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Size, Spillovers and Soft Budget Constraints

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Abstract

There is much evidence against the so-called "too big to fail" hypothesis in the case of bailouts to subnational governments. We look at a model where districts of different size provide local public goods with positive spillovers. Matching grants of a central government can induce socially-efficient provision, but districts can still exploit the intervening central government by inducing direct financing. We show that the ability and willingness of a district to induce a bailout and district size are negatively correlated. Furthermore, we argue that these policies can be equilibrium strategies.

Key Words: bailouts, soft budget constraints, district size, spillovers

JEL Codes: H4, H7, R1

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1 Introduction

There is much evidence supporting the conjecture that the occurrence of bailouts to subnational governments in general contradicts the so-called "too big to fail" hypothesis. A first example is that, based on the constitutional principle of uniformity of living conditions throughout the nation, the German Constitutional Court supported in 1992 the bailout claims of the two smallest state governments in terms of population, Bremen and Saarland. The Constitutional Court forced the federal government to give bailout transfers to ensure the basic supply of local public services in these states (Seitz, 1999). At the beginning of the 1990s, the health system was facing a deficit of about 15% in small regions in Italy.¹ Following the constitutional principle that guarantees citizens access to the same quality of services, the central government stepped in and covered the deficits thus incurred to prevent health care in these regions break down (von Hagen et al, 2000 and Bordignon 2000). In Sweden, the central government was empowered by law during the period 1974-1992, to provide discretionary transfers to support municipalities in financial distress.² Econometric evidence for this period (Dahlberg and Pettersson, 2003), shows that population size has a significant negative association with realized bailouts. Also in Latin America, a number of recent experiences in Argentina, Colombia and Costa Rica contradict the "too big to fail" hypothesis. In Argentina for example, the central government has often used extraordinary resources to face fiscal and financial crises at provincial

¹In 1992, ordinary regions spent 71% of their total resources on health services. Almost 96% of their revenues came from central government (matching) grants (von Hagen et al, 2000).

²This relief program was not part of a regular intergovernmental transfer scheme (von Hagen et al, 2000).

level since the return of democracy in 1983. In general, they took place in jurisdictions that are among the smallest in terms of population³ (Nicollini et al, 2002).⁴ Two aspects of these episodes motivate the analysis of this paper: First, the risk of underprovision of public goods by subnational governments is an important reason for central governments to bail out subnational governments. Second, subnational governments of small districts are more likely to induce and get a bailout from the central government.

This paper investigates the ability and willingness of local governments to induce a central government to directly finance the provision of the local public goods, i.e. to induce bailouts. Note that bailouts are usually provided to cope with high public indebtedness. Although there is no debt in our model, the implication is the same since coping with high public debt could imply that jurisdictions have to cut expenditures drastically, resulting in severe deteriorations of the supply of public goods. We develop a two-tier hierarchy model with the central government at the top and several districts of different size at the bottom. Districts provide local public goods and we assume that there are (positive) externalities in the provision of

³Bailout episodes during the 1990s include the provinces of Jujuy, La Rioja, Tucuman, Catamarca, Corrientes, Santiago del Estero and Rio Negro, that are the smallest in terms of population if we exclude the extremely sparsely populated and oil producing provinces in Patagonia in the south of the country. Moreover, these provinces together represent less than 13% of the total population and less than 10% of national GDP.

⁴It is important to point out that we are not interested in episodes of generalized bailouts like, for example, the rescue operation implemented by the federal government in Mexico early after the financial crisis in December 1994 which included extraordinary transfers to *all* state governments. Another example is Brazil, where the federal government assumed all state and municipal debt in 1993 and 1997 (Dillinger and Webb, 1998). Moreover, note that the recent fiscal crisis faced by the city of Philadelphia in the US in 1990 cannot be considered as a case of bailout since the fiscal cost of the crisis was mainly internalized by its residents living with reduced public services, additional sales tax and city workers facing a wage freeze and a reduction in employee benefits (Inman 1995).

public goods. This *spillover* effect is modeled in a similar way as Besley and Coate (2003), that is, public goods provided in a district do not only benefit individuals in this particular district, but also entail a positive externality for individuals in other districts.

The paper also analyzes whether and when the central government is willing to make an extraordinary transfer (*bailout*) to a district, which decides to underprovide local public goods.⁵ We argue that district size plays an important role in the bailout policy of central and local governments, as well as in the occurrence of bailouts in equilibrium. The willingness of the central government to provide a bailout to a certain district depends negatively on the size of this district: the larger the district, the more costly a bailout. The central government's bailout policy, however, does not fully characterize the occurrence of bailouts, since it is not obvious whether districts are indeed willing to induce bailouts.

In general, bailouts are attractive for individuals in a district if the amount of public goods provided under the central government's bailout policy is big enough. It turns out that small districts get a larger amount of public goods per capita under the bailout policy. In agreement with the empirical evidence, individuals in small districts are, therefore, more likely to induce and get a bailout. Furthermore, we argue that these bailout policies can be the strategies in a subgame perfect Nash equilibrium.

This line of research drawing the attention to size effects when analyzing problems of soft budget constraints was pioneered by Wildasin (1997), who develops a model

⁵This decision making process is similar to the one studied by Caplan et al. (2000) when they look at a federation with centralized leadership and immobile residents.

where externalities in the provision of local public goods explain the allocation of bailouts among districts.⁶ In clear contrast to our results, Wildasin finds that the size of a district positively affects its likelihood of demand and obtaining a bailout.⁷ As we argue above, this does not seem to find support in recent episodes of bailouts to sub-national governments. The difference between Wildasin's and our result stems from the way externalities are modeled. In our model, the spillover effect from the provision of local public goods in a given jurisdiction only depends on the amount of local public goods provided in that district. In Wildasin's model, on the contrary, the spillover effect from the provision of local public goods in a given jurisdiction also depends on the externalities from the provision of local public goods in all other districts, giving additional weight to the externalities from big districts. Furthermore, our paper differs from Wildasin's by analyzing explicitly how bailouts can occur in equilibrium.

The remainder of the paper is organized as follows. In Section 2 we introduce the model and define the non-cooperative and efficient outcomes under *hard budget constraints*. In a non-cooperative Nash equilibrium, individuals choose the amount of local public goods to be provided in their district. A common finding for this form of decision making is, however, that the spillover effect is not taken into account and, therefore, underprovision of public goods occur. We further characterize the optimal

⁶Recent literature on soft budget constraints and bailouts also include: Qian and Roland (1998), Inman (2001), Sanguinetti and Tommasi (2002) and Breuille et al (2004). See also Kornai (1986), who introduces the discussion on soft budget constraints in the study of state-owned enterprises, Dewatripont and Maskin (1995) for soft budget constraints in a credit model and Maskin (1999) for a survey.

⁷In another related paper, Goodspeed (2002) writes that it is not clear whether small districts are more likely to induce bailouts.

level of local public goods provision and define a system of matching grants implemented by a central government that can be used to achieve this efficient outcome.

The paper then shifts attention to the issue of *soft budget constraints*. In Section 3, it analyzes whether and when the central government is willing to make an extraordinary transfer to a district that decides to underprovide a local public good. It turns out that the willingness of the central government to provide a bailout depends negatively on the size of this district. In addition to that, we argue that the central government's bailout policy does not fully characterize the occurrence of bailouts. Since it is costly for individuals to induce a bailout (in case of a bailout there will be less local public goods in their district than they are willing to pay for), the conditions under which local governments indeed choose to induce such a bailout are subsequently identified. In agreement with the empirical evidence, as district size decreases, the bailout becomes in general more attractive for a district, and the willingness of a local government to induce a bailout increases.

In Section 4, we argue that these bailout policies can be the strategies in a subgame perfect Nash equilibrium. Even though the central government could choose to change the optimal system of matching grants to avoid costly bailouts, it turns out that this is not enough to avoid bailouts in all cases. Finally, Section 5 summarizes and concludes.

2 The model

Suppose that a country is divided in several districts of different size. The country has a population of N individuals and each district i has a population of n_i , where $n_i < N/2$ for all districts. Each individual has an endowment y and there are local public goods g_i . To simplify notation and to show that the results do not depend on heterogeneity among individuals, we assume that all individuals have identical preferences and endowments. We assume that an individual's payoff is quasilinear in the endowment and that the utility function is additively separable.

We assume that there is a variable cost that depends on the total amount of public goods that individuals want to provide. A district i provides per capita an amount $g_i \geq 0$ of the local public goods and each individual in district i pays a lump-sum district tax t_i to finance public good provision in district i . If a district provides an amount g_i of the public goods then individuals in this district will get a benefit $v(g_i)$ from these public goods. We assume that $v(\cdot)$ is strictly concave, that $v'(\cdot) > 0$ and that $v(0) = 0$. An individual, however, does not only get a payoff from the public goods in his own district but also from the public goods in all other districts. The degree of this (positive) spillover effect is denoted by κ , $0 < \kappa < 1$, so that an individual in district i gets a benefit $\kappa v(g_j)$ of the public goods provided in district j , ($i \neq j$).

To illustrate this consider two examples, health care and education. An individual in the first place benefits from vaccinations and basic literacy in his own district. There are, however, diminishing returns since an individual benefits less from say

plastic surgery or some forms of university education. In the second place, an individual also indirectly benefits from these goods provided in other districts since an individual may sometimes interact with individuals from other districts, and the provision of public goods there make these interactions more beneficial. In these examples, the variable costs represent how much health care or education per individual is available.

An individual in district i thus gets a benefit $\kappa v(g_j)$ of the public goods provided in district j . This can be motivated by, for example, health care. Individuals find it important that the individuals in other district also get health care, as they feel sorry for health problems of others. However, health care in other districts is less important than the health care provided in their own district, since it then touches their own health. The main perception behind the "too big to fail" hypothesis is, however, that spillovers are increasing in district size. This is for example the case when the spillover effect is proportional to district size, so that an individual in district i gets a benefit $\kappa n_j v(g_j)$ of the public goods provided in district j . In an Appendix we show that the main results of our paper are robust to this alternative specification.

The utility of an individual in district i is

$$v(g_i) + \sum_{j \neq i} \kappa v(g_j) + y - t_i - T, \quad (1)$$

where t_i and T are the taxes the individual has to pay to its local government and the central government, respectively. The costs of providing public goods differ per

district and its variation is captured by $p_i > 0$. The value of p_i is drawn from a distribution function $\mathcal{P}$ and observed by the individuals in district i but unknown to the central government. We first consider the case without a central government, i.e., $T = 0$. Since districts have balanced budgets, tax rates t_i are given by

$$t_i = p_i g_i. \quad (2)$$

We assume that individuals in a district can choose the amount of local public goods provided in their district. Since the individuals within a district are identical, however, we only have to look at the preferences of a single individual as these preferences prevail for all individuals in the same district. The level of public goods provided in a district i is thus determined by maximizing (1) with respect to g_i , where t_i is given by (2). The (non-cooperative) Nash equilibrium outcome is characterized by the following first-order condition of this maximization problem:⁸

$$\begin{cases} v'(g_i) = p_i & \text{if } v(g_i) > p_i g_i \\ g_i = 0 & \text{otherwise.} \end{cases} \quad (3)$$

It is a common finding that in the form of decision making described above, the spillover effect is not taken into account and, therefore, underprovision of local public goods occurs.⁹ A system of grants, however, can be used to achieve an efficient

⁸In this and in subsequent maximization problems the strict concavity of $v(\cdot)$ implies that the first order conditions are sufficient. Moreover, the strict concavity implies that the solutions are unique.

⁹See, for example, Besley and Coate (2003) who work with a model in which individuals differ

equilibrium without completely centralizing decision making. We assume that such a system is implemented by a benevolent social-welfare maximizing central government and that, to finance this system, individuals pay a national lump-sum tax T . In order to characterize such an equilibrium, we first determine the optimal levels of local public good provision as a benchmark for normative evaluation of equilibrium outcomes. Then we characterize a system of matching grants that induces local governments to provide these optimal levels of local public goods.

Since in this model the payoffs are quasilinear in the endowment, for efficiency it suffices to focus on an outcome in which all individuals pay the same tax level. In finding the optimal level of g_i , the objective is thus to maximize the equally weighed sum of individual payoffs:

$$n_i v(g_i) + \sum_{j \neq i} n_j \kappa v(g_i) + n_i y - n_i p_i g_i. \quad (4)$$

We define $\hat{g}_i$ to be the socially optimal or efficient per-capita amount of public goods, $\hat{g}_i$ thus satisfies the following first-order condition for maximizing (4) with respect to g_i :

$$\begin{cases} v'(\hat{g}_i) = \frac{n_i p_i}{n_i + (N - n_i) \kappa} & \text{if } v(\hat{g}_i) + \frac{1}{n_i} \sum_{j \neq i} n_j \kappa v(\hat{g}_i) > p_i \hat{g}_i \\ \hat{g}_i = 0 & \text{otherwise.} \end{cases} \quad (5)$$

A comparison of the first-order conditions (5) with (3) yields that there is indeed underprovision of public goods, since the levels of public goods in a non-cooperative Nash equilibrium are lower than the levels in an efficient outcome.

in their preferences over public good provision. Feidler and Staal (2012) show that district size can be seen as a proxy for this heterogeneity in preferences.

Below, we consider a system consisting of matching (or conditional) grants. The timing is now as follows.

1. Nature selects the costs parameters.
2. The central government chooses a system of matching grants.
3. Each local government observes the cost parameters and the system of matching grants and chooses the amounts of local public goods that will be provided.

Let m_i denote the share of total spending for which the local government of district i is reimbursed. This reimbursement is chosen by the utilitarian welfare maximizing central government such that the marginal incentives to provide local public goods are efficient. Again, districts have balanced budgets and therefore tax rates previously given by expression (2) are now given by

$$t_i = p_i g_i (1 - m_i) \tag{6}$$

and the national tax rate is given by

$$T = \frac{\sum_j p_j n_j g_j m_j}{N} \tag{7}$$

The level of local public goods provided in a district i is then given by maximizing (1) with respect to g_i , where t_i and T are given by expressions (6) and (7), respectively.

The first-order condition of this maximization problem is given by

$$\begin{cases} v'(g_i) = p_i(1 - m_i) + \frac{n_i p_i m_i}{N} & \text{if } v(g_i) > p_i g_i(1 - m_i) + \frac{n_i p_i g_i m_i}{N} \\ g_i = 0 & \text{otherwise.} \end{cases} \quad (8)$$

Thus, a positive amount of local public goods is provided only when the local benefit $v(g_i)$ is larger than the local tax $p_i g_i(1 - m_i)$ and the federal tax $n_i p_i g_i m_i / N$, necessary to finance the matching grant.

From (5) and (8) it follows that the marginal incentives to provide local public goods is optimal with the following conditional transfers $\hat{m}_i$

$$\hat{m}_i = \frac{N\kappa}{n_i + (N - n_i)\kappa}. \quad (9)$$

The marginal incentives to provide public goods are now efficient, moreover, a comparison of the conditions in (5) and (8) with $m_i = \hat{m}_i$ reveals that the decision whether to provide public goods is now also efficient, that is $g_i = \hat{g}_i$ for all i .

Note that $g_i = \hat{g}_i$ and $m_i = \hat{m}_i$ constitute a subgame perfect Nash equilibrium. Since local governments make their choices after the central government has implemented a system of matching grants, the game is dynamic. The (utilitarian welfare maximizing) central government does not observe the cost parameters p_i , suggesting that the equilibrium concept to use would be perfect Bayesian. However, since the choice of the central government does not depend on the p_i , the incomplete information does not affect the strategy of the central government and we therefore consider the subgame perfect Nash equilibrium of the game (due to the fact that local gov-

ernments observe p_i , there are indeed proper subgames). The central government can thus induce the optimal outcome, even though it does not observe the cost parameters p_i . In the next sections, however, we show that even with this system of matching grants, the $\hat{g}_i$'s will not always be the provided amounts when there is a soft budget constraint.

3 The soft budget constraint

In Section 2, we show that the first-best outcome can be reached with matching transfers $\hat{m}_i$ when there is a hard budget constraint. The motivation behind a system of matching grants is given by the benefits individuals outside a district get from the local public goods provided in this district. This motivation also creates, however, a caveat. When a district does not provide any local public goods at all, the central government could make a transfer to this district so that at least some public goods are provided in this district so that people outside the district have the benefits from the spillovers. This motivation seems to be an essential feature of *bailouts* to local governments. Note that even though bailouts are usually provided to cope with high public indebtedness, the implication of these bailouts are the same since coping with high public debt could result in severe deteriorations of the supply of public goods. The bailout policy is thus carried out in the interest of those individuals that are not located in the district inducing a bailout.

It is sufficient to focus on the decision of the individuals in a single district i and in the analysis we assume that all other districts choose the positive levels given in

Section 2. Even when the central government is willing to give a district a bailout, the choice of the individuals whether to induce such a bailout still depends on the increase in the central tax level necessary to finance the bailout, and the amount of local public goods provided in the district under a bailout. The decision on the bailout is taken after the decisions on the amount of local public goods are made by the districts. The timing is thus:

1. Nature determines the costs parameters.
2. The central government chooses a system of matching grants.
3. The local governments observe their respective cost parameters and the system of matching grants, and choose the amounts of local public goods that will be provided and whether to induce a bailout.
4. When a local government induces a bailout, the central government makes a bailout decision after observing the cost parameter and the amount of public goods provided by this local government.

In the following analysis we look at this game recursively, first at the central government's bailout policy and then at the decision over local public goods provision in district i . For the bailout decision the central government first undertakes a cursory audit of local governments, which is costless but provides it with information on which local governments will be looking for a bailout. Then it undertakes a detailed audit, which costs c_{BO} , to learn the cost parameters p_i of the local governments which have chosen to induce a bailout. Finally, we use $\underline{m}_i$ to denote the size of the

bailout to district i and T_{BO} for the change in the tax rate of the central government needed to finance the bailout.

3.1 Central government bailout policy

In this section we look at the reaction of the central government when the individuals in a district choose a g_i and a t_i such that $g_i < \hat{g}_i$. The central government can then intervene in district i 's provision of local public goods g_i by making an earmarked grant $\underline{m}_i \geq 0$ such that, per capita, an amount of local public goods in district i of $g_i + \underline{m}_i$ is provided. We do not drop the assumption that budgets are balanced, so to finance this transfer the central tax level is increased by $n_i p_i \underline{m}_i / N$. Finally, bailouts are costly, so the central tax rate additionally increases by c_{BO} / N for each bailout by the central government.

When deciding on bailouts, the central government maximizes the payoff of an individual located outside the district that might get a bailout. One may argue that the central government changes the objective function for the bailout policy compared to the one used in Section 2. Note, however, that this decision made by the central government is equivalent to the one made by the jurisdictions in a more decentralized context. That is, if individuals (and thus their local governments) outside the district i that might get a bailout would decide, they maximize their own payoff.¹⁰ It is straightforward to see that this implies the same bailouts $\underline{m}_i$ that

¹⁰That is, individuals in jurisdiction $k \neq i$ would solve

$$\max_{\underline{m}_i} v(g_k) + \kappa v(g_i + \underline{m}_i) + \sum_{j \neq i, k} \kappa v(g_j) + y - (c_{BO} + n_i p_i \underline{m}_i) / N - t_k - T.$$

would follow from (10).

The optimization problem for the bailout can be written as

$$\max_{\underline{m}_i} \quad \kappa v(g_i + \underline{m}_i) - T_{BO}, \quad (10)$$

where T_{BO} denotes the change in the central tax rate due to the bailout and is given by

$$T_{BO} = \frac{c_{BO} + n_i p_i \underline{m}_i}{N}. \quad (11)$$

The first-order condition of this maximization problem is given by

$$\begin{cases} v'(g_i + \underline{m}_i) = \frac{n_i p_i}{\kappa N} & \text{if } \kappa v'(g_i) > \frac{n_i p_i}{N} \\ \underline{m}_i = 0 & \text{otherwise.} \end{cases} \quad (12)$$

A comparison of conditions (12) and (5) reveals that the amount of public goods provided under the bailout policy is lower than the amount chosen by the individuals when there is a hard budget constraint. This implies that it is potentially costly for individuals to induce a bailout - in case of a bailout there will be less local public goods in their district than they are willing to pay for. Moreover, it follows that, in per-capita terms, individuals in bigger districts get smaller bailouts, making bailouts less attractive for them. In the next subsection we look at the decision to induce a bailout in more detail. Condition (12) also implies that the central government only gives a bailout when the marginal per-capita costs $\frac{n_i p_i}{N}$ are larger than the marginal benefits $\kappa v'(g_i)$. Finally, it follows that the central government is more likely to provide a bailout when the spillover effect is "strong enough" and that the size of

the bailout is increasing in the spillover effect. Condition (12) thus makes it possible to characterize the central government's bailout policy.

Lemma 1 *There exist critical values $\overline{n_C(p_i)}$ and $\overline{g_C(n_i, p_i)}$ such that:*

1. *if $n_i > \overline{n_C(p_i)}$ the central government does not provide district i a bailout, even when district i chooses a zero level of own-contribution to local public good provision;*
2. *if $n_i < \overline{n_C(p_i)}$ the central government provides a bailout to district i if and only if $g_i < \overline{g_C(n_i, p_i)}$.*

Proof of Lemma 1:

(1): From condition (12) it follows that when $g_i = 0$ a necessary condition for $\underline{m_i} > 0$ is $\kappa v'(0) > \frac{n_i p_i}{N}$. Hence, for $n_i > \overline{n_C(p_i)} = \frac{\kappa N v'(0)}{p_i}$ the central government never provides a bailout.

(2): Let $\overline{g_C(n_i, p_i)}$ be so that $\kappa v'(\overline{g_C(n_i, p_i)}) = n_i p_i / N$. Then for $g_i < \overline{g_C(n_i, p_i)}$ it holds that $\kappa v'(g_i) > n_i p_i / N$. From condition (12) it then follows that the central government will provide a bailout. $\square$

It follows from Lemma 1 that the willingness of the central government to provide bailouts and district size are negatively related, since bailouts to large districts are more costly. As argued above, however, the willingness of the central government to give a bailout is not sufficient for bailouts to take place. In the following section, we therefore look at whether local governments indeed choose to induce such a bailout.

3.2 Local government bailout policy

The central government bailout policy, implicitly given by condition (12), does not fully characterize the occurrence of bailouts. The condition shows how and when a district can get a bailout. This does not, however, imply that such a bailout is attractive for the individuals in a district. In other words, condition (12) is *necessary*, but not *sufficient*. As already mentioned in the previous section, it follows from (12) that in per-capita terms, individuals in bigger districts get smaller bailouts, thus making the choice for a bailout less attractive to them. Below we analyze this choice made by the local government that acts in the interest of the individuals in its district, given the soft budget constraint and a system of matching grants $\hat{m}_i$.

First note that, for any g_i such that $\kappa v'(g_i) < n_i p_i / N$, the district will receive no bailout at all. In this case, the optimal choice for the individuals in district i is, therefore, $\hat{g}_i$. Secondly, when g_i is such that $g_i < \hat{g}_i$ and as long as $\kappa v'(g_i) > n_i p_i / N$, it follows that the amount of local public goods provided under a bailout is not affected by the value of g_i . Individuals within the district that induces a bailout naturally are interested in making their own contribution to local public good provision as small as possible. An obvious way to do this is by choosing $g_i = t_i = 0$.

For analytical tractability we focus in the remaining of this section on the cases when $v(g) = \ln(g + 1)$ or $v(g) = g^{1-\alpha} / (1 - \alpha)$ for $\frac{1}{2} \leq \alpha < 1$. This covers a broad range of payoff functions $v(\cdot)$ that are "concave enough".

Individuals within district i prefer to induce a bailout with $g_i = 0$ over an optimal

level of public goods $g_i = \hat{g}_i$ when

$$\begin{aligned} v(\underline{m}_i) + \sum_{j \neq i} \kappa v(\hat{g}_j) + y - \frac{c_{BO} + n_i p_i \underline{m}_i}{N} > \\ v(\hat{g}_i) + \sum_{j \neq i} \kappa v(\hat{g}_j) + y - p_i \hat{g}_i (1 - \hat{m}_i) - \frac{n_i p_i \hat{g}_i \hat{m}_i}{N} \end{aligned} \quad (13)$$

From Section 3.1 it already follows that the amount of public goods provided under a bailout is smaller than the amount chosen by the individuals when there is a hard budget constraint. Moreover, in per-capita terms, individuals in bigger districts get smaller bailouts. Based on this and on condition (13), we can now characterize the local government's bailout policy.

Lemma 2 *There exists a critical value $\overline{n_L(p_i)}$ such that if $n_i < \overline{n_L(p_i)}$ and if the central government is willing to give a bailout to district i , then the local government of district i will induce a bailout.*

Proof of Lemma 2: First note that when the central government is not willing to give a bailout, the local government will not induce a bailout since the per-capita costs of inducing would be c_{BO}/N .

Secondly, look at the case in which the central government is willing to give a bailout. Note that (13), using expressions (5), (9) and (12), can be rewritten as

$$v(\hat{g}_i) - v(\underline{m}_i) < v'(\hat{g}_i)\hat{g}_i - \kappa v'(\underline{m}_i)\underline{m}_i - \frac{c_{BO}}{N} \quad (14)$$

The left-hand side of (14) then increases more when n_i increases than the right-hand

side if

$$\begin{aligned} & v'(\hat{g}_i) \frac{\partial \hat{g}_i}{\partial n_i} - v'(\underline{m}_i) \frac{\partial \underline{m}_i}{\partial n_i} > \\ & v''(\hat{g}_i) \frac{\partial \hat{g}_i}{\partial n_i} \hat{g}_i + v'(\hat{g}_i) \frac{\partial \hat{g}_i}{\partial n_i} - \kappa v''(\underline{m}_i) \frac{\partial \underline{m}_i}{\partial n_i} \underline{m}_i - \kappa v'(\underline{m}_i) \frac{\partial \underline{m}_i}{\partial n_i} \end{aligned} \quad (15)$$

For $v(g) = \ln(g+1)$ expression (15) can be rewritten as

$$\frac{1}{n_i} - \frac{N\kappa}{n_i(n_i + (N - n_i)\kappa)} > p_i \left(\frac{1}{N} - \frac{N\kappa}{(n_i + (N - n_i)\kappa)^2} \right)$$

and this inequality holds for $p_i \leq N/n_i$. In addition, from Lemma 1 we know that the central government only provides bailouts when $p_i \leq \kappa N v'(0)/n_i = \kappa N/n_i < N/n_i$.

Therefore, it follows that inequality (15) holds for $v(g) = \ln(g+1)$.

For $v(g) = g^{1-\alpha}/(1-\alpha)$ expression (15) can be rewritten as

$$\left(\frac{1}{\alpha} - \frac{\kappa}{\alpha} + \kappa \right) > \left(\frac{n_i + (N - n_i)\kappa}{N\kappa} \right)^{\frac{1}{\alpha}-2}$$

and this inequality holds when $\frac{1}{2} < \alpha < 1$ for all possible values of κ , n_i and N , so inequality (15) holds for $v(g) = g^{1-\alpha}/(1-\alpha)$.

This leads to three possibilities. Firstly, when (14) holds for all possible values of n_i , the local government induces a bailout and then $\overline{n_L(p_i)} = N/2$. Secondly, when (14) does not hold for any n_i , the local government never induces a bailout and then $\overline{n_L(p_i)} = 0$. Finally, when neither of these two is the case, then by the intermediate value theorem there exists an $\overline{n_L(p_i)}$ such that condition (14) holds if and only if $n_i < \overline{n_L(p_i)}$. $\square$

Since the amount of public goods provided under a bailout is lower than the amount chosen by the individuals when there is a hard budget constraint, individuals (and

thus the local government) do not always choose to induce a bailout. It follows from Lemma 2 that individuals are more likely to induce a bailout when they are in a small district. This is due to the fact that individuals in bigger districts get, per capita, smaller bailouts, making bailouts less attractive for them.

4 Bailouts in equilibrium

The analysis in Sections 3.1 and 3.2 specified the bailout policies of the central government and of the local government, respectively. In this section we argue that these bailouts can occur in a subgame perfect Nash equilibrium. Without loss of generality, we assume for simplicity that except for district 1 with size n_1 , all districts have the same size n , where n is such that the latter districts do not induce bailouts. Consider the following strategies:

Definition 1 *Let the strategy set $\mathcal{S}$ consist of*

1. *The central government announces a system of matching grants based on expression (9).*
2. *The local government of district 1 induces a bailout when the conditions of Lemmas 1 and 2 are met, otherwise provides an amount of the public good that satisfies conditions (5).*
3. *When the local government of district 1 induces a bailout, then the central government provides a bailout to district 1 when the conditions of Lemma 1 hold.*

Proposition 1 *The strategies $\mathcal{S}$ can be the strategies of a subgame perfect Nash equilibrium, and bailouts will be induced and provided when $n_1 < \min\{\overline{n_C(p_1)}, \overline{n_L(p_1)}\}$.*

Proof of Proposition 1: See Appendix.

First consider the equilibrium concept in Proposition 1. As we have argued in Section 2, these strategies constitute a subgame perfect Nash equilibrium. Note that since the central government does not observe the cost parameters, it cannot simply dictate required policies to local governments, or take over their functions. Moreover, the subgame perfectness implies that the central government cannot stick to a non-bailout policy, since this is not a credible threat.

The crucial requirement for the strategies $\mathcal{S}$ to be equilibrium strategies is thus that the central government does not have an incentive to change the system of matching grants $\hat{m}$ in the first stage of the game to avoid bailouts. Recall that bailouts are costly from a social welfare point of view, since less public goods than the socially optimal amount are provided. The central government might, therefore, try to adjust the system of matching grants to avoid bailouts. Note that a change in the system of matching grants $\hat{m}$, changes the incentives of the districts to induce bailouts, more specifically, an increase in the matching grant would decrease the incentives to induce a bailout. However, the more the matching grant exceeds the optimal grant $\hat{m}$, the lower is the net aggregate social welfare, due to overprovision of local public goods when the matching grant exceeds the optimal grant $\hat{m}$. By increasing the system of matching grants, therefore, two competing effects arise that influence the aggregate social welfare. In the Appendix we show that if the size of

the district is small enough, the cost in terms of social welfare of providing a bailout to the district is smaller than the cost of changing the system of matching grants.

The intuition goes as follows. Note that the central government may have an incentive to change the matching grants $\hat{m}_1$ in the first stage of the game. This changes the incentives of district 1 to induce a bailout, more specifically, an increase in $\hat{m}_1$ would decrease the incentives to induce a bailout. As mentioned before, however, the more the matching grant exceeds the optimal grant $\hat{m}_1$, the lower is the net aggregate social welfare due to overprovision of public goods by district 1 if it does not induce a bailout. Moreover, the welfare costs of the bailout is smaller for lower n_1 since smaller districts get, per capita, larger bailouts. This decreases the loss in aggregate social welfare a bailout would cause.

It thus follows that a social-welfare maximizing government does not have an incentive to change $\hat{m}_1$ if district 1 is small enough. The cost of providing a bailout to district 1 is lower than the cost of trying to avoid a bailout by increasing the system of matching grants $\hat{m}_1$. $\mathcal{S}$ then indeed describes equilibrium strategies, and bailouts take place in equilibrium.

5 Concluding remarks

An important feature of bailout problems is the inability of the central government to bind its own actions to the enforcement of fiscal discipline on the state government. Even if the central government knows perfectly well that the state government caused its own financial distress by irresponsible behavior, it may not be willing ex-post to

punish the state government or simply leave it in distress, and may instead choose to provide a bailout if the state government claims that it would have to underprovide local public goods or services. A common finding in episodes of bailouts in federations is indeed that state governments claim that, if they would have to cope with the fiscal burden associated with the high level of indebtedness they have reached, they would have to introduce severe expenditure cuts, associated with dramatic reductions in the supply of public goods and services (Seitz, 1999). Another common finding in episodes of bailouts in federations, both in developing as well as developed countries, is that relatively small districts are more likely to be bailed out.

Von Hagen et al. (2000) argue that the central government may find it optimal to provide a bailout for different reasons: 1) because of high vertical fiscal imbalance that makes it difficult to make subnational governments accountable for potential fiscal distress; 2) because it benefits politically from extending the bailout, or 3) because in the absence of the bailout, there would be negative externalities on the rest of the country. Note that while, for example, Stein (1999) and Goodspeed (2002) have analyzed 1) and 2) respectively, this paper has concentrated on 3), following the line of research pioneered by Wildasin (1997).

This paper focuses on the relationship between size, spillovers and soft budget constraints in a model where positive externalities in the provision of local public goods motivates grants and bailouts from the central government to districts. We obtain results that differ from previous contributions, but that are in line with the evidence. From the model three broad conclusions emerge:

[1] The willingness of the central government to bail out a subnational jurisdiction

depends negatively on the size of the jurisdiction.

[2] The willingness of a subnational jurisdiction to induce a bailout and the size of this jurisdiction are negatively related.

[3] Bailouts can occur in equilibrium. As long as the subnational jurisdiction that might get a bailout is small enough, the prevention of a potential bailout is too costly.

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7 Appendix: Spillovers

In this appendix we show that the main results of the paper are robust to a different specification of the spillover effect, namely that the spillover effect is increasing in the size of the district where the public good is provided.

In the main text, the spillover effect is related to the per capita amount of local public goods. When the central government considers a bailout, the costs of a bailout are increasing in district size, but the spillover effect does not. In this appendix the spillover effect is, however, increasing in the total amount of local public goods. The spillover effect is thus increasing in district size. We argue that even in this case the main conclusions still hold.

We assume that an individual in district i gets a benefit $\kappa n_j v(g_j)$ of the public goods g_j provided in district j , ($i \neq j$). In a non-cooperative equilibrium the utility of an individual in district i thus is

$$v(g_i) + \sum_{j \neq i} \kappa n_j v(g_j) + y - t_i$$

where t_i is given by (2). It is straightforward to show that the non-cooperative equilibrium is again given by (3).

The socially optimal or efficient outcome is now determined by the following maximization problem:

$$\max_{g_i} n_i v(g_i) + \sum_{j \neq i} n_j \kappa n_i v(g_i) + n_i y - n_i p_i g_i.$$

Let $\hat{g}_i$ again denote the socially optimal or efficient outcome, where $\hat{g}_i$ satisfies the following first-order condition of this maximization problem

$$\begin{cases} v'(\hat{g}_i) = \frac{p_i}{1+(N-n_i)\kappa} & \text{if } v(\hat{g}_i) + \sum_{j \neq i} n_j \kappa v(\hat{g}_i) > p_i \hat{g}_i \\ \hat{g}_i = 0 & \text{otherwise.} \end{cases} \quad (16)$$

A comparison of the first-order conditions (16) with (3) yields that there is again underprovision of public goods. As in Section 2, it is possible, however, to find a system of matching grants that induces the optimal outcome. Individuals choose to provide the social efficient when the central government chooses the following matching transfers $\hat{m}_i$

$$\hat{m}_i = \frac{N\kappa}{1 + (N - n_i)\kappa}$$

We now focus on soft budget constraints. As in Section 3.1, we first analyze the central government bailout policy. The central government maximizes the payoff of an individual located outside the district that might get a bailout, and this optimization problem can be written as

$$\max_{\underline{m}_i} \quad \kappa n_i v(g_i + \underline{m}_i) - T_{BO}$$

where T_{BO} is given by (11). The first-order condition of this maximization problem is given by

$$\begin{cases} \kappa v'(g_i + \underline{m}_i) = \frac{p_i}{N} & \text{if } \kappa v'(g_i) > \frac{p_i}{N} \\ \underline{m}_i = 0 & \text{otherwise.} \end{cases} \quad (17)$$

Condition (17) makes it possible to characterize the central government's bailout

policy.

Lemma 3 *There exists critical values $\underline{\kappa}_C(p_i)$ and $\overline{g}_C(p_i)$ such that:*

1. *if $\kappa < \underline{\kappa}_C(p_i)$ the central government does not provide district i a bailout, even when district i chooses a zero level of own-contribution to local public good provision;*
2. *if $\kappa > \overline{\kappa}_C(p_i)$ the central government provides a bailout to district i if and only if $g_i < \overline{g}_C(p_i)$.*

Proof of Lemma 3:

(1): From condition (17) it follows that when $g_i = 0$ a necessary condition for $\underline{m}_i > 0$ is $\kappa v'(0) > \frac{p_i}{N}$. Hence, for $\kappa < \underline{\kappa}_C(p_i) = \frac{p_i}{N v'(0)}$ the central government never provides a bailout.

(2): Let $\overline{g}_C(p_i)$ be such that $\kappa v'(\overline{g}_C(p_i)) = p_i/N$. Then for $g_i < \overline{g}_C(p_i)$ it holds that $\kappa v'(g_i) > p_i/N$. From condition (17) it then follows that the central government will provide a bailout. $\square$

As in Section 3.2, we now focus on the local government's bailout policy. In the remaining of this appendix we assume that the spillover effect is important enough, that is, κ is bigger than the inverse of the minimum district size. Individuals within district i prefer to induce a bailout with $t_i = 0$ over an optimal level of public good provision $g_i = \hat{g}_i$ when

$$v(\underline{m}_i) + \sum_{j \neq i} \kappa n_j v(\hat{g}_j) + y - \frac{c_{BO} + n_i p_i \underline{m}_i}{N} > v(\hat{g}_i) + \sum_{j \neq i} \kappa n_j v(\hat{g}_j) + y - p_i \hat{g}_i (1 - \hat{m}_i) - \frac{n_i p_i \hat{g}_i \hat{m}_i}{N}$$

which, using expressions (5), (9) and (12), can be rewritten as

$$v(\hat{g}_i) - v(\underline{m}_i) < v'(\hat{g}_i)\hat{g}_i - \kappa n_i v'(\underline{m}_i)\underline{m}_i - \frac{c_{BO}}{N} \quad (18)$$

Condition (18) makes it possible to show how district size and the local government's bailout policy are related.

Lemma 4 *There exists a critical value $\overline{n_L(p_i)}$ such that if $n_i < \overline{n_L(p_i)}$ and if the central government is willing to give a bailout to district i , then the local government of district i will induce a bailout.*

Proof of Lemma 4: First note that when the central government is not willing to give a bailout, the local government will not induce a bailout since the per-capita costs of inducing would be c_{BO}/N .

Secondly, look at the case in which the central government is willing to give a bailout. The left-hand side of (18) increases more when n_i increases than the right-hand side if

$$0 > v''(\hat{g}_i) \frac{\partial \hat{g}_i}{\partial n_i} \hat{g}_i - \kappa v'(\underline{m}_i) \underline{m}_i.$$

When $v(g) = \ln(g + 1)$ then this inequality can be rewritten as

$$(1 + (N - n_i)\kappa)(N - n_i)\kappa^2 N < p_i((1 + (N - n_i)\kappa)^2 - N\kappa)$$

and since (from (16)) $p_i \leq (1 + (N - n_i)\kappa)$, a sufficient condition for this inequality to hold is that $\kappa > \frac{1}{n_i}$.

For $v(g) = g^{1-\alpha}/(1-\alpha)$ expression (15) can be rewritten as

$$(1 + (N - n_i)\kappa)^{1/\alpha-2} < (\kappa N)^{1/\alpha-1}$$

and this inequality holds for all values of $\kappa > \frac{1}{N}$ when $\frac{1}{2} < \alpha < 1$.

This leads to three possibilities. Firstly, when (18) holds for all possible n_i then bailouts always take place, and this is the case when $\overline{n_L(p_i)} = N/2$. Secondly, when (18) does not hold for any n_i then bailouts never take place and this is the case when $\overline{n_L(p_i)} = 0$. Finally, when neither of these two does hold, then by the intermediate value theorem there exists an $\overline{n_L(p_i)}$ such that condition (18) holds if and only if $n_i < \overline{n_L(p_i)}$. $\square$

8 Appendix: Proof of Proposition 1

From Lemma 1 it follows that a condition for the central government to provide a bailout is $n_1 < \overline{n_C(p_1)}$ and from Lemma 2 it follows that a condition for the local government to induce a bailout is $n_1 < \overline{n_L(p_1)}$. It should therefore hold in an equilibrium in which bailouts can take place (which, in addition, requires that the central government has no incentive to change the system of matching grants), that bailouts will be induced and provided when $n_1 < \min\{\overline{n_C(p_1)}, \overline{n_L(p_1)}\}$.

As in section 3.2 we look at the utility function $v(g) = g^{1-\alpha}/(1-\alpha)$ and for tractability, we focus on $\alpha = 1/2$. The possible values for the cost parameter p_1 of district 1 are p^L and p^H , with $p^L < p^H$, where $Prob[p_1 = p^L] = Prob[p_1 = p^H] = \frac{1}{2}$. Note that these probabilities (but not the actual value of p_1) are known by the central

government when the central government chooses the matching grants.

First note that when $v(g) = 2g^{1/2}$, and when it is efficient to provide a positive amount of local public goods in district 1, then this amount is given by

$$\hat{g}_1 = \left(\frac{n_1 + (N - n_1)\kappa}{n_1 p_1} \right)^2 \quad (19)$$

and if a bailout is given to district 1 than the amount of public goods is given by

$$\underline{m}_1 = \left(\frac{N\kappa}{n_1 p_1} \right)^2$$

We impose the condition $p^H > 2$. Note that it is socially optimal to provide no public good in district 1 when $p_1 = p^H$ if

$$n_1 v(\hat{g}_1) + (N - n_1) \kappa v(\hat{g}_1) - n_1 p^H \hat{g}_1 < 0 \quad (20)$$

using (19) it follows that (20) holds if $p^H > 2/n_1$. Since a district should consist of at least one individual a sufficient condition is $p^H > 2$. With $p^H > 2$, it is thus too costly to provide a local public good in region 1.

No change in the matching grant: The central government does not have an incentive, from the aggregate social welfare point of view, to change the matching grant to district 1 if for any matching grant m the expected payoff is lower than for $\hat{m}_1$. There are two possibilities after changing the matching grant. In the first, individuals in district 1 start providing public goods when $p_1 = p^H$, and in the second individuals do not. In the following, let $g(L, m)$ denote the amount of public goods

individuals in district i provide when the matching grants are m and $p_1 = p^L$, while $g(H, m)$ denotes the amount of public goods with m and $p_1 = p^H$.

In the first case the government does not have an incentive to change the matching grant if

$$\begin{aligned}
& \{Prob[p_1 = p^L]\} \{n_1 v(g(L, m)) + (N - n_1) \kappa v(g(L, m)) - n_1 p^L g(L, m)\} + \\
& \{Prob[p_1 = p^H]\} \{n_1 v(g(H, m)) + (N - n_1) \kappa v(g(H, m)) - n_1 p^H g(H, m)\} < \\
& \{Prob[p_1 = p^L]\} \{n_1 v(\underline{m}_1) + (N - n_1) \kappa v(\underline{m}_1) - n_1 p^L \underline{m}_1 - c_{BO}\} \\
& \iff \\
& n_1 v(g(L, m)) + (N - n_1) \kappa v(g(L, m)) - n_1 p^L g(L, m) + \\
& n_1 v(g(H, m)) + (N - n_1) \kappa v(g(H, m)) - n_1 p^H g(H, m) < \\
& n_1 v(\underline{m}_1) + (N - n_1) \kappa v(\underline{m}_1) - n_1 p^L \underline{m}_1 - c_{BO}
\end{aligned} \tag{21}$$

In the second case the government does not have an incentive to change the matching grant if

$$\begin{aligned}
& n_1 v(g(L, m)) + (N - n_1) \kappa v(g(L, m)) - n_1 p^L g(L, m) < \\
& n_1 v(\underline{m}_1) + (N - n_1) \kappa v(\underline{m}_1) - n_1 p^L \underline{m}_1 - c_{BO}
\end{aligned} \tag{22}$$

When the matching grant differs from $\hat{m}_1$, an amount of public goods is provided in district 1 that differs from the efficient one, so the net aggregate payoff from providing public goods in district 1 decreases. Recall that n_1 and p^H are such that it is efficient to provide no public good in district 1 when $p_1 = p^H$. Using (20) this

implies that for all $g(H, m)$ the following inequalities hold

$$\begin{aligned} n_1 v(g(H, m)) + (N - n_1) \kappa v(g(H, m)) - n_1 p^H g(H, m) &\leq \\ n_1 v(\hat{g}_1) + (N - n_1) \kappa v(\hat{g}_1) - n_1 p^H \hat{g}_1 &\leq 0 \end{aligned}$$

This implies for (21)

$$\begin{aligned} n_1 v(g(L, m)) + (N - n_1) \kappa v(g(L, m)) - n_1 p^L g(L, m) + \\ n_1 v(g(H, m)) + (N - n_1) \kappa v(g(H, m)) - n_1 p^H g(H, m) &\leq \\ n_1 v(g(L, m)) + (N - n_1) \kappa v(g(L, m)) - n_1 p^L g(L, m) < \\ n_1 v(\underline{m}_1) + (N - n_1) \kappa v(\underline{m}_1) - n_1 p^L \underline{m}_1 - c_{BO} \end{aligned}$$

so it is sufficient to look at condition (22).

With a change in matching grants the central government tries to avoid a bailout. A bailout is less attractive for individuals in district 1 when they get a higher matching grant. On the other hand, however, the more the matching grant exceeds the optimal grant $\hat{m}_1$, the lower the net aggregate social welfare, since the left-hand side of (22) is decreasing in m . The social-welfare maximizing central government therefore tries to find the smallest matching grant m^* such that individuals in district 1 are indifferent between providing public goods and inducing a bailout. This m^* is implicitly given by

$$v(g(L, m^*)) - \frac{n_1 p^L g(L, m^*)}{n_1} (1 - m^*) - \frac{n_1 p^L g(L, m^*)}{N} m^* = v(\underline{m}_1) - \frac{n_1 p^L \underline{m}_1}{N} - \frac{c_{BO}}{N}$$

It follows from Section 3.2 that bailouts are more attractive for individuals in smaller

districts, so the smaller the district the bigger the m^* that makes the individuals indifferent between providing public goods and inducing a bailout. The left-hand side of inequality (22) is, however, decreasing in m while the right-hand side does not depend on m , so an increase in $m = m^*$ makes it more likely that inequality (22) is satisfied and that it is optimal not to change the system of matching grants.

Note that when $p_1 = p^L$ and $g(L, \hat{m}_1) = \hat{g}_1$, inequality (22) is not satisfied for any $c_{BO} > 0$. When $m = 1$, however, inequality (22) can be written as

$$c_{BO} < (1 - \kappa)^2 \left(\frac{1}{2}N - n_1 \right)$$

and is thus satisfied for some $c_{BO} > 0$ since, by assumption, $n_i < N/2$. As argued above, a decrease in n_1 increases m^* , so it follows from the intermediate value theorem that there exists an n^* such that when $n_1 < n^*$ then the central government does not have an incentive to change the matching grant to district 1. $\square$

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