inspired by the theory of property rights [Grossman and Hart (1986), Hart and Moore (1990)]. According to this approach, ownership rights over physical assets confer authority because the owner has the right to decide on the usage of the asset in all circumstances that are not explicitly accounted for by a contractual arrangement. Despite incompleteness of contracts, the efficient use of assets can be ensured via efficient bargaining among the parties involved. Still, authority remains important because it determines the parties’ threat points in negotiations and thus, how the negotiation surplus is shared. The division of future gains from trade in turn affects the parties’ incentives to invest into their relationship. Although property rights theory has primarily focused on the optimal allocation of control rights within firms, we believe that it also provides a natural framework to address the question of authority and optimal governance structure in the context of fiscal federalism.² Incomplete contracts play a key role in the

¹These last two presumptions have evoked some criticism in the recent literature. See Lockwood (1998) and Besley and Coate (1999) which are surveyed below.

²Aghion and Tirole (1997) have noted that authority may not only result from ownership over physical assets, but more generally from a contract allocating the right to decide on specified matters to some member or group of an organization. Hence, we can reinterpret the notion of ownership rights over physical assets as the authority to take decisions over policy variables.

relationships of jurisdictions.³ Bilateral and multilateral treaties, or national constitutions, only roughly specify the rights and obligations of political actors. Mostly, these contracts are confined to assigning authority over certain political decisions, and to distribute the cost burden of policies among regions in the federation. Also, investments into the returns or costs of subsequently pursued policy projects are often so complex that they cannot be part of inter-jurisdictional arrangements. Examples of such public investments are school reforms that raise the likelihood of success of education programs, efforts in designing welfare programs that improve health care or provide aid to the poor, or industry restructuring that makes environmental regulations more beneficial. In these and other situations the subsequent policy projects are associated with inter-regional spillovers so that jurisdictions have a joint interest to negotiate a mutually beneficial agreement [Coase (1960)]. Indeed, political bargaining to align regional interests is the rule rather than the exception both in national assemblies and in supra-national federal systems as the EU.

To study the issue of regional versus federal authority in this context, we consider a simple model with two regions which are members of a federation. One region can pursue an innovative policy project with spillover effects on the other region. Prior to policy choice, the region with access to the project can invest resources that positively affect its overall return. Authority over the implementation of the policy can either be assigned to the regional, or to the federal level. Under decentralized governance, the region can unilaterally decide on the (variable) project size it likes to implement. Under centralized governance, two scenarios are distinguished. First, any deviation from the status quo (no new policy) may require the unanimous approval by all regional delegates in the federal assembly.⁴ Second, decisions on the federal level may be taken under majority rule in which case the region holding a majority in the central legislature may be able to enforce the policy it prefers.

Although local representatives solely pursue the interest of their home region, the presence of spillovers creates room for mutually beneficial policy coordination as noted above. Importantly, we allow for such coordination irrespective of the governance structure. In particular, regional delegates can negotiate an efficiency-improving agree-

³In relations between independent countries that do not form a union, one important reason for contractual incompleteness is arguably the difficulty to enforce international treaties due to lack of enforcement possibilities.

⁴This setting has been coined ‘cooperative federalism’ [Inman and Rubinfeld (1997)].

ment even under decentralized governance where the political decision right rests on the regional level.⁵ For simplicity, we assume that negotiations always ensure that the surplus-maximizing political decision is taken. Since the - for given investments - socially optimal policy decision is reached under both possible governance structures, their relative merits have to be judged with respect to the investment incentives they provide for the regions involved. Those will generally differ across regimes because authority endogenously determines the ‘disagreement’ policy which is implemented when negotiations fail. In our analysis, we also allow for cost-sharing rules that are prescribed before public investments are made: the cost incidence of policies can be determined in an initial agreement (a constitution) and determines what fraction of final policy costs the region with access to the project has to bear.⁶

Our main findings are as follows. First, if there is no cost sharing provision, decentralized authority dominates centralized governance whenever the external effect of the policy on other regions is sufficiently weak. Conversely, central authority is preferable when externalities are strong. Although this conclusion thus reinforces the standard theory, its explanation is different: the traditional view holds that decentralized authority leads to a suboptimal allocation because the region conducting a policy does not internalize spillovers in its objective function. In the present framework, policy coordination brought about by a political bargaining process removes these inefficiencies so that this argument does not apply. Rather, if spillovers are weak, there is almost no room for negotiations and the policy a region can unilaterally choose under decentralized governance is close to socially optimal. As a consequence, the region recovers almost the entire social marginal return on its investments and invests nearly efficiently. When externalities are important, in contrast, there is a large gain from policy coordination which it has to share with the other members of the federation, and investment incentives are reduced. Hence, under decentralization, strong externalities

⁵See also Klibanoff and Morduch (1995) and Persson and Tabellini (1996). In contrast, previous literature often assumes that coordination occurs only under centralized governance, while federal regions do not coordinate their policy choice under decentralized governance.

⁶Note that the allocation of decision rights over policies is logically distinct from the question of who finances those projects. Also, contrary to most contributions in the literature which assume that costs are shared equally among all federal citizens under centralized governance, and solely among regional inhabitants otherwise, we allow for more general financing rules. This generality is empirically important in light of the various cost-sharing provisions observed in practice [see Inman and Rubinfeld (1997)], and also sheds light on the economic consequences and desirability of various cost-sharing provisions.

trigger small investments and vice versa.

Under centralized authority with unanimity rule, each region can unilaterally block the implementation of the policy so that the disagreement point when negotiations fail is the status quo policy. Although negotiation always leads to the efficient project size, the investing region now has to share the entire social net surplus with others which, again, generally results in underinvestment. However, when its bargaining power vis-a-vis other federation members is large, or the externality is strong, its investment incentives are higher than under decentralization.

Second, we show that decentralized authority becomes strictly superior when cost-sharing arrangements in form of linear matching grants are feasible.⁷ In particular, an appropriately chosen linear cost matching grant allows for a socially optimal outcome under decentralized governance as long as spillovers are not too pronounced. Intuitively, the smaller the region's cost share, the larger the project it chooses when negotiations fail. Since prior investments are more valuable for larger projects, cost matching grants stimulate benefit-enhancing investments. In contrast to this positive outcome, a grant provision leaves investment incentives unaffected under centralized authority with unanimity rule because other regions can veto the project, thereby making the initial agreement obsolete. Thus, although the equilibrium outcome may entail cost sharing, this is independent of previous agreements, and so are investment incentives. Finally, we study whether inter-regional cost sharing facilitates efficient investment under centralized governance when decisions in the federal assembly are taken by majority vote. Although matching grants now affect the disagreement policy (chosen by a majority fraction in the central legislature), a socially optimal outcome remains unfeasible unless the delegates from the investing region form the majority. Intuitively, if other regions are in the majority, they can 'exploit' the minority region, thereby adversely affecting its investment incentives.

The present paper is related to some recent theoretical contributions on fiscal federalism. Ellingsen (1998), Lockwood (1998) and Besley and Coate (1999) also investigate

⁷Categorical grants are quite common. The European Union exhibits a wide variety of regional funds often in form of matching grants, most importantly the agricultural and structural funds. In some policy fields, German states are eligible for cost-sharing grants from the federal government. For example, the construction of universities is subsidized at a matching rate of 50 percent. In the US, the federal health care program Medicaid and the program Aid for Families with Dependent Children (AFDC) are currently open-ended matching programs in which the subsidy varies inversely with state income, ranging from 50 percent to 78 percent [Quigley and Rubinfeld (1996)].

the relative merits of decentralization in settings where regions within a federation conduct policies that give rise to spillovers.⁸ Ellingsen (1998) analyzes a model where regions can contribute to a pure public good, and where the policy outcome is determined by majority vote over individual contributions either in the entire economy (under centralized governance), or within each region (under decentralized governance). Under decentralized governance, free riding behavior necessarily leads to inefficiencies because a binding bilateral arrangement on regional contributions is unfeasible. Under centralization, free-riding is of no concern but the policy will be applied uniformly within the federation. Thus, inter-regional heterogeneity may render this governance structure undesirable. In Lockwood (1998) and Besley and Coate (1999), the case for decentralization arises from political economy considerations. Both papers derive policy outcomes from explicit legislative rules. Lockwood shows (rather than assumes) that under centralized authority policies will be uniform across a federation when externalities are large. Even when regions are homogeneous, this uniformity is a cost to centralized decisionmaking because the political process makes the equilibrium outcome independent from project benefits. Conversely, decentralized authority suffers from the familiar problem that interregional externalities are not internalized.⁹ Besley and Coate employ a reduced-form political economy model of policy determination. While the intra-regional political process takes place via majority vote, elected officials from each region become central decision maker with some probability. Whether centralization or decentralization is preferable depends on the degree of spillovers, the heterogeneity of districts and a parameterized weight that the central decisionmaker attaches to the interest of the other region. The authors show that centralized governance is more efficient when spillovers are small, or when the degree of heterogeneity among regions is large. Moreover, uniform policy provision under central authority is not needed to attain this conclusion.

These approaches differ from the present paper in that we assume policy coordination (resulting in mutually beneficial policy choices) to be feasible under both centralized

⁸See also Seabright (1996). In his model, centralization involves benefits from policy coordination, but has its costs in terms of a diminished probability that the welfare of a given region affects the reelection probability of the central government.

⁹In a variety of situations, the gains from decentralization are higher when regions are heterogenous or spillovers are small. However, this general finding has to be qualified because the relative efficiency of centralization is not necessarily monotonically increasing in the spillover size, and some restrictive conditions are required to show that increased heterogeneity renders decentralization more preferable.

and decentralized governance. Thus, for any given investment level, regimes do not differ in the final policy chosen (e.g., the provision of a public good). Rather, differences between governance structures emerge from the different incentives they provide to invest into the subsequent return from new public projects.¹⁰ Furthermore, we do not take the cost incidence of policies as exogenously given, but allow cost-sharing to be optimally adjusted in a way as to provide optimal investment incentives.

The remainder of this paper is organized as follows. Section 2 presents the model. Section 3 analyzes the implications of centralized and decentralized governance in absence of inter-regional cost sharing arrangements. Section 4 introduces matching grants and analyzes decentralized governance as well as centralized governance under unanimity and majority rule. Section 5 concludes.

2 A Model

Consider an economy that is divided into two jurisdictions, $j \in \{A, B\}$, which may be countries, states, or regions in a federal system. Region A has access to a public project x which has some spillover effect on the other region B .¹¹ The model has two stages: in a first stage, region A can expend public resources that increase the (uncertain) benefit of the policy measure to be pursued subsequently. For example, the project may be to build a new airport that benefits both regions and whose social value can be enhanced by investing into the surrounding infrastructure. Thereafter, in stage 2, a state of

¹⁰In that respect, our paper is related to contributions by Schmidt (1996) and Caillaud, Jullien and Picard (1996) who, however, consider frameworks with asymmetric information. Caillaud, Jullien and Picard analyze the contracting problem between a private firm which can implement a socially beneficial project, and a public authority in charge. While a regional government designs an incentive scheme that does not internalize spillovers and leads the firm to underinvest, the central government does not observe the firm's investment level which gives rise to costly informational rents. The authors show that a combination of central grants and decentralized authority is then second-best optimal because it internalizes externalities and reduces informational rents at the same time. In a privatization context, Schmidt (1996) demonstrates that a welfare-maximizing government might find it optimal to privatize a public firm. While production under private governance is inefficient because regulation proceeds under asymmetric information, the resulting informational rents which flow to a private owner induce him to expend a larger cost-reducing effort than under public governance.

¹¹As will become clear later, we can regard B as a composite entity that comprises all federal states except A . Also, the assumption that only one region pursues one policy is made for simplicity only. Our findings immediately translate to the more general case where both regions have access to (possibly multiple) policy projects.

the world is revealed and regions negotiate on the implementation of the new policy in a way that is specified in detail below. We will consider two governance structures: under decentralized governance (DG), region A has the (residual) right to decide on the policy measure. Conversely, this discretion lies with a central government under centralized governance (CG).

Regions are governed by local governments and the central government is composed of delegates from both jurisdictions. Throughout the analysis, we assume that local governments as well as regional delegates act in the best interest of their constituents. This behavioral assumption naturally holds if all individuals within a region have identical preferences. Otherwise, an intraregional voting process may select a politician who represents some weighted average of individual preferences within a region.¹²

Let $x \in [0, \bar{x}] \subset \mathbb{R}$ be the realized size of the project, e.g., the size of an airport, the quantity of a public good provided, or the rigidity of environmental standards. The prior investments of the region with access to the project (region A) are denoted by $e \in \mathbb{R}_0^+$ and the corresponding investment outlays by $\psi(e)$. In stage 2, a project of size x provides a total gross benefit measured in monetary terms of $V(x, e, \theta)$ and imposes (implementation or other) costs $C(x)$. The variable θ is a random shock that affects the projects returns and is assumed to be distributed according to a continuous cumulative distribution $F(\theta)$ on the support $[\underline{\theta}, \bar{\theta}]$. This state of the world is realized after region A expended its investments, but before the policy project has to be implemented. Benefits and costs of a ‘status quo’ policy $x = 0$ are normalized to zero.

Assumption 1. The functions $V(\cdot)$, $C(\cdot)$, and $\psi(\cdot)$ are bounded, non-negative, twice continuously differentiable, strictly increasing in their arguments, and satisfy for all e , θ and $x > 0$ (subscripts denote derivatives)

- a) $\lim_{x \rightarrow \bar{x}} V(x, e, \theta) - C(x) < 0$ and $V(x, e, \theta) - C(x) > 0$ for some $\theta < \bar{\theta}$,
- b) $V_{xx} \leq 0$, $C_{xx} > 0$, $V_{ex}(\cdot) > 0$,

¹²For the purpose of this paper, we disregard the possibility of heterogeneous intra-regional preferences so that the actual procedure of intraregional ballots is irrelevant. Heterogenous preferences can easily be incorporated in our framework, however. When the regional decisionmaker (or delegate in the federal assembly) is chosen by majority vote, the individual with median preferences would be elected under centralized as well as decentralized governance, because in our setting voters have no incentive to strategically elect individuals with different preferences than the median voter [for models where strategic delegation arises in equilibrium, see Persson and Tabellini (1992) and Besley and Coate (1999)].

c) $\psi_{ee}(\cdot) > 0$, $\psi(0) = \lim_{e \rightarrow 0} \psi_e(e) = 0$ and $\lim_{e \rightarrow \infty} \psi_e(e) = \infty$.

Parts a) and b) ensures that the socially efficient project size is strictly positive in some states θ and always less than the maximal size \bar{x} , irrespective of investments. The last assumption in b) states that public investments are socially more valuable, the larger the project. In other words, the marginal return from investments e increases in project size x . Part c) then implies some positive but finite investment level is optimal ex ante.

Region A which pursues the policy reaps a gross return of $V^A = \beta V(\cdot)$ while the return of the other region B is $V^B = (1 - \beta)V(\cdot)$. Thus, the parameter $\beta \in [0, 1]$ measures the relative spillovers of the policy pursued in A on region B . Suppose for example that x is a pure public good and all individuals in the economy have identical valuations. Then, $V(\cdot)$ is the sum of individual utilities in the overall economy, and β represents the fraction of individuals living in A while $(1 - \beta)$ indicates the fraction of individuals who live in B . The case where there are no externalities corresponds to $\beta = 1$.¹³

For subsequent reference, let us first compute the socially optimal policy level $x^*(\cdot)$ that is to be chosen at stage 2. At that date, region A has already expended its investments e and the state of the world θ has been revealed. Assuming that utility is perfectly transferable across regions (disregarding wealth effects), the efficient project size solves

$$x^*(e, \theta) = \arg \max_{x \in [0, \bar{x}]} S(x, e, \theta) \equiv V(x, e, \theta) - C(x) \quad (1)$$

where $S(\cdot)$ is the joint continuation surplus net of the costs of project provision. Under our previous assumptions, $x^*(e, \theta) > 0$ for a nonempty set of realizations θ which is then uniquely determined by the first-order condition

$$V_x(x^*; e, \theta) = C_x(x^*). \quad (2)$$

Define $S^* \equiv S(x^*(e, \theta), e, \theta)$ as the maximum surplus in stage 2 and note that S^* is independent of β and strictly increasing in e if $x^*(\cdot) > 0$.

Next, we calculate the socially optimal investment outlays e^* to be expended by region A in stage 1. These investments maximize the ex-ante expected overall surplus in the economy, i.e.,

$$e^* \in \arg \max_{e \geq 0} E_\theta [S(x^*(\cdot), e, \theta)] - \psi(e). \quad (\text{FB})$$

¹³The case of negative externalities, $(1 - \beta) < 0$ can (with appropriate adjustments) be analyzed analogously and is therefore disregarded in our formal analysis. See, however, fn. 25 below.

Again, Assumption 1 ensures that e^* satisfies the corresponding first-order condition which, using the envelope theorem, reads

$$E_{\theta} V_e(x^*(\cdot), e^*, \theta) = \psi_e(e^*). \quad (3)$$

Hence, we arrive at the familiar condition that the marginal expected returns from investments (as measured at the conditionally optimal policy level) equate their marginal costs.

Because the project is associated with spillovers, there may be gains from policy coordination before the final decision on x is taken. As mentioned before, we assume that regions can enter negotiations on the level of x to be implemented in stage 2, irrespective of whether authority over x initially lies exclusively with region A (under DG) or with the central government (under CG).¹⁴ Recall that both regions share all relevant information. Instead of explicitly modeling the procedure that leads to a final policy choice, we therefore postulate that the involved regions will agree upon the ex-post efficient project size $x^*(e, \theta)$.¹⁵ In particular, we follow the property-rights literature [e.g., Grossman and Hart (1986), Hart (1995)] and assume that the unfolding bargaining process between the representatives from each country results in the generalized Nash-bargaining solution.¹⁶ How the maximum surplus $S^*(\cdot)$ is then distributed among regions depends on a) their relative bargaining power and b) their ‘disagreement payoffs’ (threat points). Specifically, each region obtains its disagreement payoff plus a fixed share of the efficiency gains that arise from the implementation of $x^*(\cdot)$ rather than the respective disagreement policy. The shares reflect a region’s bargaining strength vis a vis the other region and are parameterized as $\gamma \in [0, 1]$ for region A and $1 - \gamma$ for region B, respectively.¹⁷ The disagreement point of each region is determined

¹⁴As stated in the Introduction, this differs from most of the existing literature which generally assumes that no inter-regional policy coordination takes place under decentralized governance, while inherent transaction costs in the political process prohibit an efficient outcome under centralization. For an exception, see the papers by Persson and Tabellini (1996) and Klibanoff and Morduch (1995) who like the present paper assume that Pareto improving negotiations are possible under decentralization as well.

¹⁵Thus, we disregard transaction costs (e.g., informational asymmetries) that may prevent the realization of an efficient outcome in the political arena. While this assumption may often be unrealistic, it is made for analytical convenience only and does not qualitatively affect the results. What is important for our conclusions is that transaction costs in negotiations do not differ across regimes.

¹⁶In general, the agreement on $x^*(\cdot)$ requires transfer payments between the regions to account for the redistributive aspects of policies. While these transfers may be monetary side payments, they can more generally be measures that enhance the payoff of the other region.

¹⁷This formulation encompasses the special cases that A has either no, or all the bargaining power

by the policy that is implemented when bargaining fails, and thus depends on the governance structure. Under DG, disagreement implies that a project size which is unilaterally optimal for region A would be implemented. In contrast, the default policy under CG depends on one of which two alternative scenarios we study: if decisions in the federal assembly have to be taken unanimously, either region can unilaterally block (veto) the realization of the project so that the disagreement point is the status quo $x = 0$. Conversely, if the decision process proceeds under majority rule, the default policy is given by the project size that is preferred by a majority in the federal assembly.

Irrespective of governance structure, however, negotiations among regional delegates ensure that $x^*(\cdot)$ is successfully realized and allocative efficiency is attained. It therefore remains to investigate whether first-best investments e^* can be implemented under any of the two possible regimes DG and CG. We can thus explore the relative merits of centralized governance and subsidiarity for different parameters of our model. In doing so, we first consider in Section 3 an institutional structure where the policy costs $C(\cdot)$ are exclusively borne by citizens from region A . Alternatively, region A may be eligible for (federal) cost-sharing grants financed by both regions. Such cost-sharing arrangements are analyzed in Section 4 below.

3 Federal System without Cost-sharing

3.1 Decentralized Governance

In a federal state with decentralized authority, region A can unilaterally decide on the project size x that is provided at date 2. As has been argued above, however, negotiations with other regions within the federation may lead A to implement another policy than it would decide upon non-cooperatively. In this section, we assume that the regions either signed no agreement prior to stage 1, or that the federal constitution does not comprise any cost-sharing provisions. In both cases, the costs of policies are solely borne by region A .

Recall that A 's gross surplus at date 2 from a policy x is $\beta V(x, e, \theta)$. Hence, unless

in negotiations and can submit a take-it-or-leave-it offer to other regions. In general, though, some intermediate distribution of net benefits may well prevail.

negotiations with region B are successful, A chooses a project size so as to maximize $S^A \equiv \beta V(x, e, \theta) - C(x)$. If the corresponding non-cooperative level $x^A(\cdot)$ is positive, it is implicitly determined by

$$\beta V_x(x^A, e, \theta) = C_x(x^A), \quad (4)$$

and increasing in e . Comparing (2) and (4) reveals that $\beta < 1$ and $x^* > 0$ imply $x^A < x^*$: since region A does not take the positive external effect on region B into account, it chooses x suboptimally low.

The disagreement payoff for region A when negotiations fail is thus given by $\hat{S}^A = S^A(x^A(\cdot), e, \theta)$. Similarly, let $\hat{S} = S(x^A, e, \theta)$ be the joint surplus realized in disagreement with $\hat{S} - \hat{S}^A = \hat{S}^B$ as the default payoff to region B . Since \hat{S} is strictly smaller than the maximal surplus S^* for $x^* > 0$ and $\beta < 1$, the representatives from A and B have a joint interest to negotiate in order to implement the ex-post efficient policy $x^*(\cdot)$. Under the Nash-bargaining solution, negotiations lead both regions to split the surplus from negotiations,

$$\Delta_{DG} = S(x^*, e, \theta) - S(x^A, e, \theta) > 0$$

according to their relative bargaining powers indicated by γ and $(1 - \gamma)$, respectively. Anticipating the outcome of negotiations in stage 2, A in stage 1 chooses

$$\begin{aligned} e_{DG} \in \arg \max_e U_{DG}^A(e) &= E_\theta \left[\hat{S}^A + \gamma \Delta_{DG} \right] - \psi(e) \\ &= E_\theta \left[S^A(x^A, e, \theta) + \gamma S(x^*, e, \theta) - \gamma S(x^A, e, \theta) \right] - \psi(e). \end{aligned} \quad (DG)$$

Substituting for the expressions of S^A and S and taking derivatives with respect to e , we obtain

$$E_\theta \left[(\beta - \gamma) V_e(x^A, \cdot) + \gamma V_e(x^*, \cdot) - \gamma (V_x(x^A, \cdot) - C_x(x^A)) \frac{\partial x^A}{\partial e} \right] = \psi_e(e_{DG}), \quad (5)$$

which characterizes an interior solution for the equilibrium investment level e_{DG} . The first term on the left hand side of (5) represents the direct effect of e on those terms in region A 's objective function that stem from the disagreement point and has two components: a small increase in e raises its own disagreement payoff by $\partial \hat{S}^A / \partial e = \beta V_e$. Second, holding the default policy x^A fixed, the joint default payoff increases by $\partial \hat{S} / \partial e = V_e$ which causes a one-to-one reduction in the negotiation surplus from

which A reaps a fraction γ . The joint effect is positive if and only if $\beta V_e - \gamma V_e > 0$ or $\beta > \gamma$. The second term in (5) captures the effect of investments on maximum surplus, weighted by region A 's bargaining power γ . Finally, the last term represents the indirect effect of e on the joint disagreement surplus \hat{S} through a change in the default project size x^A , again weighted by A 's bargaining power.¹⁸ Note that $x^A < x^*$ and $\partial x^A / \partial e \geq 0$ imply that this effect is positive. As the disagreement payoff rises (the negotiation surplus falls), however, the marginal return from investment is reduced.

Analyzing condition (5) yields

Proposition 1. *Suppose there is no interregional cost-sharing. Then, public investments e_{DG} under decentralized governance (DG) are strictly lower than the socially optimal investments e^* if there are spillovers, i.e., $\beta < 1$. Only for $\beta = 1$, region A invests efficiently. If, in addition, $\partial x^A / \partial e$ is non-increasing in β , then e_{DG} is strictly increasing in β for any $\beta \in [0, 1]$.*

Proof. See the appendix.

It is important to note that the explanation for this result is quite different from the traditional argument for inefficiencies under decentralized authority where suboptimal outcomes emerge because the region that decides on x fails to take into account the external effect on other members of the federation. In our framework, this problem does not arise because negotiations among regional governments always ensure an ex-post efficient policy $x^*(\cdot)$. Still, the fact that A does not internalize B 's utility also plays a role in our setting because it affects A 's incentives to provide valuable investments prior to policy implementation, a problem which is often disregarded in the literature. In the present framework, the size of the externality affects the default policy x^A that is realized when negotiations between representatives from regions A and B fail. Although this never occurs in equilibrium, x^A influences A 's equilibrium utility and, hence, the region's return from its public investment into the project ex ante. If spillovers are absent ($\beta = 1$), for example, we have $x^A = x^*$ so that $\hat{S}^A = \hat{S} = S^*$. Then, program (DG) coincides with (FB). Since A recovers the full social return from its investments under decentralized governance, the region's public expenditures are socially optimal. For *any* spillovers ($\beta < 1$), however, the region underinvests for two reasons: first, due

¹⁸Also, since the indirect effect on \hat{S}^A is zero by the envelope theorem, this term equals the indirect effect on region B 's disagreement payoff \hat{S}^B , i.e., $\partial \hat{S} / \partial x = \partial \hat{S}^B / \partial x$.

to $x^A < x^*$, the marginal return on its own disagreement payoff falls short of the social return, and second, because lower expenditures (both directly and indirectly) decrease the disagreement surplus which benefits A in subsequent negotiations.

3.2 Centralized Governance

If decision rights are centralized, the central government C has the authority to direct the implementation of policies at stage 2. When evaluating CG, we must take into account that C does not have its own idiosyncratic agenda, but is composed of representatives from the individual regions. Most reasonably, the representatives aim to maximize the payoffs of their respective home regions in ensuing negotiations on policy measures. Again, delegates will agree upon an ex-post efficient policy. Throughout the present subsection, we suppose that decisions in the federal assembly require unanimity, which means that no policy can be implemented unless the delegates from all regions in the federation agree.¹⁹ An important example for this scenario is the European Union, where each country in a variety of policy fields has veto power on the implementation of new projects. In the EU, policy areas that are subject to unanimity include taxation, industry, culture, as well as the provision of regional and social funds [see, e.g., European Commission (2000)].

If decisions in the federal assembly have to be taken unanimously, either region can unilaterally veto the realization of the project. Thus, the disagreement payoffs are determined by the status quo $x = 0$ where no policy project is implemented and are equal to zero.²⁰ The additional surplus which can be realized in the bargaining process under CG is then simply given by

$$\Delta_{CG} = S(x^*, e, \theta) > 0 \quad \text{for } x^*(e, \theta) > 0.$$

In stage 1, Region A now maximizes $U_{CG}^A(e) = E_\theta \gamma S(x^*, e, \theta) - \psi(e)$ and the corresponding equilibrium investment e_{CG} is determined by the first-order condition

$$\gamma E_\theta V_e(x^*, e_{CG}, \theta) = \psi_e(e_{CG}). \tag{6}$$

¹⁹In this Section, we disregard centralized governance under majority rule to shorten the exposition. Majority voting is extensively explored in Section 5 below.

²⁰The unanimity rule is the equivalent to the notion of ‘joint asset ownership’ in the relation between private parties. If renegotiations break down, no party has the right to use an asset independently since asset usage requires the unanimous consent by both agents [see, e.g., Hart (1995)].

Hence,

Proposition 2. *Suppose there is no cost-sharing provision. Then, centralized governance attains efficiency if only if $\gamma = 1$, i.e., if and only if the bargaining power in the federal assembly rests entirely with the delegates from the investing region A . Otherwise, region A will underinvest. The equilibrium expenditures e_{CG} are independent of β and monotonically increasing in γ with $e_{CG} = 0$ for $\gamma = 0$.*

The claim follows immediately by comparing (6) with (3) and a proof is therefore omitted. Intuitively, central governance under unanimity rule results in suboptimal investments because negotiations in the assembly lead to surplus-sharing among the members of the federation. Unless the region that executes a policy has full bargaining power, underinvestments arise because surplus sharing diminishes the marginal return from investments from its individual perspective.

3.3 Comparison of Regimes

We are now in a position to compare the outcomes under centralized and decentralized governance. Recall that through negotiations, region A accrues a fraction γ of the maximal surplus S^* in both regimes. The main difference between DG and CG therefore lies in the disagreement policy: in contrast to centralized governance under unanimity rule, the project will generally be carried out in the decentralized regime even if no agreement is reached ($x^A > 0$). At first glance, one may be tempted to believe that this feature necessarily provides additional investment incentives for region A . However, the joint disagreement surplus grows at the same time and thus the available gain in negotiations for region A is reduced. Formally, we can compare the marginal returns (MR) from investment under the two governance structures, which are given by the left-hand side of equations (5) and (6), respectively:

$$MR_{DG} - MR_{CG} = E_\theta \left[(\beta - \gamma)V_e(x^A, \cdot) - \gamma(V_x(x^A, \cdot) - C_x(x^A, \cdot)) \frac{\partial x^A}{\partial e} \right].$$

Consider first $\beta \leq \gamma$ and note that $x^A < x^*$ implies $V_x(x^A, \cdot) - C_x(x^A) > 0$. Then, this difference is negative: marginal investment incentives are *lower* under decentralized governance than in the centralized regime. As indicated above, $\beta \leq \gamma$ (large externalities or significant bargaining power) means that the investing region is more concerned

with the direct (negative) effect of its investments on the negotiation gain (due to the increase in the disagreement surplus) than it is with their direct (positive) effect on its own disagreement payoff. Moreover, the indirect marginal return from e through the change in x^A , thereby decreasing Δ_{DG} , is negative as well. Both effects are absent under centralization where region A is unable to affect the default policy/disagreement points by its investments. However, if spillovers are absent ($\beta = 1$) the disagreement point coincides with the social optimum and region A invests efficiently under decentralized governance. Formally, this corresponds to $x^A = x^*$ (the second term vanishes) and $MR_{DG} - MR_{CG} > 0$ unless $\gamma = 1$. We have

Proposition 3. *Consider a federal system without cost sharing. Then, centralized authority is the socially optimal governance structure if $\beta \leq \gamma$. Conversely, there exists some $\tilde{\beta} \in (\gamma, 1]$ such that decentralized authority is the socially preferred governance structure if $\beta \geq \tilde{\beta}$.*

Proof. See the Appendix.

Proposition 3 asserts that subsidiarity leads to better results than centralized authority if the degree of spillovers of policy projects on other regions is not too strong, and vice versa. Also, the choice between both authority structures is a second-best choice, because (unless in non-generic circumstances) no regime reaches the pareto- frontier.²¹ This result is seemingly at odds with some fundamental insights from the property rights literature. At first sight, the possibility that centralized authority can give rise to larger investment incentives surprises because property rights theory suggests a positive correlation between authority and investment incentives. In the standard property-rights framework, though, no externality occurs when the parties involved do not agree on ‘working together’. Since the party with decision rights (the owner of a physical asset) enjoys a higher disagreement payoff, authority results in strong marginal incentives to invest [Hart and Moore (1990), Hart (1995)]. In our framework, this result corresponds to the case $\beta = 1$ where a first-best outcome is attained under

²¹Our findings are thus well in line with Oates’ (1972) celebrated ‘decentralization theorem’. Yet, the underlying reasons for these qualitatively similar results differ. Although large spillovers make decentralized governance less advantageous in our framework as well, the policy uniformity which harms centralized governance according to Oates does play no role in our model since we allow for efficient negotiations on the federal level. Rather, governance structures differ in the incentives they provide to regions to invest into policies with spillover effects.

decentralized governance.²² Otherwise, subsidiarity may be dominated. Consider for example $\gamma = 1$ so that the full negotiation surplus accrues to region A. In such a situation, the outcomes under centralized and decentralized governance do *not* coincide because under DG, there is still an external effect (of investments) on region B for $\beta < 1$. Under CG, in contrast, region A cannot realize x unilaterally but reaps the full marginal return from its investments if it has full bargaining power. Thus, centralization would be preferable.

4 Constitutional Grant Systems

In this section, the assumption that regions cannot sign (contingent) agreements prior to the first stage is relaxed. In line with the incomplete contract paradigm, we assume that the nature of public investments e and the state of the world θ is sufficiently complex so that those variables cannot be contracted upon. Therefore, grant payments can only be contingent on the project size x and on the cost $C(x)$ of a given policy. In what follows, we will concentrate on linear grant schemes and, without loss of generality, consider *costs matching grants*.²³ If region A is eligible for a grant, the subsidy helps to pay for the costs of policies it provides. Such inter-regional transfer systems are not only frequently observed within nations, but are also commonly found in international federations like the EU.

Let α is a cost-share parameter that determines the part of production costs that are borne by citizens of country A, while residents from B contribute the fraction $(1 - \alpha)$ of $C(\cdot)$. We start with a simple yet important observation. Under centralized governance and unanimity rule, matching grants provided for at a constitutional prestage have no impact on efficiency: even if an initial grant system requires region B to bear a share $1 - \alpha$ of final project cost $C(\cdot)$, the fact that it can unilaterally block the realization of the project later implies that regional disagreement payoffs are independent of α . Expressed differently, because any previously agreed upon cost sharing arrangement is

²²In the standard property rights framework, the first best is achievable only if investments are not relationship-specific to some degree, i.e., if the asset value remains unaffected when the owner switches to a relationship with some (usually unmodelled) third party. Otherwise, underinvestments prevail.

²³Since production costs are an increasing function of x , confining attention to cost-sharing grants is without loss of generality. Also note that purely redistributive transfers (which are not explicitly tied to the implementation of the policy) have no impact on subsequent outcomes in the absence of income effects.

tied to the project and region A cannot insist on its realization unilaterally, the grant system is inconsequential for the outcome of negotiations. While surplus sharing in stage 2 will generally require cost sharing *ex post*, the way in which those costs are shared is independent of how costs were supposed to be shared *ex ante*. Thus, region A accrues γ of the overall net surplus, independent of α . The following conclusion is immediate:

Proposition 4. *Under centralized authority with unanimity rule, matching grants do not affect the outcome. Equilibrium investments e_{CG} are given by (6), independent of $\alpha \in [0, 1]$. Again, a socially optimal outcome is unfeasible unless $\gamma = 1$.*

Thus, even conditional grants have no allocative consequences provided the subsequent decision on project realization has to be taken unanimously. Clearly, this conclusion does not carry over to decentralized governance.

4.1 Dezentralized Governance

If region A is eligible for a matching grant that reduces its cost share to a fraction α , it will in stage 2 unilaterally realize project of size

$$x^A(\alpha, e, \cdot) = \arg \max_{x \in [0, \bar{x}]} S^A = \beta V(x; e, \theta) - \alpha C(x) \quad (7)$$

when negotiations with B fail. Two observations are notable: first, $x^A(\alpha, \cdot)$ increases as region A's cost share falls and always coincides with the socially optimal size $x^*(\cdot)$ for $\alpha = \beta$, where the cost subsidy $(1 - \alpha)$ equals the size of the external effect $(1 - \beta)$. Second, $\lim_{\alpha \rightarrow 0} x^A(\cdot) = \bar{x}$, i.e., if region A bears *no* cost at all, its most preferred policy is the largest possible project size \bar{x} . Denoting A's disagreement payoff again by $\hat{S}^A = S^A(x^A, e, \theta)$ and the joint default payoff by $\hat{S} = S(x^A, e, \theta)$, and taking the surplus $\Delta_{DG} = S^* - \hat{S}$ to be divided in negotiations into account, region A solves in stage 1,

$$e_{DG} \in \arg \max_e U_{DG}^A = E_\theta [S^A(x^A, e, \theta) + \gamma(S^*(e, \theta) - S(x^A, e, \theta))] - \psi(e). \quad (DG')$$

Accordingly, A's marginal return from investments MR_{DG} reads [see also (5)]

$$E_\theta \left[(\beta - \gamma)V_e(x^A, e, \theta) + \gamma V_e(x^*, e, \theta) - \gamma(V_x(x^A, e, \theta) - C_x(x^A, e, \theta)) \frac{\partial x^A}{\partial e} \right]. \quad (8)$$

Suppose first $\alpha = 1$. Then, (DG') coincides with (DG) and Proposition 1 tells us that region A underinvests whenever some spillovers are present ($\beta < 1$). Next, consider the 'Pigouvian' cost share $\alpha = \beta < 1$. In this case, $x^A(\cdot) \equiv x^*(e, \theta)$ and $\hat{S} \equiv S^*$, i.e., A would unilaterally choose a socially optimal project size. Yet, underinvestment still occurs because for $x^A = x^*$, (8) reduces to

$$\begin{aligned} E_\theta[\partial \hat{S}^A / \partial e] &= \beta E_\theta V_e(x^*, e, \theta) \\ &< E_\theta V_e(x^*, e, \theta) = E_\theta[\partial S^* / \partial e] \quad \text{for } \beta < 1. \end{aligned} \quad (9)$$

Hence, although region A internalizes the external effect of its policy choice for $\alpha = \beta$, it does not internalize the external effect of its investments. As a result, those will be suboptimally low. Note, however, that if

$$\beta > \gamma, \quad (C1)$$

(9) still strictly exceeds the marginal return from investments under centralized governance with unanimity rule, given by $E_\theta[\partial \gamma S^* / \partial e] = \gamma E_\theta V_e(x^*, e, \theta)$. Under (C1), therefore, DG weakly dominates CG with unanimity rule. The condition requires either region A's bargaining power or the size of the externality to be small. To see why these values are important, recall the discussion in Section 3.3. For $\beta > \gamma$, region A cares more about increasing its own disagreement payoff \hat{S}^A than about decreasing the joint disagreement payoff \hat{S} , thereby raising the renegotiation surplus from which it reaps a fraction γ . For $\alpha = \beta$, $\hat{S} = S^*$ and the latter effect equals its marginal return under centralized governance with unanimity rule.

Finally, let us examine $\alpha = 0$ so that $x^A(\cdot) = \bar{x} > x^*(e, \theta)$ and $\partial x^A / \partial e = 0$. From (8),

$$MR_{DG} = E_\theta [(\beta - \gamma)V_e(\bar{x}, e, \theta) + \gamma V_e(x^*, e, \theta)], \quad (10)$$

which exceeds the social marginal return $E_\theta[\partial S^*(\cdot) / \partial e] = E_\theta V_e(x^*, e, \theta)$ if (C1) holds and

$$\lim_{x \rightarrow \bar{x}} E_\theta V_e(x, e, \theta) > \frac{1 - \gamma}{\beta - \gamma} E_\theta V_e(x^*, e, \theta). \quad (C2)$$

Recall that returns to investment increase in project size, that is, $V_{ex} > 0$. Hence, the inequality in condition (C2) essentially requires the maximal project size \bar{x} to be sufficiently large. In particular, (C2) will be satisfied for all reasonable functional forms of $V(\cdot)$ and finite investment levels e as long as x can in principle be chosen arbitrarily

high. If (C1) holds in addition, region A 's marginal return from investment strictly increases in its default policy x^A and, since the latter exceeds the socially optimal policy x^* , for sufficiently small α , may be well above the social return.

Summarizing the preceding discussion, we have seen that $e_{DG} < e^*$ for $\alpha = \beta$ and, provided (C1) and (C2) are satisfied, $e_{DG} > e^*$ for $\alpha \rightarrow 0$. Applying the Theorem of the maximum and a simple intermediate value argument, the following proposition is immediate.

Proposition 5. *Consider cost-matching grants and suppose that condition (C1) holds. Then, decentralized governance accompanied by a linear grant scheme $\alpha = \beta$ is socially preferred to centralized governance with unanimity rule. If, in addition, (C2) is satisfied, there exists a linear cost-sharing parameter $\alpha^* \in (0, \beta)$ that induces A to invest efficiently under decentralized governance.*

Thus, if spillovers are not too strong or region A 's bargaining power is small, cost sharing generally implements the socially optimal outcome under decentralized governance.²⁴ Moreover, under the optimal grant scheme, the region bears a cost share that is strictly smaller than its fraction of gross benefits from a given policy level: the distribution of costs must be biased to the advantage of the region that conducts a policy to account for the external effect of its investments.

It is important to note that (C1) and (C2) are only sufficient conditions for socially optimal investments to be implementable with linear matching grants under DG.²⁵ To see why, suppose α is such that $x^A(\cdot) < \bar{x}$ so that $\partial x^A(\cdot)/\partial e > 0$ for some θ . Then, the last term in (8) which measures the indirect effect of e on joint default surplus \hat{S} through the induced policy change does not vanish. For $\alpha < \beta$, we have $x^A > x^*$ and, hence, $V_x(x^A, e, \theta) - C_x(x^A, e, \theta) < 0$ by definition of x^* . Since $\partial x^A(\cdot)/\partial e > 0$ in some states and the joint default surplus falls (the negotiation surplus rises) as x^A grows, this indirect effect provides additional investment incentives. The appendix presents a natural example where this effect is sufficiently pronounced to always ensure socially

²⁴If bargaining power is associated with a region's relative economic wealth, Proposition 5 suggests that matching grants are more likely to render an efficient outcome feasible the less affluent the region to which this grant is assigned.

²⁵If the policy of region A imposes a negative externality on B , i.e., if $\beta > 1$, A will overinvest for any $\alpha \in [0, 1]$. In this case, it is immediate that efficiency under decentralized governance can be attained by imposing a Pigouvian tax on A so that $\alpha > 1$.

optimal investments, i.e., irrespective of β and γ .²⁶

4.2 Centralized Governance under Majority Rule

When decisions under centralized governance are taken by majority rule, the majority of delegates in the federal assembly can succeed with its preferred policy against the will of the minority. In practice, most legislatures apply simple majority rules to determine policy outcomes, and delegates put some weight on the interests of their respective constituency.²⁷ In our stylized framework, we have only two regions and all delegates from a region have homogeneous preferences over policies for any constitutionally fixed cost-sharing rule. Hence, a Condorcet winner always exists and we do not have to impose specific legislative rules to determine a default policy outcome that prevails when inter-regional negotiations fail.²⁸ In particular, since the cost incidence of policy projects is fixed, the preferences of delegates from each region are single-peaked in the quantity dimension of policies, and the region with a greater number of delegates in the federal assembly can always enforce its preferred choice.²⁹

We now formally examine centralized authority under majority rule, taking as given the previously agreed upon cost-share parameter α . In doing so, we assume that delegates

²⁶In general, however, centralized governance with unanimity rule may be preferable if $\beta < \gamma$ because the first term in (8) is then negative and may dominate the last term for any α . Then, the optimal cost sharing parameter would be the boundary solution $\alpha = 1$, which implies that CG remains second-best optimal by Proposition 3.

²⁷Examples are Congress and Senate in the US whose members are elected in their home states, or the Council of the European Union which is responsible for most policy decisions in the EU. This body is composed of ministers from each country who are responsible to their national parliaments and public opinions. Decisions in the Council are taken by qualified majority voting in some policy fields, and by unanimity in others. In some countries, the central government is split into two chambers, one of which is comprised of representatives from the state governments within the federal country. In Germany, for example, the *Bundesrat* acts as Upper House of Parliament and takes decisions by majority vote.

²⁸In a framework with more than two jurisdictions and heterogeneous preferences across these regions, voting cycles may prevent the existence of a Condorcet winner. Then, specific legislative rules have to be imposed to ensure a majority voting outcome. See Lockwood (1998) who applies the agenda-setting process put forward by Ferejohn, Fiorina and McKelvey (1987).

²⁹In the European Union or the *Bundesrat*, representatives from more populous countries (or states) carry a greater weighting in the legislative process. In the EU, Council decisions that are subject to qualified majority voting pass by a number of 62 out of 87 votes (roughly a two-thirds majority). Specifically, the largest countries France, Germany, Italy and the UK each have 10 votes. Conversely, the smallest countries Ireland, Denmark and Finland carry 3 votes and Luxembourg 2 votes.

from region A represent the minority while delegates from region B form the majority in the central parliament (otherwise, the outcomes under centralized and decentralized governance coincide and there is no loss in assigning authority to A). This scenario would naturally arise in our context if one interprets B as a composite region which encompasses delegates from all federal states except A . If negotiations fail, region B can then force A to implement its preferred policy x^B in stage 2, which is defined as

$$x^B(\alpha, e, \cdot) = \arg \max_{x \in [0, \bar{x}]} (1 - \beta)V(x, e, \theta) - (1 - \alpha)C(x). \quad (11)$$

For obvious reasons, B 's disagreement policy is strictly increasing in α , the cost burden of A . For $\alpha \neq \beta$, $x^B(\cdot)$ again differs from the efficient project size so that negotiations that lead to $x^*(\cdot)$. yield an efficiency gain $\Delta_{CG} = S^* - \hat{S}$ where $\hat{S}(\cdot)$ is as before the joint disagreement surplus, now evaluated at x^B .

Accordingly, A 's optimization program at stage 1 can be written as

$$U_{CG}^A = E_\theta [S^A(x^B, e, \theta) + \gamma(S(x^*, e, \theta) - S(x^B, e, \theta))] - \psi(e). \quad (CG')$$

With the appropriate substitutions, region A 's marginal return from investment thus yields

$$E_\theta \left[(\beta - \gamma)V_e(x^B, \cdot) + \gamma V_e(x^*, \cdot) + (1 - \gamma)(V_x(x^B, \cdot) - C_x(x^B, \cdot)) \frac{\partial x^B}{\partial e} \right]. \quad (12)$$

To assess this expression, note first that the last term is the net indirect effect of e on A 's disagreement payoff \hat{S}^A .³⁰ Now consider $\beta > \gamma$ and recall that - in contrast to DG - the default policy $x^B(\cdot)$ increases in α because it is now chosen by region B . Suppose first that $\alpha > \beta$, i.e., the matching grant to region A is small (note that this includes as special case $\alpha = 1$ where no transfer scheme exists). Then, the majority region B will choose a $x^B(\cdot) > x^*(\cdot)$. At first glance, one may thus think that a properly chosen matching grant implements efficient investments by a similar argument than under decentralized governance: when α and therefore the cost share of region A is raised, $x^B(\cdot)$ increases and A obtains a larger return on its marginal investments for any given default policy [the first term in (12) is positive]. Yet, a countervailing effect now emerges. Since region A bears a disproportionate share of implementation costs,

³⁰We have $\partial \hat{S}^A / \partial x = \partial \hat{S} / \partial x = V_x(\cdot) - C_x(\cdot)$ because $\partial \hat{S}^B / \partial x = 0$ in states where $\partial x^B / \partial e \neq 0$. Hence, $\partial \hat{S}^A / \partial x - \gamma \partial \hat{S} / \partial x = (1 - \gamma) \partial \hat{S}^A / \partial x$.

it has an interest to decrease the default policy level that is subsequently chosen by B : the third term in (12) which represents the indirect effect of e on \hat{S}^A is negative and the marginal return to investment is reduced. If, in contrast, $\alpha < \beta$ so that $x^B < x^*$, the third term in (12) is positive: A bears only a small portion of implementation costs and has an interest to invest because larger investments lead B to increase x^B . At the same time, however, the direct effect of investments on A 's default payoff is small, which *ceteris paribus* mitigates the region's investment incentives.

If $\beta \leq \gamma$, we see that the direct effect of investment [the first term in (12)] is negative, irrespective of α . Again, however, small enough values of α induce positive indirect incentives. These opposing effects make it difficult to derive a clearcut conclusion. Whether the first best is attainable for some α , now depends on the size of $V_e(\cdot)$ on the one hand, and $(V_x(\cdot) - C_x(\cdot))\partial x^B/\partial e$ on the other. The appendix presents a natural example with specific functional forms $V(\cdot) = xe\theta$, $C(\cdot) = x^2/2$ and $\psi(e) = e^3/3$. For this example, we demonstrate that no subsidy scheme attains the first best for any $\beta \in [0, 1]$, and the underinvestment problem cannot be overcome under centralized authority with majority vote if A is in the minority.

Proposition 6. *Consider centralized authority with majority rule and suppose region A is in the minority. In general, there does not exist a cost-matching grant α which induces A to invest efficiently and underinvestment prevails.*

The statement of Proposition 6 may run counter immediate intuition. As under decentralized governance, an appropriately chosen grant scheme can generate any desired default policy $x^B(\cdot)$ which then affects the investment incentives of region A . Hence, one may be tempted to believe that, at least if $\beta > \gamma$, the first best can generically be attained. This argument, however, ignores one crucial distinction between DG and CG with majority rule: under decentralized governance, a large matching grant (a small α) leads not only to a large default policy level x^A and therefore to high marginal returns on investments, but makes it also desirable for A to exert investments in order to raise the subsequently chosen default project size [the third term in (8) is positive]. In contrast, a large default policy $x^B(\cdot)$ chosen by region B under CG requires that A pays a large portion α of implementation costs. Now, A has an interest to reduce $x^B(\cdot)$ by lowering its investments [the third term in (12) is negative]. A change in α therefore triggers two opposing effects, and the first best remains in general unfeasible even if the matching grant can be optimally chosen.

Our findings have a nice economic interpretation. Subsidiarity leaves not only the investment choice, but also the implementation decision in the hands of the region which invests into a new public project. Hence, a large cost subsidy aligns the region's incentives to expand the project size, and to sink considerable investments. Conversely, centralized governance with majority rule adds an element of exploitation of the minority by the majority, and therefore leads minority regions to pursue a suboptimal investment policy. A final comparison concerns the two modes of centralized governance. Since $\alpha = \beta$ implements the same investments under DG and CG with majority rule, Proposition 5 implies that the majority rule performs strictly better than unanimity if $\beta > \gamma$. Hence, if matching grants are feasible, the majority rule strictly dominates the unanimity rule as long as spillovers are sufficiently weak.³¹

Overall, our results suggest that decentralized governance is generally the preferable governance structure, provided jurisdictions can sign costs sharing agreements prior to investments. If $\beta > \gamma$ so that the external effect of policy projects on other regions is not too strong (or if region A 's negotiation power is sufficiently small), subsidiarity implements the socially optimal outcome while centralized governance in general does not. Although our results for the majority rule are less clearcut than those for the unanimity rule, they show that our qualitative conclusions are quite robust with respect to assumptions on the decision processes in a federal assembly.³²

5 Conclusion

The present paper has argued that the relative merits of centralized and decentralized governance depend on how authority over allocative decisions interacts with constitutional provisions concerning the cost incidence of policies. Most of the literature assumes that the costs of a public policy are equally shared among all individuals in a federation in a centralized regime, while have to be borne by the citizens in the region conducting a policy under decentralization [see, for example, Caillaud, Jullien and Pi-

³¹Otherwise, if $\beta < \gamma$, the efficiency ranking is ambiguous.

³²As the example in the Appendix demonstrates, there are natural formulations where an efficient outcome is always reached under DG whereas it is never reached under CG, irrespective of the parameters of the model or of whether central decisions are taken under unanimity or under majority rule (and region A is in the minority).

card (1995), Ellingsen (1998) and Lockwood (1998)].³³ In view of the various vertical or horizontal transfer schemes observed in reality, we found it important to take a broader perspective and to examine the primitives that lead to cost-sharing arrangements. An important element of our model was to allow the jurisdictions in the federation to negotiate the final policy decision, irrespective of governance structure. While we do not doubt that political decision processes are subject to possibly large transaction costs which may prevent successful negotiations to the efficiency frontier, there seems to be no compelling reason why the size of transaction costs is affected by the mode of governance. Naturally, if jurisdictions are members of a federal system, the federal assembly provides a forum for negotiations prior to policy implementation regardless of whether the final policy decision rests *a priori* with a jurisdiction or with the federal government. But even if jurisdictions are autonomous countries, international treaties can be negotiated to ensure a mutually beneficial policy choice.

Starting from this presumption, our main results were as follows. If an initial agreement (or the constitution) does not prescribe a cost-sharing arrangement, either governance structure fails to implement an efficient outcome. Centralized authority is socially preferable when externalities are large, while regional authority leads to higher investment in reverse situations. This picture changes when we consider optimally adjusted cost-sharing and grant systems. We found that whenever a country's bargaining power is relatively small or spillovers are not too pronounced, it is possible to design a linear matching grant scheme that induces a region to invest efficiently under decentralized governance. In contrast, centralized governance does not resolve the underinvestment problem in general. Therefore, our findings suggest that subsidiarity may be the dominant governance mode when member countries in a federation carefully design cost-sharing arrangements at a constitutional stage.

³³For an exception, see Besley and Coate (1999) who assume that all individuals in the economy pay identical head taxes.

6 Appendix

Proof of Proposition 1:

Recall that e^* solves (FB) and e_{DG} solves (DG). If $\beta = 1$, $x^A \equiv x^*$ so that program (DG) coincides with (FB) by inspection. Hence, $e_{DG} = e^*$. Next, we argue that $\beta < 1$ implies $e_{DG} < e^*$. By Assumption 1, $e^* > 0$ so that the claim follows trivially if $e_{DG} = 0$. If $e_{DG} > 0$, both are interior optima and therefore satisfy the first order conditions (3) and (5), respectively, which equate the marginal return of investments (MR) with their marginal costs $\psi_e(e)$. Since the latter are independent of β , it suffices to show that $\beta < 1 \Rightarrow MR_{FB} > MR_{DG}$ for all levels of e : e_{DG} must then be different from e^* and cannot exceed e^* because marginal costs are increasing in e . Hence, we must have $e_{DG} < e^*$. Substituting MR_{DG} [the left hand side of (5)] from MR_{FB} [the left hand side of (3)] yields

$$MR_{FB} - MR_{DG} = E_\theta \left[(1 - \gamma)V_e(x^*, e, \theta) + (\beta - \gamma)V_e(x^A, \cdot) - \gamma(V_x(x^A, \cdot) - C_x(x^A)) \frac{\partial x^A}{\partial e} \right].$$

Since $\beta < 1$, $x^A(\cdot) \leq x^*(\cdot)$ with strict inequality whenever $x^* > 0$. $V_{ex} > 0$ thus implies $E_\theta V_e(x^A, \cdot) < E_\theta V_e(x^*, \cdot)$ for all e so that the sum of the first two terms is strictly positive. Likewise, $V_x(x^A, \cdot) - C_x(x^A) \geq 0$ as $x^A(\cdot) \leq x^*(\cdot)$ by definition of x^* . Due to $\partial x^A / \partial e \geq 0$, the third term is non-negative. Thus, $\beta < 1 \Rightarrow MR_{FB} - MR_{DG} > 0$ for all e which together with $\psi_e > 0$ implies $e_{DG} < e^*$.

Finally, suppose $\partial x^A / \partial e$ is non-increasing in β . Under this assumption, we proceed to show $\beta' > \beta \Rightarrow MR_{DG}(\beta') \geq MR_{DG}(\beta)$ with strict inequality if $e_{DG}(\beta) > 0$. By the same argument as above, this proves $e_{DG}(\beta') \geq e_{DG}(\beta)$ with strict inequality for $e_{DG}(\beta) > 0$. If this is the case, we can use (5) to compute

$$MR_{DG}(\beta') - MR_{DG}(\beta) = E_\theta \left[(\beta' - \gamma)V_e(x^A(\beta'), \cdot) - (\beta - \gamma)V_e(x^A(\beta), \cdot) - \gamma[V_x(x^A(\beta'), \cdot) - C_x(x^A(\beta'))] \frac{\partial x^A(\beta')}{\partial e} + \gamma[V_x(x^A(\beta), \cdot) - C_x(x^A(\beta))] \frac{\partial x^A(\beta)}{\partial e} \right].$$

For $\beta' > \beta$, $x^A(\beta') \geq x^A(\beta)$ so that the first difference is strictly positive due to $V_{ex} > 0$. Similarly, $x^* \geq x^A(\beta') \geq x^A(\beta)$ implies $V_x(x^A(\beta'), \cdot) - C_x(x^A(\beta')) \leq V_x(x^A(\beta), \cdot) - C_x(x^A(\beta))$ because $S(x, e, \theta)$ is strictly concave in x by Assumption 1. Hence, the second difference is non-negative if $\partial x^A(\beta') / \partial e \leq \partial x^A(\beta) / \partial e$ which completes the proof. \square

Proof of Proposition 3:

The line of reasoning in the text shows that $MR_{DG} - MR_{CG} < 0$ if $\beta \leq \gamma$. By the same argument as in the proof of Proposition 1, this implies $e_{CG} \geq e_{DG}$ with strict inequality if $\gamma > 0$ which proves the first part of the proposition (recall that $e_{CG} > 0$ for all $\gamma > 0$ because $E_\theta V_e(x^*, e, \theta) > 0$). Next, we know from Proposition 1 that $e_{DG} = e^*$ for $\beta = 1$, irrespective of γ so that for all $\gamma < 1$, $e_{DG}(\beta = 1) > e_{CG}$ by Proposition 2. Now let $e_{DG}(\beta)$ be a continuous selection from the correspondence $\varepsilon(\beta) \equiv \arg \max_e U_{DG}^A(e, \beta)$ (the Theorem of the Maximum ensures that such a correspondence exists). Since $e_{DG}(0) < e_{CG}$ and $e_{DG}(1) \geq e_{CG}$ with strict inequality if $\gamma < 1$, there must exist a $\tilde{\beta} \in (\gamma, 1]$ such that $\beta \geq \tilde{\beta}$ implies $e_{DG}(\beta) > e_{CG}$ which proves the second part of the proposition. If one additionally assumes that $\partial x^A / \partial e$ is non-increasing in β , $e_{DG}(\beta)$ will be strictly increasing in β (see Proposition 1) and $\tilde{\beta}$ will be unique. Decentralized governance is then socially preferable if and only if $\beta \geq \tilde{\beta}$. \square

Example: First Best (Un)Feasible under Decentralized (Centralized) Authority

Suppose that

$$V(x, e, \theta) = xe\theta, \quad C(x) = \frac{1}{2}x^2 \quad \text{and} \quad \psi(e) = \frac{1}{3}e^3.$$

Under these assumptions, $S(e, x, \theta)$ is strictly concave in both arguments. For simplicity, we take $\bar{x} \rightarrow \infty$ so that we can ignore corner solutions for x . Then, $x^* = e\theta$ and $e^* = E_\theta(\theta^2)$. We first show that for all values of γ and $\beta > 0$, we can find a cost-sharing parameter α such that $MR_{DG} \equiv MR_{FB}$, and, hence, $e_{DG} \equiv e^*$. From the Proof of Proposition 1, $MR_{DG} = MR_{FB} \forall e$ if and only if

$$E_\theta \left[(1 - \gamma)V_e(x^*, e, \theta) + (\beta - \gamma)V_e(x^A, \cdot) - \gamma(V_x(x^A, \cdot) - C_x(x^A)) \frac{\partial x^A}{\partial e} \right] = 0,$$

for all values of e . For the specific functional forms above, $x^A(e, \cdot) = \beta e \theta / \alpha$ and this condition reads

$$E_\theta \left\{ (1 - \gamma)(e\theta^2) - \left[(\beta - \gamma) \frac{\beta}{\alpha} + \gamma \frac{(\beta - \alpha)\beta}{\alpha^2} \right] e\theta^2 \right\} = 0,$$

which requires for $e > 0$,

$$\frac{\beta}{\alpha^2} [\alpha(\beta - \gamma) + \gamma(\beta - \alpha)] = (1 - \gamma). \tag{13}$$

For any $\beta > 0$, the left-hand side of (13) becomes positive and converges to infinity if $\alpha \rightarrow 0$. Note that the second term in brackets (the indirect effect) weakly dominates the first term (the direct effect) as $\alpha \rightarrow 0$ so the marginal return from investments increases in α even if $\beta \leq \gamma$. Conversely, as $\alpha \rightarrow 1$, the LHS converges to a value smaller than (equal to) the right-hand side for any $\beta < 1$ (for $\beta = 1$). Accordingly, continuity of the LHS in α guarantees the existence of some $\alpha^* \in (0, 1]$ so that condition (13) holds and the socially optimal investments can be implemented under decentralized governance for any $\beta > 0$.

Next, consider centralization with majority rule (and region A in the minority). We proceed to show that $MR_{CG} < MR_{FB} \forall e > 0 \Rightarrow e_{CG} < e^*$ for all values of α , β and $\gamma < 1$. Using (12), this condition is equivalent to

$$E_\theta \left[(\beta - \gamma)V_e(x^B, \cdot) - (1 - \gamma)(V_x(x^B, \cdot) - C_x(x^B, \cdot)) \frac{\partial x^B}{\partial e} \right] < \gamma E_\theta V_e(x^*, \cdot),$$

which translates for the specific functional forms of the example and $x^B = (1 - \beta)e\theta / (1 - \alpha)$ into

$$1 - \gamma > \frac{(\beta - \gamma)(1 - \beta)}{1 - \alpha} - (1 - \gamma) \frac{(\alpha - \beta)(1 - \beta)}{(1 - \alpha)^2}. \quad (14)$$

Manipulating (14), our claim holds if and only if

$$1 > \frac{1 - \beta}{1 - \alpha} \left[\frac{\beta - \gamma}{1 - \gamma} + \frac{\beta - \alpha}{1 - \alpha} \right]. \quad (15)$$

Note first that for $\beta = 1$, the the right-hand side of (15) is zero. Thus, suppose $\beta < 1$ and notice that RHS strictly decreases in γ . Inserting $\gamma = 0$ and taking the derivative of the right-hand side of (15) with respect to α , we find

$$\frac{dRHS}{d\alpha} > (<) 0 \quad \Leftrightarrow \quad \frac{1 - \beta}{(1 - \alpha)^3} [3\beta - 1 - \alpha(1 + \beta)] > (<) 0.$$

Since the sign of the derivative is monotonic in α , we only need to consider the grant schemes $\alpha = 0$ and $\alpha = 1$, respectively. For $\alpha = 0$, (15) reads $1 > 2\beta(1 - \beta)$ which is satisfied for any $\beta < 1$. Finally, for $\alpha \rightarrow 1$, the term in brackets on the RHS of (15) is strictly negative for $\beta < 1$, so that $RHS \rightarrow -\infty$. Hence, unless $\gamma = 0$, efficient investments cannot be implemented under centralized governance with majority rule for any (α, β, γ) .

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