Intergovernmental Grants and Public Input Provision: Theory and Evidence from Germany

Sebastian Hauptmeier

ZEW

Zentrum für Europäische
Wirtschaftsforschung GmbH

Centre for European
Economic Research

Intergovernmental Grants and
Public Input Provision:
Theory and Evidence from Germany

Sebastian Hauptmeier

Non-Technical Summary

There exists a broad literature on fiscal competition which, so far, has mainly focussed on the aspect of tax competition. The standard argument states that competing governments lower their tax rates in order to attract a mobile tax base, thereby neglecting negative externalities which arise for other jurisdictions. The bottom line is an inefficiently low level of taxation and a relative underprovision of public goods. Recent theoretical literature suggests that fiscal externalities resulting from tax competition tend to be internalised by redistributive grant systems, thereby raising efficiency of local public finances. Empirical research supports the view that revenue sharing exerts a strong impact on jurisdictions' tax policy.

An aspect which has attracted far lesser attention in the literature on fiscal competition is that local governments may also compete for mobile tax bases via the provision of productivity-enhancing public goods. Theoretical research suggests that fiscal competition in the presence of a public input to production leads to a bias in the local spending mix, i.e. a relative overprovision of this public input and a relative underprovision of a purely consumptive public good. Here, we use a simple model of fiscal competition and introduce a system of redistributive grants. As we assume tax policy to be coordinated at the federal level, local jurisdictions can only attract the mobile tax base by providing a productivity-enhancing public input. Using this framework of "expenditure competition" we analyse how fiscal equalisation transfers affect the local spending mix. We find that a higher degree of redistribution induces the local governments to rebalance their expenditure towards a higher share of purely consumptive spending. As the provision of federal expenditure matching grants constitutes a way of correcting positive fiscal externalities due to public input provision we also expand our framework in order to analyse the effects of federal co-financing on the pattern of local public spending.

The implications from the theoretical analysis are finally tested in the

course of an empirical analysis of German state expenditure policies. Germany is a very interesting case to study in this context as tax rates for the most important tax sources are set coordinately at the federal level and, on the other hand, states can rather freely decide on the composition of the expenditure side of their budgets. Also, Germany is characterised by a complex system of intergovernmental grants. The results from our panel analysis indicate that fiscal equalisation transfers exert an incentive effect on state expenditure policies as suggested in our theoretical analysis. We find that a revenue-neutral increase in the marginal contribution rate to the fiscal equalisation system induces local jurisdictions to increase the overall budgetary share of consumptive public goods.

Intergovernmental Grants and Public Input Provision: Theory and Evidence from Germany

Sebastian Hauptmeier[†] (ZEW)

January 2007

Abstract: This paper uses a simple model of fiscal competition between local jurisdictions to analyse the impact of intergovernmental grants on the composition of public spending. We find that a higher degree of redistribution within a system of "fiscal equalisation" coincides with a smaller overall share of spending on productivity-enhancing public inputs. Furthermore, in order to test the theoretical predictions, we carry out an empirical analysis based on a panel of German states. The results are consistent with the theoretical findings and support the existence of an incentive effect of intergovernmental grants on state expenditure policies.

Key Words: Fiscal competition; Fiscal equalisation; Intergovernmental grants; Public expenditure; Germany

JEL Classification: H72, H77

[†]Centre for European Economic Research (ZEW), L7,1, D-68161 Mannheim, phone: +49 621 1235 143, email: hauptmeier@zew.de.

1   Introduction

The literature on fiscal competition has so far mainly focussed on the aspect of tax competition. The standard argument states that competing governments lower their tax rates in order to attract a mobile tax base, thereby neglecting negative externalities which arise for other jurisdictions. The bottom line is an inefficiently low level of taxation and relative underprovision of public goods (e.g., Zodrow and Mieszkowski, 1986). Recent literature (e.g., Koethenbuerger, 2002; Bucovetsky and Smart, 2006) suggests that fiscal externalities resulting from tax competition tend to be internalised by redistributive grant systems, thereby raising efficiency of local public finances. Previous empirical research by Buettner (2006) supports the view that revenue sharing exerts a strong impact on jurisdictions' tax policy. An aspect which has attracted far lesser attention in the literature on fiscal competition is that local governments may also compete for mobile tax bases via the provision of productivity-enhancing public goods. Fuest (1995) argues that the interaction of tax and expenditure policies needs to be taken into account when analysing interjurisdictional competition in the presence of a publicly provided input to production. Moreover, Keen and Marchand (1997) use a standard framework of fiscal competition and show that without coordination there arises the tendency for a systematic bias in the composition of local public spending, i.e. a relative overprovision of public inputs and a relative underprovision of purely consumptive public goods.

Given this background we use a simple model of fiscal competition and, similar to Bucovetsky and Smart (2006), introduce a system of redistributive grants. As we assume tax policy to be coordinated at the federal level, local jurisdictions can only attract the mobile tax base by providing a productivity-enhancing public input. Using this framework of expenditure competition we analyse how fiscal equalisation transfers affect the local spending mix. We find that a higher degree of redistribution induces the local governments

to rebalance their expenditure towards a higher share of purely consumptive spending. As the provision of federal expenditure matching grants constitutes a way of correcting positive fiscal externalities due to public input provision (see, e.g., Dahlby, 1996) we also expand our framework in order to analyse the effects of federal co-financing on the pattern of local public spending.

The implications from our theoretical analysis are finally tested in the course of an empirical analysis of German state expenditure policies. Germany is a very interesting case to study in this context as tax rates for the most important tax sources are set coordinately at the federal level and, on the other hand, states can rather freely decide on the composition of the expenditure side of their budgets. Also, Germany is characterised by a complex system of intergovernmental grants. The results from our panel analysis indicate that fiscal equalisation transfers exert an incentive effect on state expenditure policies as suggested in our theoretical analysis. We find that a revenue-neutral increase in the marginal contribution rate to the fiscal equalisation system induces local jurisdictions to increase the overall budgetary share of consumptive public goods.

The paper proceeds as follows. In section 2 we conduct the theoretical analysis and derive testable empirical implications. Section 3 then describes the empirical analysis of state expenditure policy in Germany. Conclusions are drawn in section 4.

2 Theoretical Analysis

2.1 The Model

The theoretical analysis considers a federation where a numeraire output is produced in each state using immobile labor L, perfectly mobile capital K and a publicly provided input P. The common production technology $F(L, K, P)$ is assumed to be linear homogenous with respect to labor and capital. The

public input P is of the factor-augmenting type and raises marginal productivity of the primary input factors, capital and labor. For analytical convenience labor is normalised to unity and we assume that firms in jurisdiction i produce according to the following (per labor unit) production technology:

$$f(k_i, P_i) \; = \; k_i^\alpha \left(P_i^\beta k_i^{-\gamma} \right), \quad 0 < \gamma < \beta, \quad \alpha > \gamma, \quad (\alpha - \gamma) + \beta \leq 1 \qquad (1)$$

The impact of public inputs is modelled by introducing a shift-term, $\left(P_i^\beta k_i^{-\gamma} \right)$, into the production function which captures total factor productivity.[3] β captures the productivity impact of the publicly provided input to private production. We allow for crowding effects as the productivity effect P_i^β of public input provision is scaled by the factor $k_i^{-\gamma}$, where γ captures the degree of rivalry in the use of P_i. Only if $\gamma = 0$ the public input is completely nonrivalrous and corresponds to a pure public good. In the other extreme, if $\gamma = \beta$, the locally provided public input features a private good characteristic. Furthermore, we assume that the production function exhibits non-increasing returns to scale, i.e. $(\alpha - \gamma) + \beta \leq 1$.

The states finance themselves by a source-based tax on capital $\bar{\tau}$, which is set in coordination with the upper-level government and therefore can not be altered by the individual jurisdictions. Free capital mobility and profit maximisation by firms then yields the following marginal productivity condition for local investment

$$\frac{\partial f(k_i, P_i)}{\partial k_i} \; = \; (\alpha - \gamma) \; k_i^{\alpha - (1+\gamma)} \; P_i^\beta \; = \; r + \bar{\tau}, \qquad (2)$$

which implies demand for capital $k_i = \phi(r + \bar{\tau}, P_i)$. Note that congestion is not treated as an externality in our setting as firms take into account congestion effects when maximising profits. From the profit maximisation condition we can derive

$$\frac{\partial k_i}{\partial r} \; = \; \frac{1}{\frac{\partial^2 f(k_i, P_i)}{\partial k_i^2}} \; = \; \frac{1}{\left((\alpha - \gamma)^2 - 1 \right) k_i^{\alpha - (2+\gamma)} P_i^\beta} \; < \; 0$$

---

[3]For an overview on different treatments of public inputs in the literature see Feehan (1989) and **?**.

3

indicating that a higher net interest rate r reduces demand for capital in jurisdiction i. Total supply of capital to the federation is given by the positive funtion $s(r)$ and therefore the capital market equilibrium is given by

$$\sum_i k_i = \sum_i s_i + s(r), \tag{3}$$

where s_i denotes per capita endowment with capital in the jurisdiction.

There is a single household in each state, which derives utility from a private good c_i and a public good Z_i. Preferences are quasi-linear according to the following utility function:

$$u_i = c_i + \delta v(Z_i) \tag{4}$$

Consumers receive total factor income and therefore private consumption in jurisdiction i is given by

$$c_i = k_i^{\alpha} \left(P_i^{\beta} k_i^{-\gamma} \right) - k_i (r + \bar{\tau}) + s_i r.$$

The state government's budget constraint is

$$b_i = Z_i + P_i = \bar{\tau} k_i + g_i,$$

where g_i corresponds to grants from the federal government. As our primary concern is not so much with the levels of public spending on Z_i and P_i but rather the public expenditure mix, we substitute $P_i = \lambda_i b$ and $Z_i = (1 - \lambda_i) b_i$ into (4), where λ_i denotes the overall budgetary share of spending on the public input P_i.

This leads to the following unconstrained maximisation problem:

$$\max_{\lambda} \ u_i = k_i^{\alpha} \left((\lambda_i b_i)^{\beta} k_i^{-\gamma} \right) - k_i (r + \bar{\tau}) + s_i r + \delta v \left((1 - \lambda_i) b_i \right) \tag{5}$$

The first order condition for the optimal expenditure structure λ_i^* can then be written as

$$\frac{\partial u_i}{\partial \lambda_i} = k_i^{\alpha - \gamma_i} \beta P_i^{\beta - 1} \left(b_i + \lambda_i \frac{\partial b_i}{\partial \lambda_i} \right) \tag{6}$$

$$- \delta v' \left(b_i - (1 - \lambda_i) \frac{\partial b_i}{\partial \lambda_i} \right) + (s_i - k_i) \frac{\partial r}{\partial \lambda_i} \overset{!}{=} 0,$$

where $\frac{\partial b_i}{\partial \lambda_i} = \bar{\tau}\left(\frac{\partial k_i}{\partial \lambda_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \lambda_i}\right)$ denotes the positive tax revenue effect due to an increase in λ_i.[4] Therefore, in spite of the assumption that $\bar{\tau}$ is exogenous to the local jurisdiction, which rules out capital tax competition within the federation, we observe competition for the mobile tax base k via the local spending decision. Note that, for simplicity, in the following we procede as in Buettner, Hauptmeier, and Schwager (2006) and assume that in equilibrium net supply of capital to the state equals zero, i.e. $s(r) = 0$. Then in all jurisdictions capital demand k_i is supplied by capital endowment s_i.

Compositional Inefficencies in Local Public Spending Rearranging (6) shows that the positive tax base effect of an increase in the expenditure structure λ_i results in a wedge between $k_i^{\alpha-\gamma}\beta P_i^{\beta-1}$, the (net) marginal product of P_i, and $\delta v'$, the marginal utility of Z_i:

$$\left(k_i^{\alpha-\gamma}\beta P_i^{\beta-1} - \delta v'\right)\left(b_i + \lambda_i\frac{\partial b_i}{\partial \lambda_i}\right) = -\delta v'\frac{\partial b_i}{\partial \lambda_i} \tag{7}$$

It follows from equation (7) that in the local government optimum $k_i^{\alpha-\gamma}\beta P_i^{\beta-1} < \delta v'$. Therefore, although standard tax competition literature suggests that a coordinated tax policy enables governments to provide public goods efficiently, i.e. $k_i^{\alpha-\gamma}\beta P_i^{\beta-1} = \delta v' = 1$, we observe a distortion of the local spending decision due to the productivity effect of public input provision. This finding is in line with Fuest (1995), who argues that when analysing fiscal competition one needs to take into account both, taxes and public expenditure. Keen and Marchand (1997) broach the issue of the impact of fiscal competition on the pattern of public spending and come to the conclusion that public inputs are relatively overprovided in an uncoordinated equilibrium. Their finding can easily be reproduced within our setting as a revenue

---

[4]Note that $\frac{\partial k_i}{\partial \lambda_i} > 0$, which means that a higher overall share of spending on public inputs leads to a higher marginal productivity of capital and therefore to a capital inflow into jurisdiction i. The impact of an increase in λ_i on net interest rate r can be derived by implicitly differentiating capital market equilibrium condition (3). This yields $\frac{dr}{d\lambda_i} = -\frac{\frac{\partial k_i}{\partial \lambda_i}}{\sum_j \frac{\partial k_j}{\partial r} - \frac{\partial s}{\partial r}} > 0$. As $\frac{\partial k_i}{\partial r} < 0$, an increase in λ_i also has an adverse interest rate effect on capital demand in jurisdiction i. Nevertheless, as this effect is of second order it follows from the Envelope Theorem that $\left(\frac{\partial k_i}{\partial \lambda_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \lambda_i}\right) > 0$.

neutral switching from P_i to Z_i, i.e. $dZ_i = -dP_i$, yields the following utility effect:

$$du_i = \left(k_i^{\alpha-\gamma} \beta P_i^{\beta-1} - \delta v' \right) dP_i > 0 \tag{8}$$

The gap between marginal productivity of P_i and marginal utility of Z_i, which, in equilibrium, arises from the productivity-enhancing characteristic of the public input, results in a positive welfare effect.

2.2 Introducing Fiscal Equalisation

In the equilibrium described above we observe compositional inefficiencies in public spending due to externalities which arise from the productivity effect of public input provision. Recent literature (e.g. Bucovetsky and Smart, 2006) suggests that efficiency of local public finances can be raised by introducing a system of fiscal equalisation which corrects for these externalities. Therefore, in this section we address the question how the implementation of a redistributive equalization scheme affects a state's provision of the tax-base-enhancing public input relative to its provision of the consumptive public good.[5]

As in Buettner, Hauptmeier, and Schwager (2006), we implement fiscal equalisation by setting a marginal contribution rate ϑ_i such that income from grants g_i is a linear function of the tax base

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

With this modification the state's budget constraint changes to

$$b_i = Z_i + P_i = (\bar{\tau} - \vartheta_i) k_i + y_i,$$

where y_i corresponds to lump-sum grants from the federal government.

---

[5]See Dahlby (2002) for a theoretical analysis in the context of the Canadian equalisation system.

2.2.1 Fiscal Equalisation and the Composition of Public Spending

Now, in order to analyse the effects of fiscal equalisation on the local expenditure structure λ_i we conduct comparative static analysis by applying the implicit function theorem on f.o.c. (6). Implicit differentiation yields

$$\frac{d\lambda_i}{d\vartheta_i} = -\frac{\frac{\partial^2 u_i}{\partial \lambda_i \partial \vartheta_i}}{\frac{\partial^2 u_i}{\partial \lambda_i^2}}, \qquad \frac{d\lambda_i}{dy_i} = -\frac{\frac{\partial^2 u_i}{\partial \lambda_i \partial y_i}}{\frac{\partial^2 u_i}{\partial \lambda_i^2}}.$$

As the second order condition for our government optimisation problem, i.e. $\frac{\partial^2 u_i}{\partial \lambda_i^2} < 0$, holds it is obvious that $sgn(\frac{d\lambda_i}{d\vartheta_i}) = sgn(\frac{\partial^2 u_i}{\partial \lambda_i \partial \vartheta_i})$ and $sgn(\frac{d\lambda_i}{dy_i}) = sgn(\frac{\partial^2 u_i}{\partial \lambda_i \partial \vartheta_i})$. Therefore, in the following sections we will focus on the numerators, $\frac{\partial^2 u_i}{\partial \lambda_i \partial \vartheta_i}$ and $\frac{\partial^2 u_i}{\partial \lambda_i \partial y_i}$, when analysing the impact of variations in the fiscal equalization parameters ϑ_i and y_i on the expenditure structure λ_i chosen by the local jurisdiction.

Income Effect of Fiscal Equalisation   The first step is to analyse how an increase in federal grants affects the state's expenditure structure λ_i. Derivation of (6) with respect to y_i yields

$$\frac{\partial^2 u_i}{\partial \lambda_i \partial y_i} = \left(k_i^{\alpha-\gamma} \beta P_i^{\beta-1} - \delta v' \right) \tag{9}$$

$$+ \quad k_i^{\alpha-\gamma} \beta (\beta-1) P_i^{\beta-2} \left\{ \lambda_i \left(b + \lambda_i \frac{\partial b_i}{\partial \lambda_i} \right) \right\}$$

$$- \quad \delta v'' \left\{ (1-\lambda_i) \left(b_i - (1-\lambda_i) \frac{\partial b_i}{\partial \lambda_i} \right) \right\}.$$

The effect of higher federal grants on the marginal utility of λ_i consists of three terms. The first term captures the gap between (net) marginal product of P_i and the marginal benefit of Z_i which according to (7) is negative in the local government optimum. This triggers an incentive to reduce the share of public inputs when the federal government raises transfers y_i. In addition higher spending on (P_i) lowers its (net) marginal product (term 2) thereby

7

further increasing downward pressure on λ_i. As $(1 - \lambda_i)$ of the increase in federal grants is also spent on (Z_i), term 3 indicates that marginal utility of the public consumption good will also fall leading to an inverse effect on the marginal utility of λ_i. Therefore, the overall effect of an increase in y_i is ambiguous.

Incentive Effect of Fiscal Equalisation   In order to capture the incentive effect of fiscal equalisation we calculate the first derivative of f.o.c. (6) with respect to the marginal contribution rate ϑ_i

$$
\begin{aligned}
\frac{\partial^2 u_i}{\partial \lambda_i \partial \vartheta_i} = & \left(k_i^{\alpha-\gamma} \beta P_i^{\beta-1} - \delta v' \right) \left(\frac{\partial b_i}{\partial \vartheta_i} + \lambda_i \frac{\partial^2 b_i}{\partial \lambda_i \partial \vartheta_i} \right) \\
& + k_i^{\alpha-\gamma} \beta \left(\beta - 1 \right) P_i^{\beta-2} \left\{ \lambda \frac{\partial b_i}{\partial \vartheta_i} \left(b_i + \lambda_i \frac{\partial b_i}{\partial \lambda_i} \right) \right\} \\
& + \delta v' \frac{\partial^2 b_i}{\partial \lambda_i \partial \vartheta_i} - \delta v'' \left\{ (1 - \lambda_i) \frac{\partial b_i}{\partial \vartheta_i} \left(b_i + \lambda_i \frac{\partial b_i}{\partial \lambda_i} \right) \right\}.
\end{aligned}
\tag{10}
$$

Note that an increase in the marginal contribution rate induces both, a negative income effect due to higher contributions to the system and a substitution effect as public input provision becomes relatively more costly. The second effect arises because the positive tax base effect of public input provision is redistributed to a greater extent as the marginal contribution rate ϑ_i rises. In order to focus on the direct incentive effect of fiscal equalisation we analytically separate the income effect from the substitution effect by assuming that jurisdictional income losses are fully compensated by higher transfers y_i from the federal government, i.e. $db_i = -k_i \, d\vartheta_i + dy_i \stackrel{!}{=} 0$. This yields the revenue neutral effect of an increase in the marginal contribution rate:

$$
\frac{\partial^2 u_i}{\partial \lambda_i \partial \vartheta_i} = \triangle_{\lambda_i} k_i \left[\lambda_i \left(\delta v' - k_i^{\alpha-\gamma} \beta P_i^{\beta-1} \right) - \delta v' \right] < 0,
\tag{11}
$$

where $\triangle_{\lambda_i} k_i = \frac{\partial k_i}{\partial \lambda_i} + \frac{\partial k_i}{\partial r} \frac{\partial r}{\partial \lambda_i}$. Equation (11) shows that a revenue-neutral increase in the marginal contribution rate reduces the jurisdiction's optimal share of public inputs λ_i^*. The absolute value of the effect becomes larger as $\triangle_{\lambda_i} k_i$, the positive tax base effect of a higher share of public inputs, increases. This is quite intuitive as fiscal competition becomes fiercer if the negative spending externality rises. On the other hand, decreasing marginal productivity of P_i consequently leads to a reduction of the absolute value of the incentive effect as the share of productive spending and the gap between (net) marginal productivity of P_i and marginal utility of Z_i increase.

Proposition 1 (Incentive Effect of Fiscal Equalisation)
Starting from an interior solution, a revenue-neutral increase in the marginal contribution rate ϑ_i to the fiscal equalisation system will induce local jurisdictions to rebalance their budget towards a higher share of purely consumptive public goods.

Note that, in line with Bucovetsky and Smart (2006), full equalisation, i.e. $\bar{\tau} = \vartheta_i$, establishes efficiency of local public finances in our setting as f.o.c. (6) reduces to

$$\frac{\partial u_i}{\partial \lambda_i} = \left(k_i^{\alpha-\gamma} \beta P_i^{\beta-1} - \delta v' \right) y_i \overset{!}{=} 0 \qquad (12)$$

Therefore, full equalisation leads to an efficient local public spending mix as $k_i^{\alpha-\gamma} \beta P^{\beta-1} = \delta v' = 1$.

Corollary 1 (Efficient Equalisation)
First-best optimal local expenditure policies can be decentralised if full equalisation is implemented by setting $\bar{\tau} = \vartheta_i$ for all i.

2.3 Introducing Matching Grants

So far we have discussed fiscal competition in the context of a tax base enhancing public input whose provision exerts negative fiscal externalities due

to capital flows within the federation. However, productive public spending may also generate beneficial external effects.[6] As we observe fast diffusion of knowledge and high mobility of academics, public expenditure on research and higher education are often cited as examples for public spending categories inducing interregional spillovers. The positive externalities from providing these public goods are not internalized by the local decision-maker and therefore one typically observes relative underprovision. A possibility for correcting such inefficiencies in local public spending is to introduce expenditure matching grants by the federal government (e.g. Dahlby, 1996). Therefore, we extend our model by assuming that the federal government covers local spending on the public input P_i up to the matching rate m_i. This changes the local government's budget constraint as follows:

$$b_i = \frac{\bar{\tau} k_i + y_i}{(1 - m_i \lambda_i)}$$

In order to analyse the effect of an increase in the matching rate on the local expenditure structure λ_i we differentiate f.o.c. (6) with respect to m_i. Again, as in section 2.2.1, we analyse a revenue-neutral variation of the exogenous parameter as we want to focus on the direct incentive effect. Assuming $db_i = k_i \, dm_i - dy_i \overset{!}{=} 0$ then yields

$$\frac{\partial^2 u_i}{\partial \lambda_i \partial m_i} = \frac{1 + \lambda_i \left(m_i + \bar{\tau} \triangle_{\lambda_i} k_i \right)}{(1 - \lambda_i m_i)^2} \left[\lambda_i \left(k_i^{\alpha - \gamma} \beta P_i^{\beta - 1} - \delta v' \right) + \delta v' \right] > 0. \quad (13)$$

The positive sign of $\frac{\partial^2 u_i}{\partial \lambda_i \partial m_i}$ is straightforward as a higher matching rate reduces the cost of local public input provision. Therefore, an exogenous increase in m_i induces the local government to raise its expenditure structure λ_i. Because of the decreasing marginal product of P_i the absolute value of the effect decreases as λ_i and the gap between (net) marginal productivity of P_i and marginal utility of Z_i increase.

---

[6]See Dahlby (1996) for an overview of various tax and expenditure externalities.

Proposition 2 (Incentive Effect of Matching Grants)
Starting from an interior solution, a revenue-neutral increase in the federal matching rate m_i will induce local jurisdictions to rebalance their budget towards a higher share of public inputs.

3   Empirical Analysis

The above propositions are of particular relevance in the case of the German federation. While the German states lack taxing autonomy concerning their most important tax types (i.e., income and corporate tax, VAT) their competencies on the expenditure side of the budget are rather unrestricted. Moreover, state public finances are influenced by a complex system of vertical and horizontal grants.

Before presenting the underlying data set and the results from our regression analysis, for a better understanding, we give a brief description of the German system of intergovernmental grants in section 3.1. Also, we define "productive" state spending categories in section 3.2.

3.1   Intergovernmental Grants in Germany

Germany is characterised by a pronounced fiscal federalism. Besides the constitutionally mandated sharing of the main tax revenues ("Gemeinschaftsteuern"), a variety of intergovernmental grants lead to the fact that public finances of the different levels of state are strongly interlinked.

The German system of fiscal equalisation ("Bundesstaatlicher Finanzausgleich") includes both vertical and horizontal transfers. It mainly builds on two pillars, the state fiscal equalisation system ("Länderfinanzausgleich"), which contains vertical and horizontal elements, and federal grants ("Sonderbedarfs-Bundesergänzungszuweisungen") to the states. Within the first pillar states with a below average fiscal capacity receive horizontal transfers from fiscally strong states. Remaining fiscal capacity differences are then further re-

duced by federal transfers ("Fehlbetrags-Bundesergänzungszuweisungen").[7] Besides these capacity based vertical and horizontal transfers, the federal government provides grants, which presently mainly flow to the eastern German states due to the infrastructural backlog after reunification. All transfers within the German system of fiscal equalisation are regulated by law (FAG - "Finanzausgleichsgesetz").

The federal government also co-finances some constitutionally determined state spending categories. These so called "joint tasks" arise from the German Basic Law (Sec. 91(a) and 91(b)) and include the extension and construction of universities and university clinics[8], the improvement of regional economic structure as well as the improvement of the agricultural structure and coastal protection. Beyond financial aid the federal government also contributes via joint planning in the field of education and by promoting research of supraregional importance. Table (1) gives an overview of the most important intergovernmental grants in the fiscal year 2003.[9]

3.2 State Productive Spending

Since the emergence of endogenous growth theory in the mid 1980's a broad empirical literature has dealt with the growth effects of fiscal policy (e.g., Aschauer, 1989; Barro, 1991). Particularly, the impact of public spending on long-term economic growth has received substantial attention. While there is a predominant consensus in the literature that high public spending ratios and fiscal deficits exert negative growth effects (e.g., Kneller, Bleaney, and Gemmell, 1999; Bassanini, Scarpetta, and Hemmings, 2001), the empirical evidence on the growth-enhancing impact of some public spending categories is heterogenous. Nevertheless, there seems to be ample indication that "core" infrastructure spending in the fields of transport and communication (e.g.,

---

[7]See Appendix C for a detailed description of the German fiscal equalisation system.

[8]Note that in the course of a recent reform of German federalism which became effective in September 2006 the joint tasks "university construction" as well as "educational planning" have become state competencies.

[9]Due to data unavailability in 2003 the joint task "Research promotion" is reported for the year 2002.

Table 1: : Intergovernmental grants 2003

Grant	Mill. €	% of GDP
Fiscal equalisation:		
State transfers (fiscal capacity based)	6610	0.31
Federal transfers (fiscal capacity based)	2941	0.14
Conditional federal grants	15466	0.71
Joint tasks:		
University construction	1060	0.05
Regional economic structure	1158	0.05
Agricultural structure and coastal protection	734	0.03
Educational planning	89	0.004
Research promotion (2002)	3257	0.15

Source: "Zweite Verordnung zur Durchführung des Finanzausgleichsgesetzes 2003", Central Data Resource of the State Finance Ministers (ZDL) and own calculations.

Easterly and Rebelo, 1993) induces beneficial productivity effects. Moreover, the empirical evidence on the impact of public activities within the educational system is rather clear-cut and several publications come to the conclusion that public spending on education promotes economic growth.[10] Concerning expenditure on research and development the question whether public activities crowd out private investment is discussed quite controversial in the literature and empirical evidence is far from being clear-cut.[11] Though, as technological progress does not typically constitute a perfectly rival good, public R&D spending can be justified from an allocative point of view and should induce, at least minor, positive growth effects.

Thoene (2005) uses the insights from a review of empirical literature on the growth-effects of different public spending categories and applies them to the German system of budgetary accounting in order to develop an indicator

---

[10]See Buysse (2002) for a panel analysis of OECD countries.

[11]See Thoene (2005) for an overview of the empirical literature on this issue.

Table 2: : Aggregate State Spending 2003

Spending category	% of Primary spending	% of GDP
"Productive" spending categories		
Education:		
- Schools and pre-school education	15.16	2.33
- Universities	5.95	0.92
- Promotion of pupils students, etc.	1.25	0.19
- Research and Development (outside universities)	0.95	0.15
Infrastructure:		
- Streets	3.09	0.48
- Waterways and ports	0.09	0.01
- Rail and public transport	2.81	0.44
- Aviation	0.04	0.01
- Municipal services (sewer system, etc.)	4.28	0.66
Overall "productive" spending:	33.62	5.19
Reporting:		
Primary spending		15.37
Debt spending (% of overall spending and GDP)	7.33	1.22

Source: German statistical office and own calculations.

for the expenditure quality of the German levels of state. Leaving aside the sustainability aspect in our analysis, we basically follow this approach when calculating the expenditure structures for the German states. As public finances of the state and municipal level are strongly interlinked in Germany we use aggregated expenditure data from the German Statistical Office. Table (2) gives an overview of the identified "productive" spending categories for the aggregated German state level in 2003.

3.3 Data

Our empirical analysis is based on an annual database for the German states which covers the period between 1975 and 2003. Since data for the new states in former East Germany are only available from 1991 onwards our panel is unbalanced.

The database contains detailed information on the composition of state spending which we used to compute expenditure structures as described in section 3.2. Table 3 presents overall "productive" spending as well as spending on universities as a share of primary expenditure. Both variables show substantial variation within the German federation. The matching rate corresponds to the rate at which the federal government co-finances state spending in the field of university construction (See section 3.1). In addition, the database contains information about the treatment of each state in the fiscal equalisation system. More specifically, the database allows us to compute for each state and each year all contributions and transfers related to fiscal equalisation at the state level (see Appendix C). Equalisation transfers vary 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 70 % at the mean, indicating that on average a state has to transfer an amount of more than 70 cents out of each Euro of additional tax revenue.[12] We have also calculated standardized marginal contribution rates and fiscal equalisation transfers in order to account for a problem of endogeneity.[13] The data set also contains detailed information on federal grants to the German states.

Some further control variables are used to capture the relative fiscal strength of a state, fiscal stress (i.e. debt service and unemployment), the population size as well as the partisan composition of state governments. The latter will

---

[12]The negative minimum value constitutes an outlier resulting from the special case of the city state of Hamburg in 2002. Also, values above 100 % are rarely observed.

[13]Standardized marginal contribution rates and fiscal equalisation transfers are computed on the basis of average tax bases. See 3.4 for further details.

control for political preferences.

3.4 Estimation approach and results

The basic estimation equation we use to identify the determinants of state expenditure policies in Germany looks as follows:

$$\lambda_{i,t} = \alpha + \beta_1 \lambda_{i,t-1} + \beta_2 \vartheta_{i,t} + \beta_3 m_{i,t} + \beta_4 feqtrans_{i,t} \qquad (14)$$

$$+ \beta_5 fgrants_{i,t} + \sum_j \gamma_j x_{i,t,j} + \chi_i + \psi_t + \varepsilon_{i,t}$$

On the left-hand side we have productive spending as a share of primary spending, λ.[14] As we assume the decision on the expenditure structure to constitute a dynamic process, we take into account the lagged dependent variable on the right-hand side of our estimation equation. The central variables capturing the incentive effects of the system of intergovernmental grants in Germany are ϑ, the marginal contribution rate, and m, the rate at which spending is co-financed by the federal government. $feqtrans$ and $fgrants$ control for income effects due to fiscal equalisation transfers and federal grants and we implement a set of control variables x_i already described in section 3.3. Fixed effects χ_i are included to control for state heterogeneity and we implement a full set of time dummies ψ_t.

Table (4) provides results using overall productive spending (% of primary spending) as defined in Table (2) as the dependent variable. Specifications (1) uses the basic set of explanatory variables and specifications (2) and (3), following Buettner (2006), test for the impact of non-linear differences in fiscal capacity. We apply a standard Least Squares Dummy Variable Estimator (LSDV) in specifications (1) - (3) and estimate an unbalanced panel only including the former eastern German states from the year 1991 onwards. In order to control for differential developments in the years after reunification,

---

[14]See section (3.2).

Table 3: : Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Fiscal variables:				
Expenditure structure (productive spending) (in %)	33.84	4.115	22.66	41.44
Expenditure structure (university spending) (in %)	13.95	3.893	1.556	19.11
Matching rate (university construction) (in %)	46.65	10.86	22.36	100.0
Marginal contribution rate (in %)	73.35	25.61	-69.81	104.8
Marginal contribution rate, standardized (in %)	64.31	29.49	1.666	98.44
Fiscal equalisation transfers (€ per capita)	93.20	226.3	-451.5	973.5
Fiscal equalisation transfers, standardized (€ per capita)	206.6	367.4	-165.8	1702
Federal grants (€ per capita)	134.0	267.6	0	1478
Relative fiscal capacity (in %)	95.54	11.71	67.82	125.8
Debt Service (€ per capita)	274.8	182.9	-32.54	949.0
Political variables:				
Conservative government	.2912	.4550	0	1
Conservative coalition government	.1319	.3388	0	1
Social democratic government	.2170	.4128	0	1
Social democratic coalition government	.2692	.4442	0	1
Grand coalition	.0882	.2839	0	1
Other control variables:				
Unemployment rate (in %)	10.16	4.801	2.1	21.8
Population (in 1000)	5538	4810	655.8	18073

Annual data for 10 western (6 eastern) German States in the period 1975-2003 (1991-2003)

we include an eastern state dummy which we interact with the time dummies between 1991 and 1995.

The strong effect of the lagged expenditure structure supports a standard partial adjustment process. With regard to the incentives generated by the state fiscal equalisation system note that the specifications test for the effects conditional on (relative) fiscal capacity. This is important to make sure that the results capture the impact of the fiscal equalisation system rather than simply reflecting differences in fiscal strength. In order to make sure that also no non-linear differences in the fiscal capacity are driving the results, specifications (2) and (3) employ quadratic and cubic specifications, respectively. Note that due to the fact that the treatment within the system of fiscal equalisation is not exogenous to the states, there arises a problem of endogeneity concerning the fiscal equalization variables. As state governments can influence their position within the system via their economic policy the states' expenditure structures and fiscal equalization variables are determined simultaneously. Therefore, in order to overcome this problem of reverse causality, we compute standardized levels of fiscal equalisation transfers and marginal contribution rates using a simulation programme of the German fiscal equalisation system. For each state, the parameters are computed at average (per capita) levels of the tax revenues from the main tax sources, i.e. income and corporate taxes as well as the local business tax, thereby only capturing variation from population developments and presumably exogenous tax sources.[15]

The results in Table 4 support the direct incentive effect of the fiscal equalisation system as stated in Proposition 1. Controlling for income effects by taking into account the transfers received from or contributed to the system we find a significant negative impact of the marginal contribution rate in specifications (2) and (3). The point estimate in specification (3) implies that an increase in the marginal contribution rate by one percentage point

---

[15]See Appendix B for further details on the computation of the fiscal equalisation parameters.

Table 4: : Determinants of States' Expenditure Structures (Productive Spending)

Variable	(1) LSDV		(2) LSDV		(3) LSDV		(4) GMM	
Expenditure structure, lag	.6335	**	.6170	**	.6117	**	.6443	**
	(.0539)		(.0555)		(.0542)		(.0459)	
Marginal contribution rate	-.0050		-.0058	*	-.0062	*	-.0066	**
	(.0033)		(.0033)		(.0033)		(.0032)	
Fiscal equalisation transfers	-.0017	**	-.0018	**	-.0019	**	-.0022	**
	(.0007)		(.0007)		(.0007)		(.0006)	
Federal grants	.0004		.0005		.0004		.0008	**
	(.0005)		(.0006)		(.0005)		(.0003)	
Social democratic government	.6895	**	.6651	**	.5921	**	.7032	**
	(.2271)		(.2269)		(.2194)		(.2738)	
Social democratic coalition government	.5716	**	.5076	**	.4086	*	.6558	**
	(.2393)		(.2397)		(.2321)		(.2289)	
Unemployment rate	-.0300		-.0080		-.0086		-.0803	**
	(.0563)		(.0553)		(.0553)		(.0256)	
Population, log	2.263		3.011		3.982		6.209	**
	(3.813)		(3.810)		(3.667)		(1.908)	
Relative fiscal capacity	-.0466	**	.1697		-2.477	**	-.0468	*
	(.0184)		(.1731)		(1.233)		(.0270)	
Relative fiscal capacity (quadratic)			-.0011		.0263	**		
			(.0008)		(.0124)			
Relative fiscal capacity (cubic)					-.0001	**		
					(.0000)			
R-squared (adjusted)	.9343		.9346		.9360			
Arellano Bond test AR (1)							z = -2.36	
Arellano Bond test AR (2)							z = 0.22	

All specifications include state-specific and time fixed effects. Robust standard errors in parentheses. If significant at 5% (10%) level coefficients are marked with two stars (one star). Insignificant control variables are not reported and include debt service, political variables as well as an interaction dummy capturing differential developments in the eastern states after reunification.

leads to a decrease in the share of productive spending by 0.0062 percentage points. Taking into account that the difference between the highest and lowest marginal contribution rate in 2003 amounted to around 50 percentage points the short run incentive effect of fiscal equalisation may sum up to

a 0.33 percentage point lower share of productive expenditure. In the long run, taking into account the coefficient of the lagged productive expenditure structure, we observe an effect of up to 0.85 percentage points.

We also observe a highly significant and negative coefficient on the fiscal equalisation transfers, which could capture the effect that states who strongly depend on fiscal capacity based intergovernmental transfers have a lesser incentive to improve their quality of public finances as higher tax revenues will diminish transfers. On the other hand federal grants, which are not formula based, coincide with a higher share of "productive" spending, though this effect is not significant in specifications (1) - (3).

It is well known that inclusion of the lagged dependent variable in fixed effects models leads to biased estimates if the time dimension T of the panel is small. According to Nickel (1981) this bias approaches zero as T approaches infinity. As the average time dimension of our data set amounts to 21 years we do not expect severely biased estimates when using the LSDV estimator. Nevertheless, in addition we perform a one-step Arellano and Bond GMM estimation in specification (4) in order to account for this so-called Nickel bias.[16] The results confirm that the bias due to inclusion of the lagged dependent variable stays within limits. The coefficients on the marginal contribution rate ϑ as well as the fiscal equalisation transfers decrease only marginally when using GMM estimation techniques. In contrast, the federal grants now turn significant at the 5% level and the corresponding coefficient doubles compared to specification (3).

Also, we find that the partisan composition of the state government constitutes an important determinant of the expenditure structure. Again, this result does not change qualitatively when performing GMM estimation. Using the case of a conservative government as reference, we observe a significantly higher share of productive spending when the state government is social democratic or a social democratically led. It is also worthwhile notic-

---

[16]See Arellano and Bond (1991) for further details on this estimation technique.

ing that the control variables capturing fiscal stress, i.e. debt service and unemployment rate, show the expected negative sign but do not turn out to be significant in specifications (1) - (3). While debt service stays insignificant in specification (4) the unemployment rate becomes highly significant when using the GMM estimator. A higher unemployment rate therefore has a negative impact on the overall share of "productive" state spending. Moreover, we observe a significant positive impact of the population number when performing GMM.

In order to test Proposition 2, i.e. the impact of matching grants on state expenditure structures, we carry out further regressions focussing on state university spending. The reason for narrowing state productive spending to the university category is the fact that data on federal co-financing rates within the "joint-tasks" described in section 3.1, to our knowledge, is only available for the field of "university construction". Table 5 provides results using university spending as a share of primary spending as the dependent variable. We use the same specifications as described in Table 4. The results do not clearly support the incentive effect stated in Proposition 2. Although, as suggested by theory, the coefficient on the federal matching rate displays a positive sign the effect is only significant in specification (1).

Note that the inclusion of the federal matching rate does not qualitatively change the results from our earlier regression reported in Table 4. The fiscal equalisation variables show robust when accounting for the impact of matching grants, although the negative effect of the marginal contribution rate decreases in absolute value while the effect of fiscal equalisation transfers increases. However, the change in absolute values might also result from the fact that we are focussing on university spending now. It is also interesting that we observe different results concerning the political variables. Again, taking the case of a conservative government as reference, we now find significant positive coefficients on the dummy variables capturing the impact of coalition governments. The effect is independent of the fact who is lead-

Table 5: : Determinants of States' Expenditure Structures (University Spending)

Variable	(1) LSDV		(2) LSDV		(3) LSDV		(4) GMM	
Expenditure structure, lag	.5330	⋆⋆	.5314	⋆⋆	.5379	⋆⋆	.5186	⋆⋆
	(.0849)		(.0856)		(.0831)		(.0849)	
Matching rate	.0080	⋆	.0078		.0072		.0049	
	(.0050)		(.0051)		(.0072)		(.0038)	
Marginal contribution rate	-.0035	⋆	-.0038	⋆	-.0039	⋆	-.0043	⋆⋆
	(.0020)		(.0021)		(.0021)		(.0015)	
Fiscal equalisation transfers	-.0029	⋆⋆	-.0029	⋆⋆	.0021	⋆⋆	-.0025	⋆⋆
	(.0007)		(.0007)		(.0006)		(.0003)	
Federal grants	-.0000		-.0000		-.0000		-.0003	
	(.0004)		(.0003)		(.0003)		(.0002)	
Social democratic coalition government	.3329	⋆	.3066	⋆	.2688		.3297	
	(.1807)		(.1837)		(.1810)		(.2059)	
Conservative coalition government	.3125	⋆⋆	.3156	⋆⋆	.3205	⋆⋆	.3271	⋆
	(.1473)		(.1471)		(.1472)		(.1897)	
Unemployment rate	-.0385		-.0309		-.0310		-.0894	⋆⋆
	(.0449)		(.0448)		(.0449)		(.0441)	
Relative fiscal capacity	-.0661	⋆⋆	.0043		-.9403		-.0499	⋆⋆
	(.0172)		(.1035)		(.6484)		(.0090)	
Relative fiscal capacity (quadratic)			.1034		.0094			
			(.0005)		(.0065)			
Relative fiscal capacity (cubic)					-.0000			
					(.0000)			
R-squared (adjusted)	.9766		.9765		.9766			
Arellano Bond test AR (1)							z = -2.54	
Arellano Bond test AR (2)							z = 0.58	

All specifications include state-specific and time fixed effects. Robust standard errors in parentheses. If significant at 5% (10%) level coefficients are marked with two stars (one star). Insignificant control variables are not reported and include debt service, political variables as well as an interaction dummy capturing differential developments in the eastern states after reunification.

ing the government and equally strong for both, social democratically and conservative coalition governments.

Taken together, we can state that the empirical analysis provides partial confirmation of the above stated theoretical predictions. First, the existence

of a direct incentive effect of fiscal equalisation is supported. We find that state governments who are facing high marginal contribution rates within the German fiscal equalisation system tend to be characterised by lower shares of "productive spending". Our hypothesis that federal co-financing should stimulate spending and therefore, in our setting, lead to a higher share of "productive" spending as formulated in Proposition 2 could not be confirmed on the basis of our data. Though we observe the expected sign the effect of the federal matching rate m is not statistically significant. The fact that, due to data unavailability, we had to focus on university spending might well be a reason for this result.

4   Conclusions

In this paper we use a simple model of fiscal competition where local jurisdiction compete for a mobile tax base via the provision of a productivity-enhancing public input. In line with the finding from Keen and Marchand (1997), we show that without coordination the local public expenditure structure is biased, i.e. productivity-enhancing public inputs are relatively over-provided compared to purely consumptive public goods. Similar to the case of tax competition for mobile tax bases (see, e.g., Bucovetsky and Smart, 2006), the implementation of a redistributive grant system can increase or, in the case of full equalisation, even restore efficiency of local public finances. We find that a revenue-neutral increase in the marginal contribution rate to the fiscal equalisation system induces local jurisdictions to increase the overall budgetary share of consumptive public goods. Finally, as the provision of expenditure matching grants constitutes an instrument for correcting positive externalities induced by local public input provision (see, e.g., Dahlby, 1996) we expand our model and derive the intuitive result that a higher federal co-financing rate encourages local jurisdictions to rebalance their budgets towards a higher share of public inputs.

Our empirical analysis of state expenditure policies in Germany partially support the theoretical implications. We find that higher marginal contribution rates to the state fiscal equalisation system induce state governments to put stronger weight on public consumptive spending. Although observing the expected sign, we cannot confirm a significantly positive impact of federal co-financing on the basis of our data set.

Our results support the existence of incentive effects of fiscal equalisation on local expenditure policies. Whether redistributive systems of fiscal equalisation in practise actually enhance efficiency of public finances and thereby, as suggested by a number of theoretical contributions, increase welfare, states a difficult and interesting question. Kotsogiannis and Schwager (2006), for example, put forward that equalisation programs can lead to perverse fiscal incentives if political accountability is reduced. Therefore, taking into account political incentives and possible inefficiencies of the public sector when analysing fiscal institutions in a fiscal competition context deserves further attention.

Appendix A: Data Sources and Definitions

The basic dataset consists of annual data for Germany in the period 1975 until 2003. Data for the former East German states are only available from 1991 onwards.

The detailed **expenditure data**, **population data** and data on state specific **unemployment rates** are obtained from the German federal statistical office (Statistisches Bundesamt). **Federal matching rates** (university construction) are taken from the "34. Rahmenplan für den Hochschulbau nach dem Hochschulbauförderungsgesetz 2005-2008". **Fiscal equalisation transfers**, **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 1975-2003 (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 1975 - 2003). These enactments are also obtained from the Bundesgesetzblatt. Data on **federal grants** ("Sonderbedarfs-Bundesergänzungszuweisungen") are taken from the FAG. **Relative fiscal capacity** is defined as the ratio of fiscal capacity to fiscal need. The information on the **partisan composition of state governments** are obtained from http://www.election.de/.

Appendix B: 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 programme 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 the state of the year 2004.[17]

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.[18] 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")

- 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.[19] To see how a marginal increase in the

---

[17]Note that in 2005 a reform of the SFES became effective. However, the basic structure and mechanisms have not been changed.

[18]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.

[19]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.

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 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

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

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

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

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

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

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 $70\,\%$ indicates that only 30 cent of the additional taxes remain in the state budget due to increased contributions or reduced transfers within the SFES.

References

ARELLANO, M., AND S. BOND (1991): "Some tests of specification for panel data," *Review of Economic Studies*, 58, 277–297.

ASCHAUER, D. (1989): "Is Public Expenditure Productive?," *Journal of Monetary Economics*, 23(2), 177–200.

BARRO, R. (1991): "Economic Growth in a Cross Section of Countries," *Quarterly Journal of Economics*, 106(2), 407–443.

BASSANINI, A., S. SCARPETTA, AND P. HEMMINGS (2001): "*Economic Growth: The Role of Policies and Institutions. Panel Data Evidence from OECD Countries,*" OECD Economics Department Working Papers 283, Paris.

BUCOVETSKY, S., AND M. SMART (2006): "The Efficiency Consequences of Local Revenue Equalization: Tax competition and tax distortions," *Journal of Public Economic Theory*, 8(1), 199–144.

BUETTNER, T. (2006): "The Incentive Effect of Fiscal Equalization Transfers on Tax Policy," *Journal of Public Economics*, 90, 477–497.

BUETTNER, T., S. HAUPTMEIER, AND R. SCHWAGER (2006): "Efficient Revenue Sharing and Upper Level Governments: Theory and Application to Germany," *CESifo Working Paper* 1656, Munich.

BUYSSE, K. (2002): "*Human Capital and Growth in OECD Countries: The Role of Public Expenditure on Education,*" in: The Impact of Fiscal Policy, Banca d'Italia, Research Department, Public Finance Workshop, Perugia.

DAHLBY, B. (1996): "Fiscal externalities and the design of intergovernmental grants," *International Tax and Public Finance*, 3(3), 397–412.

———— (2002): "The incentive effects of fiscal equalization grants," conference paper, Montreal.

EASTERLY, W., AND S. REBELO (1993): "Fiscal Policy and Economic Growth: An Empirical Investigation," *Journal of Monetary Economics*, 32(3), 417–458.

FEEHAN, J. (1989): "Pareto-Efficiency with Three Varieties of Public Input," *Public Finance*, 44(2), 237–248.

FUEST, C. (1995): "Interjurisdictional Competition and Public Expenditure: Is Tax Co-ordination Counterproductive?," *Finanzarchiv*, 52, 478–496.

KEEN, M., AND M. MARCHAND (1997): "Fiscal Competition and the pattern of public spending," *Journal of Public Economics*, 66, 33–53.

KNELLER, R., M. BLEANEY, AND N. GEMMELL (1999): "Fiscal policy and growth: evidence from OECD countries," *Journal of Public Economics*, 74(2), 171–190.

KOETHENBUERGER, M. (2002): "Tax competition and fiscal equalization," *International Tax and Public Finance*, 9, 391–408.

KOTSOGIANNIS, C., AND R. SCHWAGER (2006): "*Fiscal equalization and yardstick competition*," CESifo Working Paper 1865, Munich.

NICKEL, S. (1981): "Biases in Dynamic Models with Fixed Effects," *Econometrica*, 49(6), 1417–1426.

THOENE, M. (2005): "*Wachstums- und nachhaltigkeitswirksame öffentliche Ausgaben ("WNA")*," FiFo-Berichte Nr. 2, Koeln.

ZODROW, G., AND P. MIESZKOWSKI (1986): "Pigou, Tiebout, property taxation and the underprovision of local public goods," *Journal of Urban Economics*, 19, 356–370.