EFFICIENT REVENUE SHARING AND UPPER LEVEL GOVERNMENTS: THEORY AND APPLICATION TO GERMANY

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Abstract

Recent literature has emphasized that redistributive grant systems may tend to internalize fiscal externalities arising from tax competition. This paper further explores the conditions under which local grant systems enforced by the state government will enhance efficiency. A system of redistributive grants among governments is introduced into a standard model of tax competition. This basic model is then extended in order to allow for variations in the government objectives at the state level. A subsequent empirical analysis of local tax policy exploits the experience with local fiscal revenue sharing in Germany. The results suggest that attempts of state level governments to extract fiscal resources from the local revenue sharing system exert an upward pressure on tax rates.

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Keywords: fiscal equalization, tax competition, fiscal federalism, Germany.

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1 Introduction

Many countries display a substantial degree of taxing autonomy for local jurisdictions not only with regard to the taxation of land or property but also with regard to income taxation. As emphasized in the tax competition literature this may lead to inefficiently low taxes due to the existence of fiscal externalities of local tax policy decisions (e.g., Wilson, 1999). However, many countries with a decentralized public sector also display some redistributive grant systems which tend to internalize fiscal externalities arising from tax competition (Bucovetsky and Smart, 2002, Köthenbürger, 2002).

While the existence of redistributive grant systems may explain why local governments in those countries make use of distortive taxes despite of tax competition (Smart, 1998, Dahlby, 2002), the welfare implications from tax competition and tax coordination strongly depend on the government objectives. In fact, as noted by Wildasin and Wilson (2004) the standard view that tax competition reduces welfare is probably most challenged by Leviathan models, where governments pursue objectives other than maximizing the utility of residents.

Given this background the current paper explores the conditions under which redistributive grant systems will or will not achieve or raise efficiency in local finances. More specifically, we consider a standard model of tax competition between local jurisdictions and follow Bucovetsky and Smart (2002) by introducing a system of redistributive grants enforced by the state level which under certain assumptions restores efficiency. This setting is then extended by introducing additional government objectives at the state level, such that the state government is not solely interested in the efficiency of local finances but also aims at pursuing own policies under its specific constraints. The extensions enable us to derive some testable hypotheses and predictions under which conditions the potentially beneficial state intervention into local finances introduces new distortions at the local level. It turns out that if the state government wants to raise expenditures related to own policies and cannot further reduce unconditional grants to local jurisdictions, it may use its influence on the local tax policy in order to raise local tax revenue, which, in turn, is transferred to the state budget by means of higher local jurisdictions' revenue sharing contributions.

The theoretical implications are finally contrasted with the experience in Germany. Germany is a particularly interesting case to study in this respect as it combines municipal tax autonomy and substantial revenue sharing among municipalities supervised and enforced by the states (Länder). Previous research also indicates that the revenue sharing among municipalities does in fact exert a strong impact on the jurisdictions' tax policy (Buettner, 2005). At the same time, some of the German states are in an increasingly difficult fiscal situation where the debt burden is rather high such that they may be tempted to induce local jurisdictions to increase taxing effort. Moreover, also the German system of fiscal federalism provides several incentives and disincentives for government policies at the state level which can be used to identify the constraints under which the states operate. This will allow us to investigate whether, in fact, the response of state governments to changes in the policy constraints, say a reduction in the grants received at the level of states, includes an adjustment of the revenue sharing system among municipalities.

Since it is very difficult to compare the complex local revenue sharing systems across German states, our analysis considers the empirical implications for the local tax policy and test whether conditions faced by state policy makers are reflected in the tax policy pursued at the local level. The results indicate that, controlling for differences in the tax base, the local tax rate does respond to some significant degree and in the way suggested by the theory to the fiscal conditions at the state level. This supports the concern that the potential benefits from local revenue sharing cannot be obtained if the state as the institution enforcing the revenue sharing system pursues own objectives.

The paper proceeds as follows. The following section contains the theoretical analysis which derives empirical implications with regard to local jurisdictions' tax policy. Section three, then, provides an empirical analysis of tax policy in Germany. The last section provides the conclusions.

2 Theoretical Analysis

This section formally explores the conditions under which a redistributive grant system enforced by the state can be expected to restore efficiency in a situation of tax competition, and, under which circumstances the grant system will introduce additional inefficiencies. A first subsection lays out a standard model of tax competition, before the second subsection defines an optimal grant system designed to raise the efficiency of the local public sector, which is closely related to Bucovetsky and Smart (2002). A third subsection, then, introduces the possibility of additional state government objectives beyond simply ensuring efficient local finances. Finally, the fourth subsection analyzes the impact of redistributive grant systems at the state level.

2.1 Tax Competition

We consider a set of n local jurisdictions, labelled $i = 1, ..., n$, which are situated in the same state. In each of them, a competitive firm produces the same homogenous private good by means of two factors, one of which is mobile, say capital, the other immobile, say labor. Denoting by k_i the amount of capital employed in jurisdiction i per unit of labor, the per capita production function $f(k_i)$ is assumed to be identical across jurisdictions with $f' > 0$ and $f'' < 0$. Local jurisdictions levy a source based tax on capital at a rate of τ_i units per unit of capital installed in jurisdiction i. Profit maximization by local firms and free mobility of capital imply that the net rate of return to capital r is equal across jurisdictions and given by the after tax marginal product of capital:

$$r = f'(k_i) - \tau_i.$$

As a consequence, capital demand (per-capita) at location i is determined by a function

$$k_i = \phi(r + \tau_i).$$

From the profit maximization condition, note that we have

$$\frac{\partial k_i}{\partial r} = \frac{\partial k_i}{\partial \tau_i} = \frac{1}{f''(k_i)} < 0.$$

Thus, both a higher net interest rate and a higher local tax rate reduce the demand for capital in jurisdiction i.

Residents of jurisdiction i derive utility u_i from private (c_i) and public (z_i) consumption per capita in their home jurisdiction according to a quasi-linear utility function

$$u_i = c_i + \alpha_i v\left(z_i\right)$$

where v is an increasing and strictly concave function. The parameter $\alpha_i > 0$ measures the intensity of preferences for the public good in jurisdiction i and may vary across jurisdictions. Private consumption per-capita is given by

$$\begin{aligned} c_i &= f\left(k_i\right) - k_i f'\left(k_i\right) + s_i r \\ &= f\left(k_i\right) - k_i\left(r + \tau_i\right) + s_i r, \end{aligned}$$

where s_i is the capital endowment of residents in jurisdiction i per-capita. Public consumption is determined by the budget constraint of the local government

$$z_i = \tau_i k_i + g_i,$$

where g_i is revenue from grants.

Suppose that the total net supply of capital to the state is a positive function $s(r)$ of the net rate of return. Then, the capital market equilibrium is given by

$$\sum_i k_i = \sum_i s_i + s\left(r\right).$$

Implicit differentiation of this condition yields

$$\frac{\partial r}{\partial \tau_i} = -\frac{\frac{\partial k_i}{\partial \tau_i}}{\sum_j \frac{\partial k_j}{\partial r} - \frac{\partial s}{\partial r}}.$$

Notice that from $\partial k_i/\partial \tau_i = \partial k_i/\partial r < 0$ and $\partial s/\partial r > 0$, it follows that $-1 < \partial r/\partial \tau_i < 0$.

We assume that the local jurisdictions choose their tax rates simultaneously such that each jurisdiction takes the tax rates of the other jurisdictions as given and neglects the impact of its tax policy on the other jurisdictions. Private consumption c_i is a function of the local capital stock k_i and the net interest rate r which in turn are determined by the local tax rates. In the absence of grants, the same is true for local public good supply z_i. The utility of the residents of jurisdiction i can thus be written as a function of the tax rate set by this jurisdiction, $u_i(\tau_i)$. The first-order condition for maximization from the perspective of the local government is

$$\frac{\partial u_i\left(\tau_i\right)}{\partial \tau_i} \;=\; -k_i \;+\; \left(s_i - k_i\right)\frac{\partial r}{\partial \tau_i} \;+\; \alpha_i \frac{\partial v}{\partial z_i}\left(k_i \;+\; \tau_i\left(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i}\right)\right) \;\stackrel{!}{=}\; 0. \tag{1}$$

As a benchmark, let us now consider a situation where the state government directly chooses the local tax rates τ_i and the levels of the local public good z_i. Assume that the state government aims at maximizing the sum of utilities

$$V^1 \equiv \sum_j u_j^1 = \sum_j \left(f\left(k_j\right) - k_j\left(r + \tau_j\right) + s_j r + \alpha_j v(z_j)\right),$$

subject to the overall budget constraint

$$\sum_j z_j = \sum_j \tau_j k_j\,.$$

With the Lagrangian

$$\mathcal{L}^1 = V^1 + \lambda^1\left(\sum_j \tau_j k_j - \sum_j z_j\right)$$

optimality from the perspective of the state level requires

$$\frac{\partial \mathcal{L}^1}{\partial z_i} \;=\; \alpha_i \frac{\partial v}{\partial z_i} - \lambda^1 \;\stackrel{!}{=}\; 0, \tag{2}$$

$$\begin{aligned}\frac{\partial \mathcal{L}^1}{\partial \tau_i} \;=\; -k_i \;+\; (s_i - k_i)\,\frac{\partial r}{\partial \tau_i} \;+\; \lambda^1 \left(k_i \;+\; \tau_i \left(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i} \right) \right) \\ +\; \sum_{j \neq i} (s_j - k_j) \frac{\partial r}{\partial \tau_i} \;+\; \lambda^1 \left(\sum_{j \neq i} \tau_j \frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i} \right) \;\stackrel{!}{=}\; 0. \end{aligned} \tag{3}$$

Equation (2) shows that in an efficient allocation, the marginal rate of substitution between private and public consumption, $\alpha_i \partial v / \partial z_i$, must be equalized across jurisdictions. Eliminating λ^1 with the help of (2), condition (3) becomes

$$\begin{aligned}\frac{\partial \mathcal{L}^1}{\partial \tau_i} \;=\; -k_i \;+\; (s_i - k_i)\,\frac{\partial r}{\partial \tau_i} \;+\; \alpha_i \frac{\partial v}{\partial z_i} \left(k_i \;+\; \tau_i \left(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i} \right) \right) \\ +\; \sum_{j \neq i} (s_j - k_j) \frac{\partial r}{\partial \tau_i} \;+\; \sum_{j \neq i} \alpha_j \frac{\partial v}{\partial z_j} \tau_j \frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i} \;\stackrel{!}{=}\; 0. \end{aligned} \tag{4}$$

A comparison between equations (1) above and (4) shows that the last two terms in (4) are not taken into account by the local governments. These terms capture the fiscal externality exerted by an increase in the tax rate in locality i on other jurisdictions. The last term, which is positive, expresses the direct benefit from capital flowing into other jurisdictions, while the second-to-last term is the indirect effect arising from a change in the equilibrium interest rate.

In order to avoid unnecessary complexity in the exposition, in the sequel, we follow Bucovetsky and Smart (2002) and restrict attention to a model where the solution to (2) and (3) displays a uniform tax rate $\tau_i = \tau_j =: \tau$. This implies that also capital demand is equalized across jurisdictions, $k_i = k_j =: k$. Moreover, for simplicity, assume that in the first best situation described by (2) and (3) the endowment with capital is equal to the demand of capital in all jurisdictions, $s_i = k$. Then, at the ensuing equilibrium rate of return the net supply of capital to the state is zero, $s(r) = 0$.

2.2 Efficient Revenue Sharing

Now, while the state government by assumption differs in its view on optimal fiscal policies it may want to raise efficiency of local taxation. In most real constitutions, however, the state government does not directly control taxes and spending in local jurisdictions as in the benchmark described in (2) and (3). One possible option to nevertheless internalize fiscal externalities consists of imposing corrective taxes or subsidies (Wildasin, 1989). This could be done, for instance, by setting a *marginal contribution rate* ϑ_i such that income from grants g_i is a linear function of the tax base[1]

$$g_i = y_i - \vartheta_i k_i.$$

Facing this grant scheme, the utility of a local jurisdiction is a function of the tax rate and the two parameters determining the grant:

$$u_i^2\left(\tau_i, \vartheta_i, y_i\right) = f\left(k_i\right) - k_i\left(r + \tau_i\right) + s_i r + \alpha_i v\left(\tau_i k_i + y_i - \vartheta_i k_i\right).$$

Under the influence of the grant scheme, the optimal tax rate chosen by the local jurisdiction will obey

$$\frac{\partial u_i^2\left(\tau_i, \vartheta_i, y_i\right)}{\partial \tau_i} \;=\; -k_i \;+\; \left(s_i - k_i\right)\frac{\partial r}{\partial \tau_i} \;+\; \alpha_i \frac{\partial v}{\partial z_i}\left(k_i \;+\; (\tau_i - \vartheta_i)(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i})\right) \;\stackrel{!}{=}\; 0. \quad (5)$$

In a situation where the net capital supply is zero in all jurisdictions the second term drops out. Rearranging yields the usual optimality condition stating that the marginal rate of substitution between public and private consumption equals the marginal rate of transformation, *i.e.* the marginal cost of raising public funds

$$\alpha_i \frac{\partial v}{\partial z_i} = \frac{k_i}{k_i \;+\; (\tau_i - \vartheta_i)(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i})}.$$

[1]This specification reflects the common characteristic of most redistributive transfer systems that transfers are inversely related to the tax base or some corresponding measure of "fiscal capacity".

As the contribution rate ϑ_i enters the denominator on the right hand side we see that the redistributive grant system allows the state government to adjust the marginal cost of raising public funds. From $\frac{\partial k_i}{\partial \tau_i} = \frac{\partial k_i}{\partial r} < 0$ and $0 > \frac{\partial r}{\partial \tau_i} > -1$ it follows that $\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i} < 0$. Hence the marginal cost of public funds decreases if ϑ_i is raised. By imposing a higher ϑ_i, hence, the state government can induce the local jurisdiction to increase the local tax rate, that is, $\partial \tau_i / \partial \vartheta_i > 0$.

The state government will choose ϑ_i and y_i in order to optimize the sum of utilities

$$V^2 \equiv \sum_j u_j^2 \left(\tau_j, \vartheta_j, y_j\right).$$

In this subsection we consider a benevolent state government. It will distribute back the full amount of resources collected from the individual jurisdictions by means of grants such that its budget constraint becomes

$$\sum_j y_j = \sum_j \vartheta_j k_j. \tag{6}$$

Formally, we set up a Lagrangian

$$\mathcal{L}^2 \equiv V^2 \; + \; \lambda^2 \left[\sum_j \vartheta_j k_j - \sum_j y_j\right].$$

Differentiation with respect to y_i yields the f.o.c.

$$\frac{\partial \mathcal{L}^2}{\partial y_i} \; = \; \alpha_i \frac{\partial v}{\partial z_i} \; - \; \lambda^2 \; \stackrel{!}{=} \; 0, \tag{7}$$

which indicates that the state government differentiates the unconditional grants y_i among local jurisdictions such that the marginal rates of substitution are equalized. The optimal choice of ϑ_i obeys

$$\frac{\partial \mathcal{L}^2}{\partial \vartheta_i} \; = \; \frac{\partial V^2}{\partial \tau_i}\frac{\partial \tau_i}{\partial \vartheta_i} \; + \; \frac{\partial V^2}{\partial \vartheta_i} \; + \; \lambda^2 \left[k_i + \left(\vartheta_i \frac{\partial k_i}{\partial \tau_i} \; + \; \sum_j \vartheta_j \frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i}\right)\frac{\partial \tau_i}{\partial \vartheta_i}\right] \; \stackrel{!}{=} \; 0. \tag{8}$$

Now inserting

$$\frac{\partial V^2}{\partial \vartheta_i} = -\alpha_i \frac{\partial v}{\partial z_i} k_i$$

and replacing λ^2 by $\alpha_i \frac{\partial v}{\partial z_i}$ according to (7), condition (8) becomes

$$\frac{\partial \mathcal{L}^2}{\partial \vartheta_i} = \left[\frac{\partial V^2}{\partial \tau_i} + \alpha_i \frac{\partial v}{\partial z_i} \left(\vartheta_i \frac{\partial k_i}{\partial \tau_i} + \sum_j \vartheta_j \frac{\partial k_j}{\partial r} \frac{\partial r}{\partial \tau_i} \right) \right] \frac{\partial \tau_i}{\partial \vartheta_i} \stackrel{!}{=} 0. \tag{9}$$

In the Appendix it is shown that the condition (9) is equivalent to (4) from the previous subsection. This confirms that a linear grant scheme can indeed internalize the fiscal externalities induced by tax competition.

Using the symmetry of the first best solution, one can further compute the optimal contribution rate $\vartheta_i = \vartheta^*$ which, in the symmetric situation, is also uniform across jurisdictions (see Appendix):

$$\vartheta^* = \tau \left(1 - \frac{\frac{\partial s}{\partial r} \frac{r}{nk}}{\frac{\partial s}{\partial r} \frac{r}{nk} - \left(\frac{n-1}{n} \right) \frac{\partial k}{\partial r} \frac{r}{k}} \right). \tag{10}$$

Here τ is the optimal local tax rate according to (4), $\frac{\partial k}{\partial r} \frac{r}{k}$ is the interest elasticity of capital demand in a single jurisdiction evaluated at the optimal capital stock k, and $\frac{\partial s}{\partial r} \frac{r}{nk}$ is the interest elasticity of capital supply to the state. We can immediately see the result of Bucovetsky and Smart (2002) that only if capital supply were completely inelastic, $\frac{\partial s}{\partial r} = 0$, the marginal contribution rate is set equal to the tax rate. Otherwise, a lower contribution rate is optimal.

Notice that even in the symmetric situation, we allow for differences in preferences expressed by different α_i. In order to obtain an efficient decentralized solution despite these, the approach of Bucovetsky and Smart (2002) requires a complete set of individual lump-sum grants y_i to each jurisdiction. In a more general setting, where also the optimal tax rates vary across jurisdictions, the contribution rates ϑ_i must also differ so as to correct incentives specifically for each local jurisdiction.

2.3 The Role of Own State Government Objectives

The preceding analysis has dealt with the state government as a benevolent institution which employs a grant policy where the sole objective is the efficiency of local finances. However, it is not obvious, whether it is appropriate to consider states as benevolent agencies solving inefficiencies from local externalities. For instance, mobility, which may be an important driving force towards efficiency, is much lower at the state as compared to the local level. This raises the question of whether the results are robust against the inclusion of separate state-level objectives.

Let us consider the case where the state government aims not simply at maximizing residents' utility. Instead, following Edwards and Keen (1996), let the state be interested in spending some public funds e even if the residents do not derive any utility from those expenditures. Formally, we define the corresponding objective function as

$$V^3 \equiv \sum_j u_j^2 \left(\tau_j, \vartheta_j, y_j\right) + \beta w\left(e\right),$$

where the first term is, as before, the sum of residents' utility, i.e., V^2 , and $w\left(e\right)$ is some increasing and strictly concave sub-utility function capturing the valuation of expenditures e by the state government. If we take account of the state budget constraint we see a trade-off between state spending e and the amount of grants allocated to the jurisdictions

$$e = m + \sum_j \vartheta_j k_j - \sum_j y_j,$$

where m is some exogenously fixed source of revenue which is not affected by local policies.

For the subsequent analysis, the role of unconditional grants is crucial. On the one hand, if the state government can adjust $\sum_j y_j$ according to its desires we have a rather trivial case where the state government's expenditure decision does not conflict with the efficiency of local finances. But, if the state drives down the volume of funds transferred to the local jurisdictions it will approach some limit where political cost increase as the operation of local

jurisdictions becomes difficult.[2] To account for such a limitation, let us assume for simplicity that there is some lower bound to the unconditional grants, where the state cannot further reduce the transfers to the local jurisdictions. At this limit, however, the state may use its influence on the local tax policy in order to induce local jurisdictions to raise tax revenue. The additional revenue will then, in turn, be partly transferred to the state budget by means of higher financing contributions of local jurisdictions in the system of revenue sharing.

In order to discuss this in the current model, assume that the average unconditional grant paid to the jurisdictions has to be, at least, at a level of y'

$$\frac{1}{n}\sum_j y_j \geq y'. \tag{11}$$

In order to distinguish the issue of horizontal redistribution among municipalities from the role of the state's objectives, in the following, we keep the assumption of Bucovetsky and Smart (2002) that the individual grants y_i are still differentiated among local jurisdictions.

By replacing e with the net receipts of funds from the municipalities and other, exogenous, sources of fiscal revenue m we can rewrite the state government's optimization problem for the case where the total amount of transfers to the municipalities is not allowed to fall short of the amount ny'. The Lagrangian becomes

$$\mathcal{L}^3 \equiv V^2 + \beta w \left(m + \sum_j \vartheta_j k_j - \sum_j y_j \right) \; + \; \lambda^3 \left(\sum_j y_j - ny' \right).$$

The f.o.c. with respect to y_i now is

$$\frac{\partial \mathcal{L}^3}{\partial y_i} \; = \; \alpha_i \frac{\partial v}{\partial z_i} \; - \; \beta \frac{\partial w}{\partial e} \; + \; \lambda^3 \quad \stackrel{!}{=} \quad 0. \tag{12}$$

[2]This is the case in Germany where the state governments have to ensure, under constitutional law, that their municipalities are able to accomplish their functions (*e.g.*, Article 73 (1) of the state constitution of Baden-Württemberg; corresponding rules can also be found for the other states). If the state would substantially reduce the transfers to the municipalities, they would appeal to the state court of justice (Staatsgerichtshof). Two of the last eight decisions of the Staatsgerichtshof in Baden-Württemberg, for example, deal with the volume of grants received by the municipalities.

This condition can take two shapes. Firstly, the constraint (11) on the minimal amount of unconditional grants may not be binding. Then $\lambda^3 = 0$ and we have $\alpha_i \frac{\partial v}{\partial z_i} = \beta \frac{\partial w}{\partial e}$. Thus, if the state can adjust the lump sum grants without restriction at the margin, she will do so until her own marginal benefit of funds equals the marginal benefit of public funds for a local juristdiction. Secondly, if the constraint on the unconditional grants binds, $\lambda^3 = \beta \frac{\partial w}{\partial e} - \alpha_i \frac{\partial v}{\partial z_i} > 0$. In this case, the Lagrange variable measures the net benefit to the state from transferring one unit of tax revenues from jurisdiction i to the state level, determined by the difference between the marginal valuation of spending at the state level and the marginal utility of public funds in jurisdiction i. Since we are interested in the case where the state government provides only minimal support for local municipalities, it is plausible to restrict attention to this case. Notice, however, that in both cases, the marginal rates of substitution $\alpha_i \frac{\partial v}{\partial z_i}$ are equalized among the local jurisdictions by means of unconditional grants y_i.

With regard to the contribution rate the optimality condition is

$$\frac{\partial \mathcal{L}^3}{\partial \vartheta_i} \tag{13}$$

$$= \left\{ \frac{\partial V^2}{\partial \tau_i} + \beta \frac{\partial w}{\partial e} \left(\vartheta_i \frac{\partial k_i}{\partial \tau_i} + \sum_j \vartheta_j \frac{\partial k_j}{\partial r} \frac{\partial r}{\partial \tau_i} \right) \right\} \frac{\partial \tau_i}{\partial \vartheta_i} + \left(\beta \frac{\partial w}{\partial e} - \alpha_i \frac{\partial v}{\partial z_i} \right) k_i \stackrel{!}{=} 0.$$

In order to assess the impact of the state's own objective on her choice of grant scheme, we start by considering the contribution rate of the first best solution (9). We then use (13) to evaluate in which direction the state would like to adjust this rate as soon as she takes the new, selfish objective into account.[3] To do so, we compare equation (13) with the benchmark (9), and note that the difference between the optimality conditions is

$$\frac{\partial \mathcal{L}^3}{\partial \vartheta_i} - \frac{\partial \mathcal{L}^2}{\partial \vartheta_i} = \left(\beta \frac{\partial w}{\partial e} - \alpha_i \frac{\partial v}{\partial z_i} \right) \left[k_i + \left(\vartheta_i \frac{\partial k_i}{\partial \tau_i} + \sum_j \vartheta_j \frac{\partial k_j}{\partial r} \frac{\partial r}{\partial \tau_i} \right) \frac{\partial \tau_i}{\partial \vartheta_i} \right].$$

[3]Since in this paper, our aim is to highlight the incentives introduced by own state objectives, we restrict attention to a local analysis of the first order conditions around the first best, or to comparative statics around a local optimum. A global analysis would be much more involved while being very unlikely to produce additional economic insights.

The sign of this expression depends first of all on the term $\beta\frac{\partial w}{\partial e} - \alpha_i\frac{\partial v}{\partial z_i}$. In the case of a binding constraint (11), this is positive, *i.e.* the state at least wants to extract further resources from the local jurisdictions.

Whether or not the state government is able to extract resources from the local revenue sharing system by inducing higher local taxes depends, however, also on the sign of the second term. This term expresses by how much the aggregate receipts from revenue sharing $\sum_j \vartheta_j k_j$ collected by the state changes if the contribution rate for state i is increased. If this term is positive, the state will indeed raise more revenue by increasing ϑ_i. This expression may be negative, however. A decrease in the contribution rate might raise revenue because it might cause, via the associated fall in the tax rate τ_i and the corresponding rise in the net interest rate r, a strong inflow of capital to the state as a whole. This might then outweigh the direct effect of taking less money away from jurisdiction i. To see under which circumstances the positive effect prevails, notice that from the capital market equilibrium and making use of the symmetry, $\vartheta_i = \vartheta_j$, we can rewrite the difference in the optimality conditions as

$$\frac{\partial \mathcal{L}^3}{\partial \vartheta_i} - \frac{\partial \mathcal{L}^2}{\partial \vartheta_i} = \left(\beta\frac{\partial w}{\partial e} - \alpha_i\frac{\partial v}{\partial z_i}\right)\left[k_i + \vartheta_i\left(\frac{\partial s}{\partial r}\frac{\partial r}{\partial \tau_i}\right)\frac{\partial \tau_i}{\partial \vartheta_i}\right].$$

In this expression, the term in squared brackets is positive if $\partial s/\partial r$ is small. Intuitively, in the extreme case where the state is (almost) a closed economy, the total amount of capital is (almost) fixed, and thus total revenue can only rise if a contribution rate is increased. Therefore, if the capital supply is not too elastic the state government gains from an increased ϑ_i and induces a higher local tax rate than in the benchmark case (9).

We can summarize these findings by the following proposition:

Proposition 1 (Distortion by State Government Objectives)
If the state government values own funds more than the funds for local jurisdictions such that it expropriates funds from the local revenue sharing system, and if the supply of capital is sufficiently inelastic, a marginal increase of the local tax rate above the first best, induced by the local revenue sharing system, is beneficial for the state government.

Proposition 1 says that a (partly) selfish state government uses her local revenue sharing system in order to induce higher local tax rates. This result can easily be applied to understand why such revenue sharing systems may lead to excessive equalization in the sense that a local jurisdiction has to pay more than 100% of additional tax revenue into the revenue sharing system. To see this, consider the case where capital supply is completely inelastic, $\frac{\partial s}{\partial r} = 0$, so that Proposition 1 applies. In this case, the first best contribution rate is $\vartheta^* = \tau$, as can be seen from (10). Hence, already in the first best, the grant system entirely takes away any increase in local tax revenue induced by an increasing tax base. Adding now a selfish motive for the state government, there is an incentive to raise the contribution still further. Thus, as the following Corollary implies, an increase in a jurisdiction's tax base actually reduces her revenues after equalization.

Corollary 1 (Excessive Equalization)
If the state government values own funds more than the funds for local jurisdictions such that it expropriates funds from the local revenue sharing system, and if the supply of capital is completely inelastic, then increasing the contribution rate above the local tax rate is beneficial for the state government.

Given that the state government extracts funds it is useful to consider as a simple comparative static exercise a variation in exogenous resources received by the state. As a reduction in m forces the state to cut spending, it contributes to an increase in the marginal benefit of state spending. Hence, we should expect that the state induces jurisdictions to set higher tax rates. To see that this is the case, let us reformulate optimality condition (13); given the symmetry and taking account of the capital market equilibrium we obtain

$$\frac{\partial \mathcal{L}^3}{\partial \vartheta_i} = \left\{ \frac{\partial V^2}{\partial \tau_i} + \beta \frac{\partial w}{\partial e} \vartheta_i \left[\frac{\partial s}{\partial r} \frac{\partial r}{\partial \tau_i} \right] \right\} \frac{\partial \tau_i}{\partial \vartheta_i} + \left(\beta \frac{\partial w}{\partial e} - \alpha_i \frac{\partial v}{\partial z_i} \right) k_i \stackrel{!}{=} 0.$$

Rearranging yields

$$\frac{\partial \mathcal{L}^3}{\partial \vartheta_i} = \frac{\partial V^2}{\partial \tau_i} \frac{\partial \tau_i}{\partial \vartheta_i} + \beta \frac{\partial w}{\partial e} \left[k_i + \vartheta_i \left(\frac{\partial s}{\partial r} \frac{\partial r}{\partial \tau_i} \right) \frac{\partial \tau_i}{\partial \vartheta_i} \right] - \alpha_i \frac{\partial v}{\partial z_i} k_i \stackrel{!}{=} 0. \tag{14}$$

Recall from above that, with a low elasticity of capital supply, the second term will be positive. Then, it is obvious that with an increase in $\beta\frac{\partial w}{\partial e}$ the second term rises. In order to restore optimality, the remaining parts of $\frac{\partial \mathcal{L}^3}{\partial \vartheta_i}$ have to decrease which, around a local maximum, requires an increase in ϑ_i. That in turn implies that the state induces local jurisdictions to raise their tax rate:

Proposition 2 (Impact of State Level Revenue)
Under the conditions of Proposition 1, if the state government experiences a reduction in revenue m independent of local jurisdictions' policies, a marginal increase of the local tax rate, induced by the local revenue sharing system, is beneficial for the state government.

2.4 Disincentive Effect of Fiscal Equalization at State Level

Besides of own objectives of state governments the efficiency orientation of states is particularly doubtful in the German situation, where the states are subject to a large degree of fiscal redistribution among states: They have to share a substantial amount of local tax revenue, say ξk, with the other states and the federal government. Thus, even if states are simply benevolent, the transfer obligation will alter the marginal cost of providing local public services and, hence, will affect efficient revenue sharing.

In order to analyze this case, we have to modify the above budget constraint (6) by the amount of transfers to other states $\xi \sum_j k_j$. Formally, we set up a Lagrangian

$$\mathcal{L}^4 \equiv V^2 \; + \; \lambda^4 \left[\sum_j \left(\vartheta_j - \xi \right) k_j - \sum_j y_j \right].$$

Differentiation with respect to y_i again yields the f.o.c. (7), $\lambda^4 = \alpha_i \frac{\partial v}{\partial z_i}$. Using this in the f.o.c. with respect to the contribution rates, we have

$$\frac{\partial \mathcal{L}^4}{\partial \vartheta_i} \; = \; \frac{\partial \mathcal{L}^2}{\partial \vartheta_i} \; - \; \alpha_i \frac{\partial v}{\partial z_i} \left[\xi \frac{\partial k_i}{\partial \tau_i} + \sum_j \xi \frac{\partial k_j}{\partial r} \frac{\partial r}{\partial \tau_i} \right] \frac{\partial \tau_i}{\partial \vartheta_i} \quad \stackrel{!}{=} \quad 0.$$

Taking once more account of the capital market equilibrium we can simplify this expression

to

$$\frac{\partial \mathcal{L}^4}{\partial \vartheta_i} \;=\; \frac{\partial \mathcal{L}^2}{\partial \vartheta_i} \;-\; \xi \alpha_i \frac{\partial v}{\partial z_i} \left[\frac{\partial s}{\partial r} \frac{\partial r}{\partial \tau_i} \right] \frac{\partial \tau_i}{\partial \vartheta_i} \quad \stackrel{!}{=} \quad 0. \tag{15}$$

The additional term captures the consequences of revenue sharing on tax policy: if a higher tax rate at i reduces capital supply, also the transfers to the state level fiscal equalization system are reduced. Consequently, this last term is positive, indicating that the contribution rate ϑ_i is increased against the case where $\xi = 0$. However, if capital supply is inelastic ($\frac{\partial s}{\partial r} = 0$), the last term vanishes. In this case the spending obligation is financed solely by a uniform reduction of grants without altering the contribution rates.

Of course, as above we could introduce the assumption that the state government extracts resources from the jurisdictions by means of the local revenue sharing system as there is a minimal mandatory endowment of jurisdictions with unconditional grants (11). In this case, the additional transfer obligations at the level of states would reduce the amount of state spending

$$e = m + \sum_j \vartheta_j k_j \;-\; \sum_j y_j \;-\; \xi \sum_j k_j.$$

Inserting this expression into the extended objective function we obtain

$$\mathcal{L}^5 \equiv V^2 + \beta w \left(m + \sum_j \left(\vartheta_j - \xi \right) k_j - \sum_j y_j \right) \;+\; \lambda^5 \left(\sum_j y_j - n y' \right).$$

The optimality condition for y_i replicates (12). The condition for ϑ_i now reads

$$\frac{\partial \mathcal{L}^5}{\partial \vartheta_i} \;=\; \frac{\partial \mathcal{L}^3}{\partial \vartheta_i} \;-\; \xi \beta \frac{\partial w}{\partial e} \left[\frac{\partial k_i}{\partial \tau_i} + \sum_j \frac{\partial k_j}{\partial r} \frac{\partial r}{\partial \tau_i} \right] \frac{\partial \tau_i}{\partial \vartheta_i} \quad \stackrel{!}{=} \quad 0. \tag{16}$$

Simplification using the capital market equilibrium condition yields

$$\frac{\partial \mathcal{L}^5}{\partial \vartheta_i} \;=\; \frac{\partial \mathcal{L}^3}{\partial \vartheta_i} \;-\; \xi \beta \frac{\partial w}{\partial e} \left[\frac{\partial s}{\partial r} \frac{\partial r}{\partial \tau_i} \right] \frac{\partial \tau_i}{\partial \vartheta_i} \quad \stackrel{!}{=} \quad 0. \tag{17}$$

While the first term is equivalent to the case of own state government objectives, the second term captures the impact of the fiscal equalization system between federal and state

governments. Note that this term is positive: it reflects the fact that a tax rate increase lowers the tax base in the state and, therefore, reduces transfer obligations out of the state budget. This exerts an incentive towards a higher contribution rate and higher taxes.

Together, the last two results can be summarized as follows:

Proposition 3 (Distortion by State Level Fiscal Equalization)
If the state government has to contribute to a redistributive system of intergovernmental transfers some part of the revenue raised at the local level, $\xi \sum_j k_j$, and if the supply of capital is not completely inelastic, then a marginal increase of the local tax rate, induced by the local revenue sharing system, is beneficial for the state government, regardless of whether it is benevolent or expropriating funds for wasteful purposes.

3 Empirical Analysis

The above propositions seem to be of particular relevance in the case of the German federation. While local municipalities make use of a local business tax and, consequently, are involved with tax competition, each state redistributes revenue substantially by means of a local fiscal revenue sharing system. Previous research has shown that the redistribution causes local municipalities to set rather high tax rates (Buettner, 2005). However, while the systems of local revenue sharing are broadly similar across states, there are differences in institutional details which make it very difficult to come up with key parameters such as the level of grants and the marginal contribution rates for all states. Therefore, the empirical analysis is concerned with the implications of a state influence on local revenue sharing for the local business tax rate.

3.1 State and Local Finances in Germany

In order to identify a state influence on local tax policy we need to find some variation in the conditions faced specifically by state governments but not by local jurisdictions. Moreover,

it is important that this variation is not affected or, statistically, correlated with the local jurisdictions taxing decisions. A first variable which comes to mind is the level of the debt burden. As the level of debt is inherited from past policy it seems useful to consider a state's debt burden as an indicator of the availability of fiscal resources in the sense of Proposition 2. However, there are two obvious problems with this approach. The first relates to a potential correlation between state and local finances. If there is some common source of shocks driving deficits both at state and local level, the empirical correlation with state level debt might be misleading. In order to overcome this problem we will include debt-variables for both state and local debt. This allows us to consider the impact of state debt conditional on the local debt burden. A second problem arises from the role of the capital market in the determination of the interest rate. If tax policies are taken into account by the capital market it seems generally possible that certain tax policies are reflected in the interest rate or the market value of the debt. However, as the federal government is forced by the constitution to provide a backing for state finances this effect is likely to be negligible.[4]

Another promising source for variation in conditions faced by state governments is the system of fiscal equalization at the state level which exerts important incentives for state government policies. Depending on the fiscal capacity relative to what is considered as "fiscal need" the system of fiscal equalization allocates funds such that states with low capacity receive transfers while those with high capacity will actually contribute to the system. A change in the grants received implies a shift in the state-government budget constraint which will according to Proposition 2 result in different local tax rates provided the state government pursues own policies and has already lowered unconditional grants to municipalities. A second potentially important variable derived from the state-level equalization system is the marginal contribution rate. This is the rate at which an increase in the state-wide business tax base is actually reducing the net transfers received within the state-level fiscal revenue sharing system. As explained above (see Proposition 3), given a higher marginal contribution rate the state might want to induce local jurisdictions to increase taxing effort. A significant positive coefficient of this variable will actually provide

[4]Seitz (1999) describes how supreme court decisions on the federal support have prevented the rating of state bonds to deteriorate relative to the federal level.

evidence on the pure (dis-)incentive effect of state level fiscal equalization on the state's operation of the local finances. With this approach, the empirical analysis is related to Baretti et al. (2002) who find some support for the hypothesis that intergovernmental relations at the state level exert adverse disincentive effects on a state's revenue collection. In contrast, our analysis is concerned with the incentive effects on local taxation which originate in the state's role to enforce revenue sharing among local jurisdictions.

As is discussed in more detail in Buettner (2005) in the context of municipalities, the fact that equalization grants and marginal contribution rate are determined by a complicated, non-linear, albeit clearly defined system of fiscal equalization, allows us to pursue an identification strategy along the lines of regression discontinuity estimation (*e.g.*, Van der Klauw, 2002, and Angrist and Lavy, 1999). Since, if we control for the potential influence of fiscal capacity in the estimation, we can separate out the differential treatment of the states.

3.2 Data

To study the German case, we have collected an annual database for German States in the period between 1970 and 2003. Since data are only available from 1991 onwards, the new states in former East Germany are excluded. Furthermore, we exclude the three so called city states of Hamburg, Bremen, and Berlin since there is no clear distinction between state and local level. The database contains information about the average tax rate for the local business tax in each of the states and corresponding revenue data as well as net interest expenses. In addition, the database contains detailed information about the treatment of each state in the state-level equalization system. More specifically, the database allows us to compute for each state and each year all contributions and transfers related to fiscal equalization at the state level (see Appendix). Some further control variables are used to capture the population size, the lagged tax base, and election years both at local and state level. The latter will control for political business cycle effects which have been found to be important at the local level (*e.g.*, Bordignon, Cerniglia and Revelli, 2002).

Table 1 provides some descriptive statistics. The local tax rate is depicted by the *collection*

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Collection rate (in %)	352.3	37.57	254.0	431.6
State debt service (€ per capita)	143.0	10.77	1.386	495.6
Municipal debt service (€ per capita)	48.19	23.11	1.340	94.13
Population (in 1000)	7372	4992	1043	18073
State (net-)equalization revenue (€ per capita)	-17.24	107.2	-474.7	196.0
State marginal contribution rate (in %)	42.97	13.94	8.139	72.01
Rel. fiscal capacity	1.861	.2785	.8901	2.460
Stand. business tax base (€ per capita)	64.77	21.57	20.87	122.6
State parliament election year	.2463	.4316	0	1
Municipal council election year	.2022	.4001	0	1

Annual data for 8 German States in the period 1970-2003

rate ("Hebesatz"), which is an unknown concept for readers not acquainted with the German case. However, it is rather simple: the tax law sets a base rate of 5% and requires each local jurisdiction to set its *collection rate*. For instance, the *collection rate* might be a figure of 380%, which means that the statutory tax rate applied to the firm is $3.8 \times 0.05 = 19\%$.

The collection rate displays substantial variation across time and states. Note that level and variation of debt service are much larger at the state as compared to the local level. State net-equalization revenue varies strongly between positive and negative figures indicating that some states receive positive transfers while others are net contributors. Note that the marginal contribution rate is above 40 % at the mean, indicating that on average a state has to transfer an amount of more than 40 cents out of each Euro of additional tax revenue. A problem with this variable is, however, that it shows not only a high degree of variation across states but also strong fluctuations in time.

3.3 Results

Table 2 provides results from alternative specifications. In order to control for the heterogeneity of states, state fixed effects are included. Since the tax policy will need some time

Table 2: Determinants of States' Business Tax Rate Averages

Variable	(1)		(2)		(3)		(4)		(5)	
Collection rate, lag	.8880	**	.8968	**	.8911	**	.8887	**	.8899	**
	(.0316)		(.0343)		(.0322)		(.0324)		(.0330)	
Standardized business tax base, log, lag	-15.24	**	-12.30	**	-15.28	**	-15.06	**	-14.96	**
	(2.825)		(3.993)		(2.841)		(2.864)		(2.892)	
State debt service, log	4.077	**	4.933	**	3.839	**	4.019	**	4.014	**
	(1.261)		(1.673)		(1.268)		(1.270)		(1.277)	
Municipal debt service, log	3.318	**	3.221	**	3.318	**	3.458	**	3.400	**
	(1.495)		(1.514)		(1.561)		(1.533)		(1.542)	
State parliament election year	-.3203		-.3201		-.2464		-.1931		-.2034	
	(.8149)		(.8218)		(.8262)		(.8179)		(.8187)	
Municipal council election year	-1.587	**	-1.638	**	-1.603	**	-1.501	**	-1.498	**
	(.7105)		(.7096)		(.7157)		(.6821)		(.6820)	
Population, log	35.96	**	47.17	**	39.39	**	32.53	**	31.31	**
	(10.48)		(20.75)		(13.17)		(12.89)		(13.10)	
State marginal contribution rate					-.0352		-.0128		-.0138	
					(.0285)		(.0307)		(.0311)	
State (net-)equalization revenue					-.0026		-.0254	*	-.0258	*
					(.0119)		(.0135)		(.0137)	
Relative fiscal capacity					-5.686		297.8	**	-131.5	
					(17.55)		(146.8)		(1488.0)	
Relative fiscal capacity (quadratic)							-160.2	**	258.5	
							(77.88)		(1467.0)	
Relative fiscal capacity (cubic)									-135.0	
									(480.1)	
R-squared (adjusted)	.9788		.9789		.9786		.9790		.9789	

All specifications include state-specific fixed effects. Robust standard errors in parentheses. If significant at the 5% (10%) level coefficients are marked with two stars (one star). Specification (2) includes a cubic trend.

to adjust the lag of the tax rate is included. We also control for the tax base, but since the current tax base is co-determined by the current tax rate, only the lag of the tax base is employed. Specification (1) uses a basic set of explanatory variables, specification (2) additionally employs some cubic trend-polynomial in order to test for the importance of common trends. Specification (3) to (5) test for an impact of the state-level fiscal equalization system including also terms capturing the differences in fiscal capacity.

The strong effect of the lagged collection rate supports a standard partial adjustment process. With regard to elections the political business cycle hypothesis is confirmed in the sense that current municipal council elections do exert the expected negative effect. Elections for the state government are not found to exert an impact on taxation. With regard to the debt service, we find not only that the municipal debt service exerts a significant impact on the local tax rate but also that the burden of debt service at state-level proves significant across all specifications. In the light of Propositions 1 and 2 this supports the view that the availability of fiscal resources at the state level exerts an impact on the tax policy of local jurisdictions. While we cannot say whether this effect is the consequence of changes in the local revenue sharing system as the above theory suggests, this result raises doubts whether the state government should really be considered as pursuing policies only in the interest of municipalities.

With regard to incentives generated by the state-level fiscal equalization system note that the specifications test for the effects conditional on (relative) fiscal capacity. This is important in order to make sure that the results capture the impact of fiscal equalization rather than simply reflecting differences in the taxing capacity. In order to make sure that also no non-linear differences in the fiscal capacity are driving the result, specifications (4) and (5) employ quadratic and cubic specifications, respectively. The results support an impact of the volume of transfers received. Since net-revenue from equalization may be negative it is entered in per-capita terms. In order to compare the magnitude of the estimate with that of an increase in the state's debt burden we have to evaluate the semi-elasticity obtained for the debt burden at the mean. Using the figure of 143 € per capita as depicted in Table 1, we obtain an average marginal effect of the state debt service of about .028 which has a

similar magnitude in absolute terms as the effect of the net-equalization revenue. Thus, the point estimates imply that an increase in state revenue or a decline in the debt burden of about 100 € per capita leads to a reduction in the collection rate by 2.5 or 2.8 percentage points, *i.e.* 0.13 to 0.14 percentage points in the statutory tax rate in the short run, or about 1.2 to 1.3 percentage points in the long run.[5] The marginal contribution rate, which determines to what extent net-transfers received shrink given an increase in business tax revenue, shows no significant effect. This variable, however, shows rather strong fluctuations since the system of fiscal equalization not only responds in a non-linear fashion to the fiscal capacity of the considered state but also in a non-linear way on the fiscal capacity of the other states. This makes it very hard to identify incentive effect of fiscal equalization at the state level.

Taken together we can state that the empirical analysis provides partial confirmation of the above theoretical predictions.[6] The results obtained for the states' debt service and the states' transfer revenues suggest that the position of the state government's budget line has a significant effect on the level of taxation chosen by the local governments in a state: a decline in available fiscal resources at the state level causes an increase in local tax rates. Broadly seen, this is in line with Proposition 2, which provides the argument that the government assigns some value to its own funds such that it extracts fiscal resources from the local governments. By contrast, the third prediction, from Proposition 3, is not confirmed. However, as we have just argued it seems likely that this failure is related to the statistical properties of the state-level fiscal equalization system.

[5]The latter calculation takes account of an estimate for the coefficient of the lag of the collection rate of about 0.89.

[6]Similar results have been obtained for Canadian provinces. Esteller-Moré and Solé-Ollé (2002) find that provinces which receive equalization grants set higher personal income tax rates if the contribution rate to the equalization system is increased. Karkalakos and Kotsogiannis (2005) show that an increase in the volume of federal grants received induces provinces to reduce their corporate income tax rates.

4 Conclusions

The recent literature has emphasized that redistributive grant systems may tend to internalize fiscal externalities arising from tax competition (Bucovetsky and Smart, 2002, Köthenbürger, 2002), at least to some extent. While the existence of redistributive grant systems might explain why local governments make use of distortive taxes despite of tax competition (Smart, 1998, Buettner, 2005), it is difficult to derive policy recommendations. The reason is that the welfare implications from tax competition and tax coordination strongly depend on the government objectives.

Given this background the current paper has explored the conditions under which redistributive grant systems will or will not achieve efficiency in local finances. We have considered a standard model of tax competition of local jurisdictions and introduced a system of redistributive grants executed at the state level. The basic model has then been extended in order to allow for variations in the government objectives at the state level. The theoretical results suggest that similar to the literature on vertical tax competition (Keen and Kotsogiannis, 2003, Wrede, 1998) attempts of upper level governments to extract fiscal resources from the local revenue sharing system will tend to undermine efficiency of local finances, and, possibly, even result in excessive equalization.

These concerns are corroborated by the empirical analysis of tax policy in Germany. The results from our empirical analysis of tax policy in Germany suggest that attempts of state governments to extract fiscal resources from the municipal revenue sharing system exert an upward pressure on tax rates. While we cannot say whether this effect is the consequence of changes in the local revenue sharing system as the above theory suggests, this result raises doubts whether the state government should really be considered as pursuing policies only in the interest of municipalities. The results of the paper support concerns that the potential benefits from local revenue sharing cannot be reaped if the state, as the institution enforcing the revenue sharing system at the local level, pursues own policies and operates under conditions which cause inefficiencies at the state level.

Appendix A: Proofs

Equivalence of (4) and (9). Since $\frac{\partial \tau_i}{\partial \vartheta_i} \neq 0$, the expression in brackets in (9) must be zero in an optimum. Computing

$$\frac{\partial V^2}{\partial \tau_i} = -k_i + (s_i - k_i)\frac{\partial r}{\partial \tau_i} + \alpha_i \frac{\partial v}{\partial z_i}\left(k_i + (\tau_i - \vartheta_i)(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i})\right)$$
$$+ \sum_{j \neq i}(s_j - k_j)\frac{\partial r}{\partial \tau_i} + \left(\sum_{j \neq i} \alpha_j \frac{\partial v}{\partial z_j}(\tau_j - \vartheta_j)\frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i}\right)$$

and using $\alpha_i \frac{\partial v}{\partial z_i} = \alpha_j \frac{\partial v}{\partial z_j} = \lambda^2$ for all i, j, condition (9) is so equivalent to

$$-k_i + (s_i - k_i)\frac{\partial r}{\partial \tau_i} + \lambda^2\left(k_i + (\tau_i - \vartheta_i)(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i})\right) \tag{A.1}$$
$$+ \sum_{j \neq i}(s_j - k_j)\frac{\partial r}{\partial \tau_i} + \lambda^2 \sum_{j \neq i}(\tau_j - \vartheta_j)\frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i} + \lambda^2\left(\vartheta_i \frac{\partial k_i}{\partial \tau_i} + \sum_j \vartheta_j \frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i}\right) \stackrel{!}{=} 0$$

Close inspection of (A.1) reveals that the terms involving the contribution rates ϑ_i and ϑ_j cancel out. Hence, since from (7), $\lambda^2 = \alpha_i \frac{\partial v}{\partial z_i} = \alpha_j \frac{\partial v}{\partial z_j}$ for all i, j, we are back with the first best optimality condition (4).

Calculation of the optimal contribution rate. Inserting the optimality condition from the perspective of the individual jurisdiction (5) in (4), using $s_j = k_j$ for all j, dividing by $\alpha_i \frac{\partial v}{\partial z_i} = \alpha_j \frac{\partial v}{\partial z_j} > 0$, and observing that in the symmetric situation, $\tau_j = \tau$ for all j, we obtain

$$\vartheta_i\left(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i}\right) = -\tau \sum_{j \neq i}\frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i}.$$

Differentiating the capital market equilibrium condition with respect to τ_i, one finds

$$\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i} = \frac{\partial s}{\partial r}\frac{\partial r}{\partial \tau_i} - \sum_{j \neq i}\frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i}.$$

Thus,

$$\vartheta_i = \tau \left(1 - \frac{\frac{\partial s}{\partial r}\frac{\partial r}{\partial \tau_i}}{\frac{\partial s}{\partial r}\frac{\partial r}{\partial \tau_i} \; - \; \sum_{j \neq i} \frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i}} \right).$$

Notice that in the symmetric situation, $\frac{\partial k_j}{\partial r}$ is identical for all jurisdictions j, say $\frac{\partial k}{\partial r}$. Then, dividing the numerator and the denominator of the fraction in the bracket by $\frac{\partial r}{\partial \tau_i} \neq 0$ and multiplying both by $\frac{r}{nk}$ yields $\vartheta_i = \vartheta^*$ as in (10).

Appendix B: Data Sources and Definitions

The basic dataset consists of annual data for Germany in the period 1970 until 2003. The population and GDP data are obtained from the federal statistical office (Statistisches Bundesamt). The same applies to the average collection rates, the standardized business tax revenues (Gewerbesteuergrundbetrag) as well as the data on debt service. Business tax revenue sharing contributions (Gewerbesteuerumlagesätze) are obtained from the federal ministry of finance (Bundesministerium der Finanzen).

Average collection rates of the business tax (Gewerbesteuer) are averages of the municipalities' collection rates (Hebesätze) for the years (Rechnungsjahre) 1970-2003 weighted by the tax base.

State net-equalization revenue and **marginal contribution rates** and **relative fiscal capacity** are obtained from a full implementation of the fiscal equalization law and further relevant statutory definitions for each year in the period 1970-2003 (a description of the system is given in Appendix C). Federal fiscal equalization rules (Finanzausgleichsgesetz - FAG) are obtained from the Bundesgesetzblatt. Data for calculating fiscal capacity (Finanzkraftmesszahl) and fiscal need (Ausgleichsmesszahl) are taken from the annual enactments to implement the fiscal equalization law (Zweite Verordnung zur Durchführung des Gesetzes über den Finanzausgleich zwischen Bund und Ländern in den Ausgleichsjahren 1970 - 2002). These enactments are also obtained from the Bundesgesetzblatt. Relative fiscal capacity is defined as the ratio of fiscal capacity to fiscal need.

Debt service is defined as annual interest expenses net of interest income.

Election years for state and local elections are obtained from the Friedrich-Naumann Stiftung (Archiv des Liberalismus).

Appendix C: State-Level Fiscal Equalization in Germany

In order to capture the incentive effects of the state-level fiscal equalization system (SFES) in Germany, we employ a simulation program to calculate transfers received as well as marginal contribution rates. The full implementation of the fiscal equalization rules into the simulation program enables us to compute various parameters of the SFES. The calculations are based on population and tax data for the German states ("Bundesländer"). The following briefly describes the system in its current state (2004).

The treatment of a state within the system depends on the ratio of its fiscal capacity ("Finanzkraftmesszahl") and its fiscal needs ("Ausgleichsmesszahl"). We will refer to this ratio as the relative fiscal capacity. A state's fiscal capacity t_i is determined by the sum of its tax revenues from different types of taxes.[7] Fiscal needs n_i are calculated by multiplying the average per capita tax revenues in the federation by the state's population. Formally

$$n_i = \frac{\sum_j t_j}{P} p_i,$$

where P represents the overall population while p_i denotes the population in state i. States with fiscal capacity below fiscal needs receive transfers, while states with a fiscal capacity exceeding fiscal need contribute to the system.

The German SFES contains three different stages:

- VAT Equalization ("Umsatzsteuervorwegausgleich")

[7] In the SFES the following main types of taxes are taken into account: income tax, corporate income tax, VAT and excise and sales taxes, and a fraction of the municipal taxes.

- State Fiscal Equalization ("Finanzausgleich i.e.S.")
- Federal Grants ("Bundesergänzungszuweisungen")

VAT Equalization In the first stage of the SFES up to 25 % of the overall VAT revenues are used to compensate fiscal capacity differences between the German states. States with a relative fiscal capacity below one receive transfers

$$z_{i1} = \gamma_1(\frac{t_{i1}}{n_{i1}})n_{i1}\,,$$

where the transfer rate in stage one of the SFES, γ_1, represents a function of the state's relative fiscal capacity.[8] To see how a marginal increase in the tax revenues in state i affects the transfers received in stage one, note that

$$\frac{\partial z_{i1}}{\partial t_{i1}} = \gamma_1' \left[\frac{n_{i1} - \frac{p_i}{P}t_{i1}}{n_{i1}}\right] + \gamma_1 \frac{p_i}{P} = \gamma_1' \left[1 - \frac{t_{i1}}{\sum_j t_{j1}}\right] + \gamma_1 \frac{p_i}{P} < 0.$$

The first term captures the effect of a decreasing transfer rate on z_{i1}. As $\gamma_1' < 0$, since an increase in fiscal capacity lowers the transfer rate, this term is negative. Taking into account that an increase in the fiscal capacity of state i will also have a positive impact on its fiscal need, the second summand is positive. The overall effect for a low capacity state, i.e. a state which is characterized by a relative fiscal capacity below one, is negative indicating that an increase in tax revenues will reduce the amount of transfers the state receives within the SFES.

On the other hand, also high fiscal capacity states will be affected by stage one. A marginal increase in the tax revenues will not only raise fiscal capacity in this state but will also raise fiscal need in state i as well as in all other states. Low capacity states will then receive additional transfers within VAT Equalization, which are financed out of the overall VAT

[8]Note that in the VAT Equalization stage only the state revenues are taken into account. In stage two and three fiscal capacity will also include a fraction of the municipal tax revenues as well as the VAT revenues.

revenue. Therefore the high capacity state i will have to contribute the additional amount

$$\frac{\partial c_{i1}}{\partial t_{i1}} > 0$$

to the SFES. Here c_{i1} denotes the contribution rate for a high capacity state within VAT Equalization.

Fiscal Equalization In the second stage of the SFES fiscal capacity differences which remain after VAT Equalization are further reduced. As in stage one, low capacity states receive transfers

$$z_{i2} = \gamma_2(\frac{t_{i2}}{n_{i2}})n_{i2}$$

depending on their relative fiscal capacity. The only difference is that now also VAT revenues as well as revenues from municipal taxes are taken into account for calculating t_{i2} and n_{i2}. The effect of an increase in fiscal capacity $\frac{\partial z_{i2}}{\partial t_{i2}}$ is equivalent to stage one.

In the Fiscal Equalization stage high fiscal capacity states, i.e. states which are characterized by a relative fiscal capacity above one, contribute the amount

$$c_{i2} = \delta_2(\frac{t_{i2}}{n_{i2}})n_{i2}.$$

The contribution rate δ_2 represents a function of the relative fiscal capacity in state i. Then the marginal effect of an increase in the fiscal capacity in state i reads

$$\frac{\partial c_{i2}}{\partial t_{i2}} = \left[1 - \frac{t_{i2}}{\sum_j t_{j2}}\right] \delta_2' + \delta_2 \frac{p_i}{P} > 0.$$

Note that the $\delta_2' > 0$ indicating that an increase in fiscal capacity will lead to a higher contribution rate. Again we can distinguish two different effects. The effect due to an increased contribution rate as well as an effect which arises from the fact, that an increase in the fiscal capacity in state i will increase fiscal need in all states. Both effects are positive leading to an overall increase in state i's contributions to the SFES.

Federal grants If a state's relative fiscal capacity lies below 0.995 after the stages one and two it will in addition receive transfers from the federal level, formally

$$z_{i3} = 0.775\,[0.995 n_{i3} - t_{i3}] = 0.771 n_{i3} - 0.775 t_{i3}.$$

Differentiating with respect to fiscal capacity in state i yields

$$\frac{\partial z_{i3}}{\partial t_{i3}} = 0.771 \frac{p_i}{P} - 0.775 < 0.$$

As this partial derivative is negative an increase in the fiscal capacity of a low capacity state i will lead to a decrease in grants from the federal government.

Marginal Contribution Rates for the SFES The marginal contribution rates for the different stages of the SFES were calculated as follows.

For low capacity states

$$\vartheta_{i1} = |\frac{\partial z_{i1}}{\partial t_{i1}}|, \quad \vartheta_{i2} = |\frac{\partial z_{i2}}{\partial t_{i2}}|, \quad \vartheta_{i3} = |\frac{\partial z_{i3}}{\partial t_{i3}}|.$$

For high capacity states

$$\vartheta_{i1} = \frac{\partial c_{i1}}{\partial t_{i1}}, \quad \vartheta_{i2} = \frac{\partial c_{i2}}{\partial t_{i2}}.$$

By adding the marginal contribution rates from the different SFES stages one receives the overall marginal effect of an increase in a state's tax revenues. For practical reasons the simulations assume a tax increase by one percent. Then, for example, the mean marginal contribution rate of 43 % indicates that only 57 cent of the additional taxes remain in the state budget due to increased contributions or reduced transfers within the SFES.

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