Fiscal Competition and the Impact of Fiscal Equalisation:

Theory and Evidence from Germany

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Chapter 1

Introduction

The traditional theory of fiscal federalism (e.g., Musgrave, 1959; Oates, 1972), from a normative point of view, deals with the question of how to optimally design the vertical structure of state. Two issues lie at the heart of this line of research, namely the assignment of functions to different levels of government and the choice of adequate fiscal instruments (e.g., Oates, 1999). While macroeconomic stabilisation, income redistribution and the provision of national public goods (like defense) typically constitute central government functions, Oates's famous decentralisation theorem suggests that, in the absence of cost savings potential from centralised provision and fiscal externalities, decentralised provision of public goods with localised effects should be welfare enhancing.[1] The basic argument is that local governments are better able to take into account local differences in preferences and costs. In order to carry out their functions, governments at the different levels of state will generally feature tax and debt instruments. Moreover, federal states are typically characterised by systems of intergovernmental grants (e.g., Boadway, 2004).

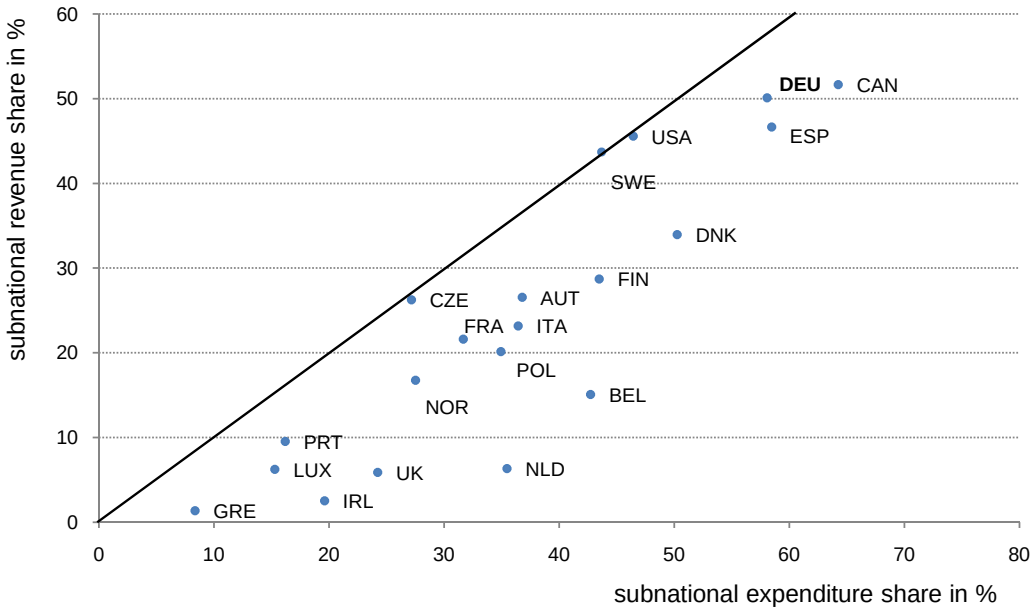
The design of fiscal federalism as well as the degree of fiscal decentralisation varies significantly across industrialised countries. This can be seen in figure 1.1 which shows subnational revenue and expenditure shares for a sample of OECD countries in the year 2005. Note that the share of subnational tax revenues lies between approximately 1% and 52% while the spending share varies from 8% to some 64%. Germany is characterised by relatively high subnational revenue and expenditure shares of 50% and 59%, respectively.[2] Although, a significant heterogeneity is observed among OECD countries regarding the degree of fiscal decentralisation, a common pattern can be identified in the gap between subnational spending and revenues. A closer inspection of figure 1.1 shows that Sweden

[1] See Oates, 1972.

[2] Note that, while simple subnational revenue and spending shares are widely used as measures for the degree of fiscal decentralisation , such indicators can hardly capture the full complexity of the institutional framework in countries characterised by a pronounced fiscal federalism. In this context, Stegarescu (2005) suggests alternative measures for the degree of revenue decentralisation which focus on the concept of autonomous tax revenue. For Germany, for example, this study reports a significantly lower level of tax revenue decentralisation which lies below 10% of overall tax receipts.

is the only country in our sample of industrialised countries displaying a subnational tax revenue share exceeding the expenditure share. Most other countries are characterised by significant "fiscal gaps" which according to a recent OECD study[3] have widened in the last decade, reflecting the tendency to assign a wider range of spending responsibilities to subcentral layers of government. At the same time, local taxing powers have been scaled back in many countries, suggesting an increased dependency of lower level governments on central government resources, in particular via intergovernmental grant schemes.

Figure 1.1: Decentralisation ratios in OECD countries, 2005



Source: National Accounts of OECD Countries

In addition, most federal countries with multiple levels of government such as Australia, Canada, Germany or Switzerland have installed some redistributive transfer system with the aim of reducing regional or local differences in revenue raising capacity or public service cost. Such fiscal equalisation schemes tend to be fairly heterogenous across countries as they are designed according to the specific architecture of fiscal federalism, e.g. the degree of fiscal autonomy at the subnational level as well as the responsibilities and fiscal resources assigned to lower levels of government (e.g., Blöchinger, Merk, Charbit, and Mizell, 2007). However, a common feature of redistributive intergovernmental transfer systems is the function of correcting for possible imbalances resulting from subcentral fiscal autonomy. In this context, a number of contributions have addressed the issue of vertical fiscal imbalance in a federation on the basis of normative theoretical frameworks (e.g. Dahlby and Wilson, 1994; Dahlby, 1996), suggesting that the pure accounting definition

[3]See Blöchliger and King (2006).

of a fiscal gap, i.e. the difference between subnational revenue and spending shares, lacks any justification from public finance theory.[4] From an allocative efficiency point of view, a federation should rather be in a state of fiscal balance if the marginal cost of raising public funds are equalised across all levels of governments. In other words, raising additional tax revenues should induce an equal deadweight loss for all levels of government. If this was not the case, a shift of taxation responsibilities within the federation would be welfare improving. One reason why, in the absence of intergovernmental grants, marginal cost of public funds might well be different between levels of government, is that most tax bases are more mobile at the subnational level. Thus, the mobility of economic units is of major concern when discussing the optimal design of federal systems. If local governments, for example, make use of taxes that are not associated with localised public goods and services, taxation will likely cause allocative distortions as households and firms are able to relocate within the federation in order to obtain a more favorable tax treatment. In this context, a seminal contribution by Gordon (1983) uses an optimal taxation framework and systematically analyses the various distortions resulting from local governments not taking into account the external effects of their fiscal policy decisions. Furthermore, a broad body of literature has extensively dealt with the topic of local tax competition for mobile tax bases (especially capital). Early contributions in this area include Zodrow and Mieszkowski (1986) and Wilson (1986) which point to inefficient low levels of local taxation and public good provision if policymakers do not take into account fiscal externalities arising from their tax policies.[5] Besides the aspect of tax competition for mobile tax bases, the theoretical literature on fiscal competition has pointed to the role of public inputs such as infrastructure spending as a means to attract private investment early on, focusing on the problem of overprovision. Taylor (1992) models a race between jurisdictions which compete for capital by building infrastructure more rapidly than their neighbors. Bucovetsky (2005) argues that public inputs, by attracting mobile factors, may create scale economies, and that governments tend to invest too much when choosing their level of spending on infrastructure. The literature has also addressed the link between taxes and public inputs in games of fiscal competition. Zodrow and Mieszkowski (1986) deal with local jurisdictions which compete for a mobile capital tax base by setting the tax rate and by providing a public input to production. Keen and Marchand (1997) extend the analysis, showing that in the presence of a productivity-enhancing public good the composition of local public spending tends to be systematically biased towards a relative overprovision of public inputs compared to public goods which are consumed directly by residents.

While systems of intergovernmental grants can serve a number of objectives within a federal system such as redistribution or equity, an important feature in the context of fis-

[4] See Dahlby (2008) for an overview.

[5] See Haufler (2001) for a comprehensive treatment of theories and evidence related to tax competition in an international context.

cal competition for mobile tax bases is the internalisation of interregional spill-overs (e.g., Boadway, 2004). A number of theoretical studies (e.g., Smart, 1998; Koethenbuerger, 2002; Bucovetsky and Smart, 2006) have recently argued that capacity-based equalisation transfers may act as corrective devices for alleviating inefficiencies in local public finances arising from capital tax competition. If the design of the equalisation mechanism is such that transfers are inversely related to a jurisdiction's tax base it tends to internalise fiscal externalities arising from tax competition, thereby promoting local tax effort and inducing governments to provide a higher level of local public goods.[6] Recent empirical analyses support the existence of such incentive effects of fiscal equalisation transfers on local tax policies. Based on a broad sample of municipalities in the German state of Baden-Wuerttemberg, Buettner (2006) shows that, in line with theoretical expectations, a higher degree of redistribution within the local equalisation system induces municipalities to increase their tax effort. Egger, Koethenbuerger, and Smart (2007) examine a natural experiment in the German State of Lower Saxony and find that a change in the equalisation formula which was introduced in 1999 exerted a significant impact on municipalities' tax policy.

This book builds on the above mentioned literature on fiscal competition and the impact of intergovernmental transfers. It aims to provide further insights into the functioning of federal systems and, in particular, the incentive effects arising from fiscal equalisation schemes. The focus thereby lies on fiscal federalism in Germany. On the basis of a multi-level government framework, chapter 2 provides a theoretical analysis of the conditions under which local grant systems enforced by an upper-level government will enhance efficiency of local public finances. A subsequent empirical analysis of local tax policy examines the experience with local fiscal revenue sharing in Germany. Chapters 3 and 4 deal with the efficiency consequences of fiscal competition when governments, in addition to a purely consumptive public good, provide a public input to production, which, besides local tax policy, serves as an alternative policy instrument to attract local investment. Here, the focus lies on the question how the local spending mix is affected if local decision makers compete for a mobile capital tax base via the provision of a productivity-enhancing public good and whether, similar to the case of pure tax competition, the implementation of a capacity-based fiscal equalisation system improves the efficiency of local public finances. The theoretical analysis presented in 3, in a first step, deals with the case of pure expenditure competition. The implications from this analysis are then tested empirically on the basis of a panel of German states. In a next step, the theoretical analysis is broadened in chapter 4 by allowing for bi-dimensional competition in taxes and public inputs. A subsequent empirical analysis uses a rich panal dataset of municipalities in the German state of Baden-Wuerttemberg to test whether local fiscal equalisation exerts a significant

[6] See section 1.2 for further details.

incentive effect on local spending policies. Finally, Chapter 5 presents a framework of interregional policy interaction which is used to derive general policy reaction functions of local governments from a model of tax and public input competition. An empirical counterpart of the system of fiscal reaction functions is then estimated using data from a large sample of German municipalities, thereby providing evidence on fiscal competition in a model treating taxes and spending on infrastructure as jointly determined endogenous variables.

Before turning to the analytical chapters of this book, we will first give an overview of the institutional framework characterising German fiscal federalism in section 1.1. Subsequently, section 1.2 deals with the main theoretical and empirical contributions in the literature on the incentive effects of fiscal equalisation transfers on local tax policies and provides an intuitive illustration of the mechanisms at work. Finally, the main results of this book are summarised and classified within the existing literature in section 1.3.

1.1 Fiscal Federalism in Germany

The Federal Republic of Germany constitutes a multi-tier federal state. It comprises the federal level (*Bund*), the 16 independent states (*Länder*) and the municipalities (*Gemeinden*), which according to the constitutional rules on public finances (Art. 104 - 115 of the *Grundgesetz* (GG) or German basic law) are part of the *Länder*. Unless otherwise stated, Article 30 of the *Grundgesetz* generally assigns the fulfillment of public functions to the *Länder*. Notwithstanding, the legislative competence has largely been displaced to the federal level which besides its exclusive legislation (Art. 71, 73, 105 para.1 GG) has made extensive use of the so called "rival" legal competence of the *Bund* (Art. 72, 74, 105 para.2 GG). In the course of the "federalism reform 2006" legislative competencies have been re-circumscribed leading to a strengthening of federal legislative competencies in areas of national relevance while fields of regulation with a regional focus have been assigned to the *Länder*. For the sake of legislative and economic unity, the *Bund* has, in particular, realised its "rival" legislative competence in the range of taxation. Therefore, the tax autonomy of the states and their municipalities is largely limited to regional excise taxes. However, municipalities have tax autonomy with respect to property as well as business tax (*Grund- und Gewerbesteuer*) and, in the course of the "federalism reform 2006", the states have gained the authority to set the tax rate with regard to the property acquisition tax (*Grunderwerbsteuer*).

While legal competencies are predominantly concentrated at the federal level, the state governments according to Art. 50 GG participate in the legislation process via the *Bundesrat*. In particular, federal legislative proposals require authorised approval by the *Länder* if they relate to taxes whose revenues partly or entirely accrue to the states or their

municipalities.[7] Moreover, legal and administrative execution is predominantly incumbent on the German states. With respect to tax administration, according to Art. 108 para. 1 GG, the Bund is merely responsible in the fields of custom duties, fiscal monopolies and excise taxes.

The German Tax and Fiscal Equalisation System

According to Art. 106 para.3 GG, both the federal as well as the state level (incl. municipalities) are entitled to adequate fiscal resources in order to cover their necessary expenditures. Moreover, revenue requirements are to be coordinated to ensure uniform living conditions within the German federation. Tax revenues are therefore distributed vertically among the different levels of state (Art. 106 GG in connection with para.1 of the fiscal equalisation law (FAG)) and horizontally among the *Länder* via the state fiscal equalisation system (Art. 107 GG in connection with para.2 FAG). In the latter case, state level tax revenues are redistributed in order to equalise per capita tax revenue differences among the states. Remaining imbalances are then further reduced by supplementary federal grants (*Bundesergänzungszuweisungen*). At the local level, revenue redistribution takes place on the basis of municipal fiscal equalisation systems which are administrated by the *Länder* and incorporate vertical and horizontal transfers. In the following, the structure of the German tax and fiscal equalisation system is described in more detail.

Vertical Tax Distribution

The German basic law, according to Art. 106, assigns a number of tax categories exclusively to different levels of state. For the federal level this includes the petroleum tax, most of the excise taxes as well as the insurance tax. The *Länder* receive the revenues from the property and inheritance tax and some excise taxes while the municipalities obtain the land and business tax revenues as well as the receipts from local excise taxes. Note that the *Grundgesetz* entitles the municipalities to autonomously set the rates of the land and business tax. On the other hand, the *Grundgesetz* defines several major taxes as so called "joint taxes" (*Gemeinschaftssteuern*) which are distributed among the *Bund*, the *Länder* and, to a degree, the municipalities. These make up approximately 70% of overall tax revenues and include the income tax (*Einkommenssteuer*), the interest rebate tax (*Zinsabschlagsteuer*), the corporate tax (*Körperschaftssteuer*) and the value-added tax (*Umsatzsteuer*).

State Fiscal Equalisation

Besides the constitutionally mandated revenue sharing of the "joint taxes", a variety of intergovernmental grants lead to the fact that public finances at the different lev-

[7] See section 1.1 for details on the vertical distribution of taxes in Germany.

els 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 im engeren Sinne*), which contains vertical and horizontal elements, and special requirement transfers (Sonderbedarfs-Bundesergänzungszuweisungen) to the states. Due to the infrastructural backlog after reunification, these special requirement transfers to a large extent at present flow from the federal level to the eastern German 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 reduced by federal transfers (*Fehlbetrags-Bundesergänzungszuweisungen*). All transfers within the German system of fiscal equalisation are regulated by law (FAG - *Finanzausgleichsgesetz*).

In the following, we will describe the Germen state fiscal equalisation system (SFES) in more detail and, with regard to the empirical analyses presented in chapters 2 and 3 of this book, highlight its basic functioning on the basis of a stylised model.[8] A particular focus will lie on the derivation of so called state-specific marginal contribution rates to the SFES, which quantify to which extent marginal revenue increases in a given state reduce its transfers received from, or in the case of fiscally strong states, raise the contributions to the system. The marginal contribution rate constitutes a key parameter when analysing the incentive effects of the German state fiscal equalisation as it captures the treatment of individual states within the redistributive grant system.

Generally, the treatment of each state within the equalisation scheme depends on its ratio of fiscal capacity (*Finanzkraftmesszahl*) to fiscal need (*Ausgleichsmesszahl*). We will refer to this ratio as the relative fiscal capacity. A state's fiscal capacity (t_i) is determined by summing up its revenues from the different tax types while the respective fiscal need (n_i) is basically calculated by multiplying average per capita tax revenues in the federation with each state's population number. 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. In principle the system of fiscal equalisation assumes equal fiscal requirements per inhabitant. However, in order to account for agglomeration costs, the problem of commuting (while decomposing taxes according to the residence principle) and the fact that metropolitan areas provide public goods of supra-regional importance the fiscal equalisation law assigns a

[8] In 2005, a reform of the German system of state fiscal equalisation came into effect which aimed at improving the incentives the German states face within the system by linearising the scheme and introducing a so called premium model. Note that, the empirical analyses presented in chapters 2 and 3 of this book are based on an institutional database comprising data prior to this reform. However, the basic functioning of state level fiscal equalisation has in principal not changed since the implementation of the system in 1970.

higher fiscal need to the city-states Hamburg, Bremen and Berlin. Moreover, inhabitants in the sparsely populated eastern states receive a higher weight when calculating fiscal need.

States with a fiscal capacity below fiscal need receive transfers, while states with a fiscal capacity exceeding fiscal need contribute to the system.

As already mentioned, the German SFES is comprised of three different stages:

- VAT Equalisation (Umsatzsteuervorwegausgleich)
- Fiscal Equalisation in the narrow sense (Finanzausgleich im engeren Sinne)
- Federal Grants (Bundesergänzungszuweisungen)

VAT Equalisation In the first stage of the SFES up to 25 % of the overall state VAT revenues are used to compensate for fiscal capacity differences between the *Länder*. States with a per capita fiscal capacity below 92% of the average receive transfers in the course of VAT equalisation.[9] These states, which are labelled as low capacity states in stage one of the fiscal equalisation scheme, receive transfers

$$z_{i1} = \left(0.92\frac{\sum_j t_{j1}}{P} - \frac{t_i}{p_i}\right) p_i, \qquad j = 1, ..., n.$$

Note that capacity differences below the threshold level are fully equalised. On the other hand, states with a per capita fiscal capacity above 92% of the average (high capacity states) will implicitly contribute to the system as transfers to fiscally weak states will reduce their own VAT revenues. These contributions of high cpacity states equal

$$c_{i1} = \frac{\sum_k z_{k1}}{\sum_m p_m} p_i, \qquad k = 1, ..., m; \quad l = 1, ..., (m - n).$$

Note that k indexes low capacity states whereas l indexes high capacity states so that the number of contributors equals $m - n$, i.e. the number of low capacity states minus the overall number of states. Now, in order to see how a marginal increase in revenues will affect transfers received and contributions made in stage one of the equalisation scheme, we can differentiate z_{i1} and c_{i1} with respect to t_i. This yields

$$\frac{\partial z_{i1}}{\partial t_i} = 0.92\frac{p_i}{P} - 1 < 0$$

and

$$\frac{\partial c_{i1}}{\partial t_i} = \frac{0.92m}{\sum_l p_l}\frac{p_i}{P} > 0.$$

[9] Note that in the VAT equalisation stage only state-specific 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 VAT revenues (after equalisation).

For a low capacity state, we observe two counteracting effects. First, as the degree of capacity equalisation below the 92% threshold level approaches 100%, the direct effect will be a complete offsetting of revenue increases through a reduction of transfers in stage one of the system. However, a secondary effect arises as the increase in tax revenues in a low capacity state will positively affect average fiscal capacity and therefore also raise its own fiscal need n_i. Note that this secondary effect, which partly offsets the transfer reduction effect, will become more important as the relative size of the transfer dependent state grows. Tax revenue increases in high capacity states will also be redistributed within stage one of the equalisation system as, again, marginal capacity increases will positively affect average fiscal capacity and therefore increase transfers to low capacity states. The corresponding rise in contributions will positively depend on the relative population size.

Horizontal Fiscal Equalisation In the second stage of the SFES, fiscal capacity differences which remain after VAT equalisation are further reduced. Now, states with a relative fiscal capacity[10] below unity (low capacity states) receive transfers

$$z_{i2} = \gamma_i \left(n_i - t_i\right), \qquad \gamma_i = \gamma(\frac{t_i}{n_i}), \quad \gamma_i' < 0$$

while high capacity states, i.e. states where the fiscal capacity exceeds fiscal need, contribute

$$c_{i2} = \delta_i \left(t_i - n_i\right), \qquad \delta_i = \delta(\frac{t_i}{n_i}), \quad \delta_i' > 0.$$

Note that, for low capacity states, the gap between fiscal need and capacity is reduced according to an equalisation rate γ_i which negatively depends on relative fiscal capacity. On the other hand, high capacity states contribute to the system according to a contribution rate δ_i which increases with relative fiscal capacity. Again, the comparative static effects of variations in the taxing capacity highlight the treatment of transfer dependent and contributing states within stage two of the equalisation scheme:

$$\frac{\partial z_{i2}}{\partial t_i} = \gamma_i' \left(\frac{n_i - t_i \frac{p_i}{P}}{n_i^2} \right) (n_i - t_i) + \gamma_i \left(\frac{p_i}{P} - 1 \right) < 0$$

$$\frac{\partial c_{i2}}{\partial t_i} = \delta_i' \left(\frac{n_i - t_i \frac{p_i}{P}}{n_i^2} \right) (t_i - n_i) + \delta_i \left(1 - \frac{p_i}{P} \right) > 0$$

The first derivative shows that for a low capacity state a marginal increase in tax revenues will trigger two effects. First, the corresponding increase in its relative fiscal capacity will negatively affect its equalisation rate which reduces transfers received. Moreover, the gap between fiscal need and capacity is diminished which in addition lowers the amount of transfers in the horizontal equalisation stage. Note that, similar to the case of VAT

[10] Note that in stage two also VAT revenues as well as revenues from municipal taxes are taken into account when determining t_i and n_i.

equalisation, the direct effect of an increase in the fiscal capacity is partly offset due to the fact that average fiscal capacity increases rises. Therefore, the transfer reduction rate of a low fiscal capacity state will decrease as its relative poulation size increases. Turning to high capacity states, a marginal increase in tax revenues positively affects contributions made in stage two. This is due to the fact that on the one hand a higher relative fiscal capacity raises the contribution rate δ_i. On the other hand, higher tax revenues increase the excess of fiscal capacity over fiscal need which adds to the positive impact of a marginal increase in the fiscal capacity on contributions made to the transfer system. Note that the relative population size also matters for high capacity states. As in the case of low capacity states, an increase in the population share will reduce the overall impact of a marginal tax revenue increase.

Federal grants Finally, in the case where a state's relative fiscal capacity lies below 0.995 after stages one and two of the equalisation scheme it will receive additional transfers from the federal level, formally

$$z_{i3} = 0.775\,[0.995n_i - t_i] = 0.771n_i - 0.775t_i.$$

Differentiating with respect to fiscal capacity yields

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

This indicates that an increase in tax revenues of a low capacity state will lead to a decrease in grants received from the federal government. Similar to stages one and two, the negative impact of a marginal increase in the fiscal capacity is alleviated as the relative population increases.

Overall, the above comparative static analysis suggests that larger states, irrespective of being characterised as low or high capacity states, face a more preferential treatment within the state fiscal equalisation system as efforts to generate further tax revenues are "punished" to a lesser degree via transfer reductions or increased contribution payments.

Marginal Contribution Rates Finally, in order to fully capture the treatment a state faces within the SFES in a single indicator, we calculate so called marginal contribution rates. These are computed by summing up the partial effects of marginal increases in fiscal capacity in the different stages of the equalisation system and relating this sum to the absolute change in tax revenues.

For low capacity states the marginal contribution rate is computed as

$$\vartheta_i^{lc} = \frac{|\frac{\partial z_{i1}}{\partial t_i}| + |\frac{\partial z_{i2}}{\partial t_i}| + |\frac{\partial z_{i3}}{\partial t_i}|}{dt_i}$$

Table 1.1: Overview: State Fiscal Equalisation 2003

Variable		Mean	Std. Dev.	Min	Max
Fiscal need	€ per capita	2296	284	2156	2886
Fiscal capacity	€ per capita	2160	409	1823	3403
Relative fiscal capacity	ratio	.944	.149	68.0	120
Transfer dependent (rel. f. c. < 0.92)	binary	.500	.516	0	1
Transfer dependent (rel. f. c. < 1.00)	binary	.188	.403	0	1
Contributor (rel. f. c. > 1)	binary	.313	.479	0	1
Fiscal equalisation transfers (capacity based)	€ per capita	95.5	291	-379	778
Federal transfers (capacity based)	€ per capita	62.9	50.5	0	130
Special requirement transfers	€ per capita	325	342	0	869
Marginal contribution rate	in %	83.4	14.2	46.3	97.8

Source: "Zweite Verordnung zur Durchführung des Finanzausgleichsgesetzes 2003" and own calculations.

while for high capacity states as

$$\vartheta_i^{hc} = \frac{\frac{\partial c_{i1}}{\partial t_i} + \frac{\partial c_{i2}}{\partial t_i}}{dt_i}.$$

In order to compute the empirical counterparts of these state-specific marginal contribution rates and thereby capture the incentives the German states face within the fiscal equalisation system, we employ a simulation program which takes into account the full set of equalisation rules defined by law. This enables us to compute various parameters of the SFES, in particular transfers received, contributions made as well as marginal contribution rates. The calculations are based on population and tax data for the German states which are officially published on a yearly basis in the "Zweite Verordnung zur Durchführung des Finanzausgleichsgesetzes" and are available from 1970 onwards when the German SFES was put in place. Table 1.1 gives an overview of the most important parameters of the German state fiscal equalisation system for the fiscal year 2003.

For the year 2003, 1.1 shows that on average fiscal need amounted to around 2300 € per capita while fiscal capacity averaged 2160 € . Therefore, the relative fiscal capacity, i.e. the ratio of fiscal capacity to fiscal need stood at around 0.94, indicating that on average states received transfers from the equalisation scheme. More concretely, in 2003, 9 out of 16 German *Länder* were characterised by a relative fiscal capacity below 92% and therefore were eligible for transfers in stage one (*Ergänzungsanteile*). Due to a relative fiscal capacity below unity, eleven states received horizontal transfers in stage two of the system while, on the other hand, five states contributed to the equalisation

scheme. The average amount of capacity based fiscal equalisation transfers amounted to around 96.6 € per capita in 2003 while federal transfers were somewhat lower, i.e. approximately 63 € per capita. The marginal contribution rate, i.e. the rate at which additional tax revenues are reduced via lower transfers received from or higher contribution to the equalisation system, stood at 83.4% in 2003, indicating that, on average, only around 17 cent of an additional Euro tax revenues remained in the state budget.[11] Note that states with a fiscal capacity below 92% of the average face particularly high transfer reduction rates (close to 100%) due to the equalisation rate of 100% in stage one of the equalisation scheme (*Umsatzsteuervorwegausgleich*). Therefore, these states have hardly any incentives to generate further tax revenues. On the other hand, states which are relatively large in terms of their population (and fiscally strong) are characterised by relatively low marginal contribution rates as revenue increases strongly affect average taxing capacity within the federation, which partly offsets the increases in the contribution rate.

Municipal Fiscal Equalisation

Besides horizontal and vertical equalisation at the state level, German fiscal federalism also features substantial revenue redistribution at the municipal level. Each state in Germany administers a municipal fiscal equalisation system according to corresponding regulations defined in the fiscal equalisation law (FAG). In principal, municipal fiscal equalisation has two objectives, namely to provide municipalities with additional revenues in order to fulfill their self-administered spending responsibilities ("vertical equalisation") and to equalise excessive fiscal capacity differences among municipalities ("horizontal equalisation"). Each state in Germany administers its own municipal equalisation system and institutional differences occur but the basic structure is similar across states. Here, in view of the empirical analyses presented in chapters 4 - 5, we focus on the equalisation scheme in the major German state of Baden-Wuerttemberg.

In principle, fiscal capacity equalisation is achieved by reducing the difference between what is defined by law as fiscal need[12] and a municipality's fiscal capacity[13]. According to their relative fiscal capacity, i.e. the ratio of fiscal need to fiscal capacity, local jurisdictions are categorised as having "low" ($< 60\%$), "medium" ($> 60\%$ and $< 100\%$) or "high" ($> 100\%$) fiscal capacity. The latter group does not receive any transfers while municipalities with relative fiscal capacity smaller than 100% receive formula-based fiscal equalisation grants. In addition, municipalities which are characterised by a "low" fiscal capacity receive supplementary transfers to ensure a relative fiscal capacity of at least 60%. Fiscal

[11] Note that, for practical reasons, when calculating marginal contribution rates on the basis of the above mentioned simulation programme we assume a tax increase by one percent.

[12] Fiscal need is determined by a basic per-capita allowance which is multiplied by the municipality's population size.

[13] The fiscal capacity of a municipality is determined by the tax base of the local business tax as well as other revenues, in particular the municipal share of income and corporate taxation.

equalisation grants are partly financed by contributions that all municipalities have to finance out of their local tax revenues. Contributions to the state and to the county occur in addition.

Buettner (2006) shows that the municipal system of fiscal equalisation in the state of Baden-Württemberg can be summarised by a linear function which relates grants to the municipal tax base, i.e. $g_i = y_i - \vartheta_i k_i$, where g_i denotes overall grants received, y_i depicts unconditional transfers which do not depend on the local tax base k_i[14], and ϑ_i constitutes the marginal contribution rate a municipality faces within the system. The latter captures to what extent marginal increases in the local tax base increase contributions made to the municipal equalisation scheme. Note that ϑ_i can be calculated as

$$\vartheta_i \equiv \tau^{rs} + (\tau_0 - \tau^{rs}) \left(\theta_i^{local} + \theta_i^{state} + \theta_i^{equal} \left(1 - \theta_i^{local} - \theta_i^{state} \right) \right), \tag{1.1}$$

where τ^{rs} labels a uniform tax rate which determines revenue sharing with the federal and state level and τ_0 constitutes a standardizing tax rate used to determine the taxing capacity of the local business tax. In addition, municipalities have to finance contributions out of their fiscal capacity to the county (θ_i^{local}), the state (θ_i^{state}) as well as formula-based contributions into the system of fiscal equalisation (θ_i^{equal}). Note that transfers to the state and county reduce fiscal equalisation contributions.

Unconditional grants y_i from the upper-level government are derived from

$$y_i \equiv x_i + \xi_i n_i \left(1 - \theta_i^{local} - \theta_i^{state} \right) - \left(\frac{\vartheta_i - \tau^{rs}}{\tau_0 - \tau^{rs}} \right), \tag{1.2}$$

where x_i labels other revenue and n_i depicts fiscal need. The parameter ξ_i captures that municipalities are being treated differently within the fiscal equalisation system conditional on whether they are characterised by a low, medium or high fiscal capacity.[15]

Table (1.2) gives an overview of the fiscal equalisation parameters for the fiscal year 2004. While fiscal need does not display substantial cross-sectional variation one observes a high standard deviation in the case of fiscal capacity. Therefore, relative fiscal capacity varies strongly between 32% and 414%. Approximately 90% of the municipalities in the state of Baden-Wuerttemberg are characterised by low or medium fiscal capacity and receive fiscal equalisation transfers. One quarter of the sample displays a relative fiscal capacity below 60% and therefore is eligible for additional equalisation transfers. These municipalities are facing particularly high marginal contribution rates. Note that, on average, municipalities were subject to an marginal contribution rate of around 13%.

[14] Note that, as already mentioned in section 1.1, German municipalities have taxing autonomy with respect to the local business tax. Therefore, profits earned by local firms make up for a large fraction of the municipal tax base.

[15] For further details on the formalization of the municipal fiscal equalisation system in the German state of Baden-Wuertemberg see the Appendix in Buettner (2006).

Table 1.2: Overview: Municipal Fiscal Equalisation 2004

Variable		Mean	Std. Dev.	Min	Max
Fiscal need (n_i)	€ per capita	726	51.6	690	954.5
Fiscal capacity	€ per capita	548	205	187	3292
Relative fiscal capacity	ratio	.7536	.2712	.3260	4.14
Low fiscal capacity	binary	.2414	.4281	0	1
Medium fiscal capacity	binary	.6633	.4728	0	1
High fiscal capacity	binary	.0953	.2937	0	1
Rev. sharing tax rate (τ^{rs})	in %	.041	0	.041	.041
Standardizing tax rate (τ_0)	in %	.145	0	.145	.145
County contribution rate (θ^{local})	in %	.3280	.0428	.27	.421
State contribution rate (θ^{state})	in %	.2118	.0101	.2045	.2795
Fiscal equalisation contribution rate (θ^{equal})	in %	.7057	.2616	0	1
Unconditional grants (y_i)	€ per capita	274	46.4	68.4	373.7
Marginal contribution rate (ϑ_i)	in %	.1313	.0118	.0922	.145
Marginal contribution rate (ϑ_i)	in %	.1313	.0118	.0922	.145

Sample size consists of 1102 municipalities in the state of Baden-Wuerttemberg.

Relating this figure to the average statutory business tax rate τ_i yields an equalisation rate of around 85%. This indicates that in 2004 only around 15 cent of an additional € revenue from the local business tax remained in the municipal budget due to higher contributions to the local equalisation scheme. Note also that unconditional transfers amounted to 274 € per capita.

Besides fiscal equalisation grants, municipalities receive additional transfers in order to fulfill their self-administered spending responsibilities. This also includes two types of specific grants: Firstly, within the so called "traffic and transport burden sharing" ("Verkehrslastenausgleich"), municipalities receive general as well as lump-sum grants depending on the length of the road network and the size of the municipal area respectively. Secondly, in the course of "school burden sharing" ("Schullastenausgleich"), municipalities receive transfers depending on the number of pupils.

1.2 The Incentive Effects of Fiscal Equalisation Transfers

The aim of this section is to give a brief overview of the existing literature dealing with the impact of capacity-based fiscal equalisation schemes on local public finances when independent governments within a federation compete for a mobile capital tax base. Moreover, based on a simple model of interjurisdictional tax competition which forms the basis of the

theoretical analyses presented in chapters 2 - 4, we want to provide an intuitive illustration of the incentive effects of fiscal equalisation transfers on local tax and spending policies and highlight the mechanisms at work.

Starting with the seminal contributions by Zodrow and Mieszkowski (1986) and Wilson (1986), a broad base of literature has emerged on the topic of interjurisdictional tax competition.[16] A central result of this strand of the public finance literature is that independent governments competing within a federation for a mobile tax base will tend to set inefficiently low tax rates and provide suboptimal levels of public goods. This inefficiency in local public finances results from the fact that each government when maximising local utility does not take into account fiscal externalities arising for other jurisdictions within the federation. More concretely, when lowering its tax rate say on mobile capital, a local government will only internalise the positive effect on its own tax base while ignoring the corresponding capital outflow from other jurisdictions. In contrast, a central planner maximising overall utility within the federation would internalise all fiscal externalities arising from local tax policies. The resulting coordinated equilibrium would then be charcterised by higher tax rates and, in turn, an increase in the overall provision of local public goods.

Besides coordinating tax policies within a federation, the implementation of intergovernmental grant systems constitutes an opportunity to take into account fiscal externalities when local governments engage in wasteful tax competition. Wildasin (1989), for example, suggests a corrective subsidy in the form of a matching grant that induces local governments to internalise the fiscal externalities resulting from their tax policies. Smart (1998) analyses the impact of capacity based equalisation transfers and argues that such transfers tend to partially compensate subnational governments for the deadweight loss resulting from the imposition of higher tax rates. Therefore, the intergovernmental grant system induces local governments to increase distortionary taxtion in order to attract equalisation transfers. More recently, a number of theoretical contributions have dealt with the relation between tax competition and fiscal equalisation. One of the first attempts in this direction is a theoretical analysis by Koethenbuerger (2002) who explores the efficiency consequences of equalisation transfers in a standard setting of interjurisdictional capital tax competition. The author explicitly assumes that each local government within the federation can influence the level of grants received from the transfer system via its tax policy. As a result, tax base equalisation induces independent local governments to increase distortionary taxation of a mobile capital tax base. Moreover, if the design of the transfer scheme is such that taxing capacity differences are fully equalised, then decentralised tax policy becomes efficient, i.e. equalisation transfers constitute a device to internalise fiscal externalities arising from competitive local tax setting. This result establishes a rational for redistributive grant systems not only on equity but also on efficiency grounds. In fact, efficiency of local public finances improves as the degree of redistribution within the

[16] See Wilson (1999) for an overview.

federation increases. While Koethenbuerger (2002) assumes identical regions and a fixed aggregate supply of capital, Bucovetsky and Smart (2006) present a more general analysis allowing for elastic tax bases and heterogeneity across regions in terms of tax capacities, population and local preferences. The authors show that in a variety of different settings a simple equalisation scheme generates an efficient decentralised optimum and thereby further promote the idea that systems of intergovernmental grants do not only serve equity objectives but also improve economic efficiency. However, the analysis suggests that full equalisation only restores a first-best optimum if the implicit coordination of local tax policies via the equalisation mechanism does not affect the nation-wide tax base. If the increase in the local tax effort induced by the intergovernmental transfer system distorts capital supply to the federation, partial equalisation turns out to generate optimal local tax policies, giving rise to a standard tradeoff between equity and efficiency.

In order to provide a more intuitive understanding of the mechanisms at work we will briefly sketch a simple theoretical model of intergovernmental tax competition similar to the one in Zodrow and Mieszkowski (1986) and introduce a capacity-based equalisation scheme. The model constitutes the basic framework used and further developed in chapters 2 - 4 of this book.

Consider a federation with a large number of regions. In each region, a homogenous output is produced using immobile labour supplied by a representative consumer and perfectly mobile capital. Each region's consumer is equipped with a uniform capital endowment ($\bar{s}$) which can be invested freely within the federation.[17] Regional governments tax locally installed capital (k_i) to provide a public good (Z_i) according to the budget constraint $\tau_i k_i = Z_i$, where τ_i denotes the tax rate. Private consumption (c_i) is financed via labour and capital income, i.e. $c_i = f(k_i) - k_i f' k_i + r\bar{s}$, where $f(k_i)$ constitutes the linear-homogenous production function and r denotes the net rate of return to capital. Note that, due to the assumption of free capital mobility, the net rate of return is equalised within the federation so that $r = f'(k_i) + \tau_i$.

When choosing the optimal capital tax rate τ_i, local governments maximise the utility of the representative consumer which we assume to be captured by a quasi-linear utility function, i.e. $u_i = c_i + v(Z_i)$, where $v' > 0$ and $v'' < 0$. Maximising with respect to τ_i and taking account of the above local budget constraint leaves us with the following optimality condition.[18]

$$v' \quad = \quad \frac{k_i}{k_i + \tau_i \frac{\partial k_i}{\partial \tau_i}}. \tag{1.3}$$

Quite intuitively, this first order condition states that in the local optimum the marginal

[17] Note that similar to Zodrow and Mieszkowski (1986) we assume that there is no external supply of capital to the federation, i.e. the sum of individual capital endowments determines the fixed nation-wide stock of capital.

[18] Note that, for simplicity, we assume that jurisdictions are completely symmetric.

utility from providing the public good needs to equal the marginal cost of raising public funds (MCPF) to finance the increased provision. Given that an increase in the local tax rate will trigger a negative tax base effect, i.e. $\frac{\partial k_i}{\partial \tau_i} < 0$, one can immediately see from equation 1.3 that the local optimum is characterised by MCPF exceeding unity. In contrast, a social planner maximising overall utility within the federation, would internalise fiscal externalities arising from local tax policies[19] and provide public goods efficiently, i.e. the coordinated equilibrium would be characterised by $v' = 1$. Therefore, given the decreasing marginal utility of Z_i, we can conclude that in a decentralised setting independent local governments will provide an inefficiently low level of public goods coinciding with tax rates below the level a central planner would choose. This is the standard result from the tax competition literature (e.g., Zodrow and Mieszkowski, 1986; Wilson, 1986).

Now, let us introduce a simple system of equalisation transfers where jusridictions receive equalisation transfers according to their respective tax base. The design we chose and which is also used in the theoretical analyses in chapters 2 - 4 is such that grants received from the upper-level government (g_i) negatively depend on the capital stock installed in a given jurisdiction, i.e. $g_i = y_i - \vartheta_i k_i$. Note that local governments receive unconditional transfers y_i which do not depend on their tax base and contribute to the nation-wide transfers system according to a marginal contribution rate ϑ_i. This changes the local budget constraint so that $Z_i = (\tau_i - \vartheta_i)\, k_i + y_i$. Again maximising local utility yields the following optimality condition:

$$v' \quad = \quad \frac{k_i}{k_i + (\tau_i - \vartheta_i)\, \frac{\partial k_i}{\partial \tau_i}} \tag{1.4}$$

From 1.4 one can immediately observe that by setting the marginal contribution rate to the equalisation system (ϑ_i) the central government is able to alter the jurisdictions' MCPF. If a local government now decreases its tax rate in order to attract the mobile tax base it will also face a higher contribution to the intergovernmental grant system. That way, the jurisdiction implicitly internalises the fiscal externalities resulting from its tax policy. Note also that the MCPF observed at the local level decrease as the marginal contribution rate increases. In the extreme case of full equalisation, i.e. $\tau_i = \vartheta_i$, decentralised tax policy turns out to be efficient as the local optimum is characterised by $v' = 1$.[20]

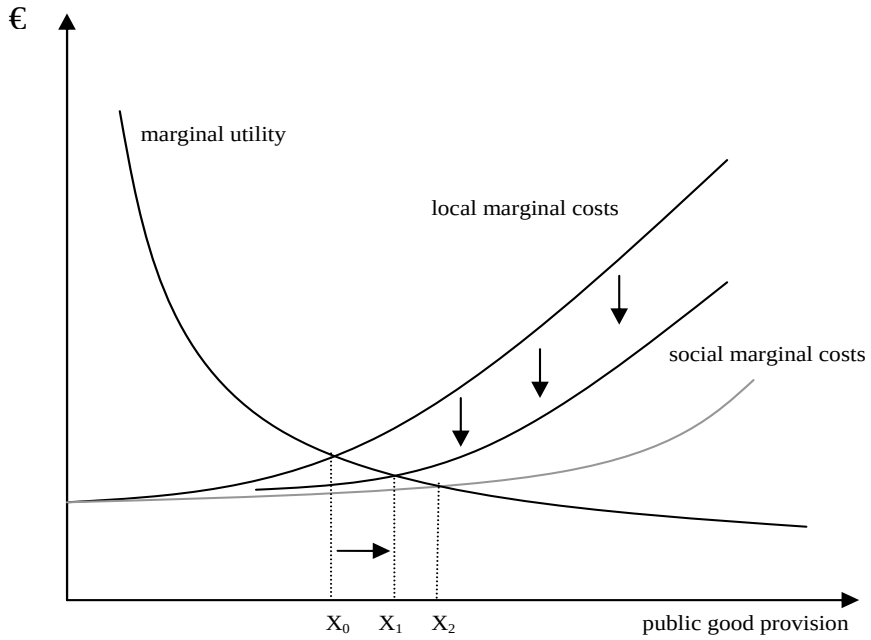
Figure 1.2 further illustrates the underlying mechanism. Note that, in the absence of fiscal equalisation transfers, independent governments will provide the level X_0 of public goods where the marginal utility (in € terms) equals the local marginal cost of raising public funds. As each local government only takes into account the impact of a change in the tax rate on its own tax base, local MCPF always exceed the social marginal cost.

[19] Note that, given the fixed nation-wide capital stock, a marginal decrease of the capital tax rate in one jurisdiction will trigger a capital inflow to this jurisdiction and a corresponding outflow from other jusrisdictions.

[20] See, e.g., Koethenbuerger (2002).

Implementing a transfer scheme as described above will now shift the local marginal cost curve downwards. As the perceived MCPF decrease as the marginal contribution rate to the equalisation system set by the central government increases, local governments are induced to increase their tax effort and provide higher levels of public goods, e.g. the level X_1 indicated in figure 1.2. Note that, in the case of full equalisation, the perceived local MCPF correspond to the social marginal costs. In this case, the regional government provides the first-best optimal level of public goods X_2. Therefore, from a theoretical point of view, capacity-based equalisation transfers operate as a corrective device for inefficiencies resulting from local tax competition tax for mobile tax bases. Note however that, as already mentioned above, the optimal design of such transfer mechanisms crucially depend on the assumptions made with regard to the elasticity of the national tax base (Bucovetsky and Smart, 2006).

Figure 1.2: Tax competition and fiscal equalisaton



Source: Buettner, T. (2006): *Tax competition and finance equilibrium*, ifo Schnelldienst 04/2006, Munich.

A number of empirical studies have recently analysed the impact of fiscal equalisation transfers on local tax policies. Snoddon (2003) investigates the incentive effects of such transfers in the context of fiscal federalism in Canada. The author examines a reform of the provincial equalisation system which took place in 1982 and finds a significant impact from this systemic change on own-source tax revenue growth for most recipient provinces. Also focussing on the case of Canada, Smart (2006) observes that provinces respond to expansions of equalisation transfers by increasing their own tax rates. Moreover, Dahlby

and Warren (2003) find a similar incentive effect of fiscal equalization transfers on regional tax policies in Australia. For the case of Germany, Baretti and Lichtblau (2002) empirically analyse the impact of fiscal equalisation on revenue collection at the state level and find that, although largely lacking taxing autonomy, efforts to collect taxes seem to be discouraged as the transfer dependency increases. Buettner and Schwager (2003) examine the incentive effects of fiscal equalisation transfers in the context of a frequently discussed reform option to provide German states with more taxing autonomy, namely a surtax on the federal income tax. The study resumes that, while a higher degree of tax autonomy at the state level would increase the scope for horizontal tax competition, the system of vertical tax sharing and, in particular, the highly redistributive equalisation scheme would undermine such tendencies. More recently, two studies focus on German municipalities which are a particularly interesting case to study in the context of capital tax competition in the presence of fiscal equalisation. This is due to the fact that local governments in Germany have tax autonomy with respect to the business tax which, since interjurisdictional mobility can be assumed to be high at the local level, should give rise to competitive municipal tax policies. At the same time municipalities are subject to significant capacity-based fiscal equalisation. Exploiting a natural experiment in the state of Lower Saxony, Egger, Koethenbuerger, and Smart (2007) provide evidence that the change in the equalisation formula as of 1999 exerted a significant impact on local business tax policies. Moreover, and strongly related to our analysis presented in chapter 4 of this book, Buettner (2006) analyses the incentive effects of fiscal equalisation transfers on municipal tax policies in the German state of Baden-Wuerttemberg. Based on a rich panel dataset and exploiting both non-linearities in the incentives generated by the municipal equalisation scheme as well as systemic changes over time the author provides evidence that municipalities facing higher marginal contribution rates[21] to the intergovernmental transfer system set significantly higher local business tax rates.

1.3 Summary of results

The remainder of the book is divided into four chapters, three dealing, both theoretically and empirically, with the incentive effects of fiscal equalisation transfers on state and local public finances in Germany. The fifth chapter presents an empirical analysis of strategic policy interactions among German municipalities.

Chapter 2 provides a theoretical analysis of the conditions under which local grant systems enforced by an upper-level government enhance efficiency of local public finances. Building on previous theoretical research (e.g., Koethenbuerger, 2002; Bucovetsky and Smart, 2006), which suggests that redistributive grant systems tend to internalise fiscal externalities resulting from tax competition and thereby improve efficiency of local public

[21] See section 1.1 for a description how such contribution rates are computed.

finances, we consider a standard model of fiscal competition between local jurisdictions and introduce a system of equalisation transfers enforced by an upper-level government. The design of the equalisation scheme is such that, while income from grants in a jurisdiction constitute a linear function of the local tax base, the state government can adjust the degree of redistribution within the system by setting the marginal contribution rate. Thus, the upper-level government is able to implicitly impact the marginal cost of raising public funds at the local level. In a first step, we assume that the upper-level government is a benevolent planer which aims at maximising overall utility in the federation when setting the equalisation parameters. In this setting, we find that, only if capital supply to the federation is completely inelastic will the state government set the marginal contribution rate of the equalisation scheme equal to the tax rate and, therefore, implement full equalisation of tax bases. In this case, inefficiencies resulting from local capital tax competition, i.e. an inefficiently low level of taxation and public good provision, are fully corrected and local governments provide a socially optimal level of public goods. However, as shown in Bucovetsky and Smart (2006), if the implicit coordination of tax policies affects capital supply to the federation, partial equalisation, i.e. a marginal contribution rate below the tax rate, turns out to be optimal resulting in a trade-off between equity and efficiency objectives. In the next step, we deviate from the assumption of a benevolent upper-level government and, similar to Edwards and Keen (1996), introduce separate state government policy objectives. More concretely, besides the objective of efficiency of local public finances, the state governments is now also interested in extracting resources from the local transfer system to finance own spending which does not affect the local residents' utility. In this setting we find that if the state government values own funds more than 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 if the local tax rate above the first best, induced by the local equalisation scheme, is beneficial for the state government. Moreover, if the supply of capital to the federation is completely inelastic, then increasing the contribution rate above the local tax rate is beneficial for the state government. In addition, we extend our analysis so that the upper-level government itself is subject to revenue equalisation at the state level and find that, if supply of capital is not completely inelastic, local public finances are distorted regardless of whether the state government is benevolent or extracting funds for wasteful purposes. The theoretical results suggest that similar to the literature on vertical tax competition (Keen and Kotsogiannis, 2002; Wrede, 1997) attempts by upper level governments to extract fiscal resources from the local revenue sharing system will tend to undermine efficiency of local finances, and possibly result in excessive equalisation. These theoretical predictions seem to be of particular relevance in the case of the German federation as municipalities make use of the local business tax which involves them in capital tax competition. Moreover, each state redistributes revenue substantially by means of local revenue sharing while itself

being subject to significant revenue sharing at the state level. These theoretical implications are contrasted with the experience in Germany. Since it is very difficult to compare the complex local revenue sharing systems across German states, our analysis considers empirical implications for the local tax policy. Specifically, we test whether fiscal conditions at the state level, i.e. debt servicing costs, the fiscal capacity as well as the treatment within the state equalisation system, affect average local business tax rates at the state level. Taken together, the empirical analysis provides partial confirmation of our theoretical predictions. In particular, 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.

The aim of the theoretical and empirical analysis in Chapter 3 is to extend the existing theoretical and empirical literature on the "internalising" impact of capacity-based equalisation schemes to the case of local expenditure policies. We therefore use a standard model of fiscal competition where local governments compete for a mobile capital tax base via the provision of a productivity-enhancing public good and analyse how the implementation of an intergovernmental grant scheme affects the local spending mix between public inputs (such as infrastructure spending or education) and public consumption. Our theoretical analysis builds on Keen and Marchand (1997) who extend the seminal paper by Zodrow and Mieszkowski (1986) and show that in the presence of a productivity-enhancing public good the composition of local public spending tends to be systematically biased towards a relative overprovision of a productivity-enhancing public good compared to public goods which are consumed directly by residents. We then introduce a system of redistributive equalisation transfers such as the one used in chapter 2. As the primary interest of our paper lies in the compositional spending inefficiencies arising from public input competition, we assume tax policy to be coordinated at the federal level. Therefore, local jurisdictions can only attract the mobile capital tax base by providing a productivity-enhancing public input and we are left with a framework of pure expenditure competition. In addition, we deviate from the analysis of Keen and Marchand (1997) by explicitly modelling the subnational governments' decision on the local expenditure structure, i.e. the ratio of spending on public inputs to overall public spending. Note that, similar to the case of pure tax competition, local jurisdictions will not take into account fiscal externalities arising from their spending policy. Specifically, governments can attract local investment by increasing their budgetary share of the public input to production as this will increase the marginal productivity of capital within the jurisdiction. This will induce a capital inflow while the other localities - given the assumption of a fixed nation-wide capital stock - will face a decrease in their tax bases. As such "spill-overs" are not taken into account by independent governments, the equilibrium in a decentralised setting will be characterised by a relative overprovision of public inputs. We then use the model to analyse how fiscal

equalisation transfers affect the local spending mix and find that a higher degree of redistribution within the intergovernmental revenue sharing system induces local governments to rebalance their budgets towards a lower budgetary share of the productivity-enhancing public input to production. This suggests that the spending bias pointed out by Keen and Marchand (1997) is (at least partially) corrected via the implementation of capacity-based equalisation transfers. The mechanism at work is again similar to the case of tax competition. As fiscal equalisation transfers are inversely related to the jurisdiction's tax base, the provision of the public input to production becomes more costly as positive tax base effects will lead to higher contribution payments to the transfer scheme. More intuitively, a higher degree of equalisation will make it less attractive for the individual jurisdiction to provide public inputs as positive tax base effects are redistributed to a higher extent among governments within the federation. This generates incentives for local governments to substitute public input provision by public consumption. Thus, a higher degree of revenue sharing induces a "price-effect" which, from the viewpoint of a single jurisdiction leads, to an implicit internalisation of fiscal externalities resulting from its spending policies. In the extreme case of full equalisation of tax bases local governments choose a socially optimal spending mix.

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 types are set coordinately at the federal level and, on the other hand, states can rather freely decide on the composition of the spending side of their budgets. Also, Germany is characterised by a complex system of fiscal equalisation among state governments. Our empirical analysis is based on an annual database of German states which covers the period between 1980 and 2003. It contains detailed data, both on the expenditure structure of the German states and on the most important parameters of the state fiscal equalisation system. This allows us to identify "productive" spending items at the state level, such as expenditure on education, R&D as well as the street infrastructure, and compute an empirical counterpart of the expenditure structure referred to in our theoretical analysis, i.e. the budgetary share of productivity-enhancing public goods. Moreover, using a simulation programme which incorporates the full set of rules implemented in the German state fiscal equalisation system, we calculated marginal contribution rates which quantify the rate at which additional tax revenues are reduced via lower transfers received from or higher contribution paid to the system. In combination with detailed data on the most important fiscal equalisation transfers, this allows us to very specifically capture the treatment of each state within the German state fiscal equalisation system. We then used this data set to estimate the determinants of state expenditure structures in Germany. Carefully taking into account potential problems of endogeneity in our regression equations, the results from our panel analysis strongly support the existence of an incentive effect of fiscal equalisation transfers

on state expenditure policies. Concretely, we observe that an increase in the marginal contribution rate to the system of fiscal equalisation induces state governments to reduce the overall budgetary share of public spending on infrastructure and education. This finding is in line with the theoretical implications from our model suggesting that fiscal equalisation exerts an incentive or price effect which induces governments to rebalance their budgets towards a lower share of productivity-enhancing spending items.

The theoretical analysis presented in Chapter 4 of this book extends the preceding analysis by assuming that local jurisdiction have available two policy instruments to compete for the mobile capital tax base, i.e. the local capital tax rate and the provision of a productivity-enhancing public input to production. Again, we analyse how the implementation of a capacity-based equalisation scheme affects the efficiency of public finances at the local level. As already shown, e.g., in Bucovetsky and Smart (2006), we find that fiscal capacity equalisation induces local jurisdictions to increase distortionary taxation of the mobile tax base. In addition, we show that increasing the degree of redistribution, while compensating for budgetary effects, induces local governments to rebalance their budget towards a lower budgetary share of the publicly provided input. Thus, in our analysis the implementation of a system of fiscal equalisation alleviates both tax as well as expenditure competition. In the case of full equalisation of tax bases, the compositional inefficiencies in local spending pointed out by Keen and Marchand (1997) vanish when assuming inelastic supply of capital. Compared to the theoretical analysis in chapter 2, the result that fiscal equalisation transfers discourage public input provision relative to purely consumptive public goods is shown in a more general setting where local jurisdictions engage in simultaneous tax and public input competition. The subsequent empirical analysis tests for the existence of the theoretically predicted incentive effect of fiscal equalisation transfers on local spending policies in Germany. It is based on a broad panel of municipalities in the German state of Baden-Württemberg. Moreover, the underlying data set, similar to the one used for the empirical analysis in chapter 2, contains detailed information on municipal expenditure structures and therefore allows us to compute budgetary shares of "productive spending", i.e. the ratio of spending on basic schools and the local road network to overall primary spending. In addition, we have computed various parameters of the municipal system of fiscal equalisation. In particular, our data set contains marginal contribution rates to the local equalisation scheme which quantify to what extent increases in the local tax base lead to increased contribution payments within the transfer system. It comprises detailed information on fiscal equalisation related transfers. We then use this data set to estimate the determinants of local expenditure structures in the state of Baden-Württemberg. Following Buettner (2006) we exploit non-linearities in the municipal equalisation scheme to identify the incentive effects of fiscal equalisation transfers on local expenditure policies. In particular, we make use of the fact that the marginal contribution rates which municipalities face within the equalisation scheme depict deterministic

albeit discontinuous functions of the local fiscal capacity which may be utilised on the basis of a regression discontinuity approach. Overall, our results strongly confirm the existence of an incentive effect of fiscal equalisation transfers on local expenditure policies. We find that a higher marginal contribution rate to the redistributive grant system induces local governments to reduce their budgetary share of infrastructure spending on the local road network and basic school expenditures. This finding is in line with the implications from our theoretical analysis which suggests that an increase in the degree of redistribution within a system of fiscal equalisation induces local governments to rebalance their budgets towards a lower share of "productive" spending.

The analysis presented in Chapter 5 deals with strategic fiscal competition among local governments in Germany. In this context, it has long been recognized that governments may use various instruments to attract mobile factors. With regard to capital, two of these instruments have received special attention in this book: Business taxes and public infrastructure investment. While it seems natural to think of governments' choices regarding tax rates and public input provision to be closely interrelated, the empirical literature on fiscal competition has in most cases treated them separately. The analysis presented in this chapter is an attempt to overcome this deficiency. In the first step, we derive general reaction functions of local governments from a model of tax and public input competition. As in Keen and Marchand (1997), our theoretical analysis is based on a model of fiscal competition with two instruments. Local jurisdictions compete for a mobile tax base by setting the capital tax rate and by providing a productivity-enhancing public input to production. As both taxes and inputs affect the tax base, the determination of optimal local taxing and spending decisions is substantially more complex than in a model with just a single policy instrument. We use the theoretical framework to highlight the forces that drive the strategic behavior of local governments when setting tax rates and public inputs. In particular, we demonstrate that governments react to taxes as well as to the level of public inputs provided by other jurisdictions when choosing each of their own policy instruments. In contrast to the theoretical literature, empirical work on governments competing for mobile capital has mostly treated fiscal competition as pure tax competition. The standard argument states that governments competing for mobile capital neglect the fiscal externality of their tax policy, resulting in an inefficiently low level of taxation and an underprovision of public goods in equilibrium. Based on the work of Mintz and Tulkens (1986), Zodrow and Mieszkowski (1986), Wilson (1986) and Wildasin (1988), a number of empirical studies have shown that the tax setting behavior of local governments in many countries appears to be in line with the predictions of the theoretical tax competition literature. Brueckner and Saavedra (2001), for instance, estimate a property-tax reaction function for U.S. cities and find a non-zero slope. Buettner (2001) identifies local business tax competition among German municipalities and Hayashi and

Boadway (2001) analyze provincial corporate income taxes in Canada.[22] Empirical contributions addressing the joint effect of taxes and public inputs on the allocation of capital are scarce. Therefore, our empirical analysis of tax and public input competition among municipalities in Germany is one of the first attempts to extend the canonical empirical model of tax competition to account for public inputs as a second policy instrument. As already mentioned, German municipalities have autonomy in setting the local business tax rate and, within their self-administration responsibilities, decide on spending on local infrastructure. In this respect, Germany is an interesting and appropriate case to study. Building on recent work of Kelejian and Prucha (2004), we estimate a system of equations allowing for the joint determination of the municipalities' business tax rate as well as their level of spending on local infrastructure. In particular, the estimation results of our system of interrelated equations show that the municipalities engage in simultaneous tax and public input competition. Firstly, in accordance with earlier research, in particular Buettner (2001), we find a positive and significant direct interaction effect in the local business tax rate. Municipalities facing competition from low-tax jurisdictions thus set lower taxes than municipalities with high-tax neighbors. Secondly, the local governments also adjust their level of spending on infrastructure towards the average level among neighboring jurisdictions. For our preferred specifications, the direct interaction effect in public input provision is statistically different from zero in 10 out of 14 cross-sections, and it tends to be larger than the direct interaction effect in taxes. Moreover, treating taxes and public inputs as alternative means to attract capital reveals that the municipalities react to competition in a rather flexible way. If neighbors lower their taxes, a municipality not only adjusts its own tax rate, but also increases its level of public input provision. Finally, we also demonstrate that our results depend on the choice of the spatial weighting scheme in a predictable way, and that all main results are robust across various cross-sections.

The main contribution of this book is to provide further insights into the functioning of federal systems and, in particular, the incentive effects arising from fiscal equalisation schemes. The analyses presented in this book go beyond the existing literature in several ways. Most notably, we extend the analysis of fiscal competition in the presence of fiscal equalisation to the case of local expenditure policies. The theoretical models presented in chapters 3 and 4, to the best of our knowledge, are the first to investigate how capacity-based equalisation transfers affect the decision of subnational governments on their spending mix between public consumption and investment. We show that equalisation transfers which are inversely related to local tax bases exert a "price-effect" or "substitution-effect" which induces local governments to rebalance their budgets towards a lower share of publicly provided inputs to production. Empirical evidence for this incentive effect of fiscal equalisation transfers on subnational expenditure policies is presented

[22] For further references on strategic tax setting of local jurisdictions see Brueckner (2003) as well as Revelli (2005).

for state and municipal governments in Germany. Moreover, the empirical analysis in chapter 5 constitutes one of the first attempts to extend the canonical empirical model of tax competition to account for public inputs as a second policy instrument. Herein, we provide original evidence for the existence of simultaneous tax and public input competition among local governments in Germany suggesting that fiscal policy interactions are much more complex than stated in the earlier literature.

Chapter 2

Efficient Revenue Sharing and Upper Level Governments

It has already been pointed out in chapter 1 that 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 emphasised 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 decentralised public sector also display some redistributive grant systems which tend to internalise fiscal externalities arising from tax competition (Bucovetsky and Smart, 2006; Koethenbuerger, 2002).

While the existence of redistributive grant systems may explain why local governments in those countries make use of distortive taxes despite tax competition (Koethenbuerger, 2002; 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 analysis presented in this chapter explores the conditions under which redistributive grant systems will or will not achieve or raise efficiency in local finances.[1] More specifically, we consider a standard model of tax competition between local jurisdictions and follow Bucovetsky and Smart (2006) by introducing a system of redistributive grants enforced at the state level which under certain assumptions restores efficiency. This model 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 pursues its own policies under specific constraints. The extensions enable

[1] An earlier version of this chapter has already been circulated as a discussion paper. See Buettner, Hauptmeier, and Schwager (2006).

us to derive some testable hypotheses and predictions to show under which conditions the potentially beneficial state intervention into local finances introduces new distortions at the local level. Consequently, 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 then 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.[2] Previous research also indicates that the revenue sharing among municipalities does in fact exert a strong impact on the jurisdictions' tax policy (Buettner, 2006;Egger, Koethenbuerger, and Smart, 2007). At the same time, some of the German states are in an increasingly difficult fiscal situation where the debt burden is sufficiently high that they may be tempted to induce local jurisdictions to increase taxing effort. 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, for example a reduction in the grants received at the state level, 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.

We will proceed as follows. The following section contains the theoretical analysis which derives empirical implications with regard to local jurisdictions' tax policy. Section 2.2, then, provides an empirical analysis of tax policy in Germany. The last section provides the conclusions.

2.1 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,

[2]See section 1.1 for further details on the municipal equalisation system.

and the circumstances under which grant system will introduce additional inefficiencies. The first subsection lays out a standard model of tax competition. 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 (2006). The third subsection, then, introduces the possibility of additional state government objectives beyond simply ensuring efficient local finances. Finally, the fourth subsection analyses the impact of redistributive grant systems at the state level.

2.1.1 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 maximisation 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 maximisation 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

$$u_i = c_i + \alpha_i v(Z_i)$$

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

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

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

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

Implicit differentiation of this condition yields

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

Note 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 maximisation from the perspective of the local government is

$$\frac{\partial u_i(\tau_i)}{\partial \tau_i} = -k_i + (s_i - k_i)\frac{\partial r}{\partial \tau_i} + \alpha_i \frac{\partial v}{\partial Z_i}\left(k_i + \tau_i\left(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i}\right)\right) \stackrel{!}{=} 0. \qquad (2.1)$$

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

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

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

$$\frac{\partial \mathcal{L}^1}{\partial Z_i} \;=\; \alpha_i \frac{\partial v}{\partial Z_i} - \lambda^1 \;\stackrel{!}{=}\; 0, \qquad (2.2)$$

$$\begin{aligned} \frac{\partial \mathcal{L}^1}{\partial \tau_i} \;=\; -k_i \;+\; (s_i - k_i)\,\frac{\partial r}{\partial \tau_i} \;+\; \lambda^1 \left(k_i \;+\; \tau_i \left(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i} \right) \right) \\ + \sum_{j \neq i} (s_j - k_j) \frac{\partial r}{\partial \tau_i} \;+\; \lambda^1 \left(\sum_{j \neq i} \tau_j \frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i} \right) \;\stackrel{!}{=}\; 0. \end{aligned} \qquad (2.3)$$

Equation (2.2) 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 (2.2), condition (2.3) becomes

$$\begin{aligned} \frac{\partial \mathcal{L}^1}{\partial \tau_i} \;=\; -k_i \;+\; (s_i - k_i)\,\frac{\partial r}{\partial \tau_i} \;+\; \alpha_i \frac{\partial v}{\partial Z_i} \left(k_i \;+\; \tau_i \left(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i} \right) \right) \\ + \sum_{j \neq i} (s_j - k_j) \frac{\partial r}{\partial \tau_i} \;+\; \sum_{j \neq i} \alpha_j \frac{\partial v}{\partial z_j} \tau_j \frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i} \;\stackrel{!}{=}\; 0. \end{aligned} \qquad (2.4)$$

A comparison between equations (2.1) above and (2.4) shows that the last two terms in (2.4) 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 (2006) and restrict attention to a model where the solution to (2.2) and (2.3) displays a uniform tax rate $\tau_i = \tau_j =: \tau$. This implies also that capital demand is equalised across jurisdictions, $k_i = k_j =: k$. Moreover, for simplicity, we assume that in the first best situation described by (2.2) and (2.3) the endowment with capital is equal to the demand for capital in all jurisdictions, $s_i = k$. At the ensuing equilibrium rate of return the net supply of capital to the state is zero, $s(r) = 0$.

2.1.2 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 (2.2) and (2.3). Nevertheless, one possible option internalise 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[3]

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

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

$$\begin{aligned} \frac{\partial u_i^2\left(\tau_i, \vartheta_i, y_i\right)}{\partial \tau_i} &= -k_i \; + \; \left(s_i - k_i\right) \frac{\partial r}{\partial \tau_i} \\ &+ \; \alpha_i \frac{\partial v}{\partial Z_i}\left(k_i \; + \; \left(\tau_i - \vartheta_i\right)\left(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i}\right)\right) \stackrel{!}{=} 0. \end{aligned} \tag{2.5}$$

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

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

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, therefore, the state government can induce the local jurisdiction to increase the local tax rate, that is, $\partial \tau_i / \partial \vartheta_i > 0$.

[3] 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".

The state government will choose ϑ_i and y_i in order to optimise 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 redistribute the full amount of resources collected from the individual jurisdictions by means of grants such that its budget constraint becomes

$$\sum_j y_j = \sum_j \vartheta_j k_j. \tag{2.6}$$

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.

$$\frac{\partial \mathcal{L}^2}{\partial y_i} \; = \; \alpha_i \frac{\partial v}{\partial Z_i} \; - \; \lambda^2 \quad \stackrel{!}{=} \quad 0, \tag{2.7}$$

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

$$\begin{aligned} \frac{\partial \mathcal{L}^2}{\partial \vartheta_i} \quad &= \quad \frac{\partial V^2}{\partial \tau_i}\frac{\partial \tau_i}{\partial \vartheta_i} \; + \; \frac{\partial V^2}{\partial \vartheta_i} \\ &+ \quad \lambda^2 \left[k_i + \left(\vartheta_i \frac{\partial k_i}{\partial \tau_i} \; + \; \sum_j \vartheta_j \frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i}\right)\frac{\partial \tau_i}{\partial \vartheta_i}\right] \stackrel{!}{=} 0. \end{aligned} \tag{2.8}$$

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 (2.7), condition (2.8) becomes

$$\frac{\partial \mathcal{L}^2}{\partial \vartheta_i} \; = \; \left[\frac{\partial V^2}{\partial \tau_i} \; + \; \alpha_i \frac{\partial v}{\partial Z_i}\left(\vartheta_i \frac{\partial k_i}{\partial \tau_i} \; + \; \sum_j \vartheta_j \frac{\partial k_j}{\partial r}\frac{\partial r}{\partial \tau_i}\right)\right]\frac{\partial \tau_i}{\partial \vartheta_i} \quad \stackrel{!}{=} \quad 0. \tag{2.9}$$

In the appendix A.1 it is shown that the condition (2.9) is equivalent to (2.4) from the previous subsection. This confirms that a linear grant scheme can indeed internalise 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:[4]

$$\vartheta^* \;=\; \tau \left(1 - \frac{\frac{\partial s}{\partial r}\frac{r}{nk}}{\frac{\partial s}{\partial r}\frac{r}{nk} - \left(\frac{n-1}{n}\right)\frac{\partial k}{\partial r}\frac{r}{k}} \right) . \tag{2.10}$$

Here τ is the optimal local tax rate according to (2.4), $\frac{\partial k}{\partial r}\frac{r}{k}$ 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 (2006) 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.

Note that even in the symmetric situation, we allow for differences in preferences expressed by different α_i. In order to obtain an efficient decentralised solution despite these, the approach taken by Bucovetsky and Smart (2006) requires a complete set of individual lump-sum grants y_i to each jurisdiction. In a more general setting, where the optimal tax rates also vary across jurisdictions, the contribution rates ϑ_i must also differ so as to correct incentives specifically for each local jurisdiction.

2.1.3 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 example, mobility, which may be an important driving force towards efficiency, is much lower at the state level 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), assume the state is 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-

[4] See appendix A.2.

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.[5] 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 partially transferred to the state budget by means of higher financing contributions of local jurisdictions in the system of revenue sharing.

In order to reflect 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'

$$\frac{1}{n} \sum_j y_j \geq y'. \tag{2.11}$$

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 (2006) 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 optimisation 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

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

[5] 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.

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

$$\frac{\partial \mathcal{L}^3}{\partial y_i} = \alpha_i \frac{\partial v}{\partial Z_i} - \beta \frac{\partial w}{\partial e} + \lambda^3 \stackrel{!}{=} 0. \tag{2.12}$$

This condition can be represented in two ways. Firstly, the constraint (2.11) 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, it will do so until its own marginal benefit of funds equals the marginal benefit of public funds for a local jurisdiction. Secondly, if the constraint on the unconditional grants is binding, then $\lambda^3 = \beta \frac{\partial w}{\partial e} - \alpha_i \frac{\partial v}{\partial Z_i} > 0$. 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. Note however that in both cases, the marginal rates of substitution $\alpha_i \frac{\partial v}{\partial Z_i}$ are equalised among the local jurisdictions by means of unconditional grants y_i.

With regard to the contribution rate the optimality condition is

$$\begin{aligned} \frac{\partial \mathcal{L}^3}{\partial \vartheta_i} &= \left\{ \frac{\partial V^2}{\partial \tau_i} + \beta \frac{\partial w}{\partial e} \left(\vartheta_i \frac{\partial k_i}{\partial \tau_i} + \sum_j \vartheta_j \frac{\partial k_j}{\partial r} \frac{\partial r}{\partial \tau_i} \right) \right\} \frac{\partial \tau_i}{\partial \vartheta_i} \\ &+ \left(\beta \frac{\partial w}{\partial e} - \alpha_i \frac{\partial v}{\partial Z_i} \right) k_i \stackrel{!}{=} 0. \end{aligned} \tag{2.13}$$

In order to assess the impact of the state's own objective on its choice of grant scheme, we start by considering the contribution rate of the first best solution (2.9). We then use (2.13) to evaluate in which direction the state would like to adjust this rate as soon as it takes the new, self-serving objective into account.[6] To do so, we compare equation (2.13) with the benchmark (2.9), and note that the difference between the optimality conditions is

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

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 (2.11), this is positive, i.e. the state wants to extract further resources

[6] 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.

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 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 observe under which circumstances the positive effect prevails, note that, from the capital market equilibrium and utilising 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 essence a closed economy, the total amount of capital is essentially 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 (2.9).

We can summarise 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 partially self-serving state government uses its 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 equalisation 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 (2.10). Hence, already in the first best, the grant system entirely eliminates any increase in local tax revenue induced by an increasing tax base. Adding now a self-serving 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 its revenues after equalisation.

Corollary 1 (Excessive Equalisation)
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 (2.13); given the symmetry and taking into account 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

$$\frac{\partial \mathcal{L}^3}{\partial \vartheta_i} = \frac{\partial V^2}{\partial \tau_i} \frac{\partial \tau_i}{\partial \vartheta_i} + \beta \frac{\partial w}{\partial e} \left[k_i + \vartheta_i \left(\frac{\partial s}{\partial r} \frac{\partial r}{\partial \tau_i} \right) \frac{\partial \tau_i}{\partial \vartheta_i} \right] - \alpha_i \frac{\partial v}{\partial Z_i} k_i \stackrel{!}{=} 0. \quad (2.14)$$

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.

2.1.4 Disincentive Effect of Fiscal Equalisation at State Level

Besides 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, 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 analyse this case, we have to modify the above budget constraint (2.6) by

the amount of transfers to other states $\xi \sum_j k_j$. Formally, we set up a Lagrangian

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

Differentiation with respect to y_i again yields the f.o.c. (2.7), $\lambda^4 = \alpha_i \frac{\partial v}{\partial Z_i}$. 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 into account the capital market equilibrium we can simplify this expression to

$$\frac{\partial \mathcal{L}^4}{\partial \vartheta_i} \; = \; \frac{\partial \mathcal{L}^2}{\partial \vartheta_i} \; - \; \xi \alpha_i \frac{\partial v}{\partial Z_i} \left[\frac{\partial s}{\partial r} \frac{\partial r}{\partial \tau_i} \right] \frac{\partial \tau_i}{\partial \vartheta_i} \quad \stackrel{!}{=} \quad 0. \tag{2.15}$$

The additional term captures the consequences of revenue sharing on tax policy: if a higher tax rate at i reduces capital supply, then the transfers to the state level fiscal equalisation 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.

As before 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 (2.11). 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

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

The optimality condition for y_i replicates (2.12). The condition for ϑ_i now reads

$$\frac{\partial \mathcal{L}^5}{\partial \vartheta_i} \; = \; \frac{\partial \mathcal{L}^3}{\partial \vartheta_i} \; - \; \xi \beta \frac{\partial w}{\partial e} \left[\frac{\partial k_i}{\partial \tau_i} + \sum_j \frac{\partial k_j}{\partial r} \frac{\partial r}{\partial \tau_i} \right] \frac{\partial \tau_i}{\partial \vartheta_i} \quad \stackrel{!}{=} \quad 0. \tag{2.16}$$

Simplification using the capital market equilibrium condition yields

$$\frac{\partial \mathcal{L}^5}{\partial \vartheta_i} = \frac{\partial \mathcal{L}^3}{\partial \vartheta_i} - \xi\beta \frac{\partial w}{\partial e}\left[\frac{\partial s}{\partial r}\frac{\partial r}{\partial \tau_i}\right]\frac{\partial \tau_i}{\partial \vartheta_i} \stackrel{!}{=} 0. \tag{2.17}$$

While the first term is equivalent to the case of own state government objectives, the second term captures the impact of the fiscal equalisation system between federal and state governments. Note that this term is positive which reflects the fact that a tax rate increase lowers the tax base in the state and, therefore, reduces transfer obligations from the state budget. This exerts an incentive towards a higher contribution rate and higher taxes.

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

Proposition 3 (Distortion by State Level Fiscal Equalisation)
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 in 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.

2.2 Empirical Analysis

The above propositions appear 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 in 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 higher tax rates (Buettner, 2006; Egger, Koethenbuerger, and Smart, 2007). The systems of local revenue sharing are broadly similar across states, however there are differences in institutional details which make it very difficult to establish 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.

2.2.1 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. It is important that this variation is not affected by or statistically correlated with the local jurisdictions taxing decisions. A first variable which comes to mind is the level of the debt burden. The level of debt is inherited from past policy, therefore 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 the state and at the 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 backing for state finances this effect is likely to be negligible.[7]

Another promising source for variation in conditions faced by state governments is the system of fiscal equalisation 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 equalisation 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 equalisation system is the marginal contribution rate. This is the rate at which an increase in the state-wide business tax base actually reduces 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 evidence on the pure (dis-)incentive effect of state level fiscal equalisation on the state's operation of the local finances. With this approach, the empirical analysis is related to Baretti and Lichtblau (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 (2006) in the context of municipalities, the fact that equalisation grants and marginal contribution rate are determined by a complicated, non-linear, albeit clearly defined system of fiscal equalisation, allows us to pursue an identification strategy along the lines of regression discontinuity estimation (e.g., Van der Klaauw, 2002; Angrist and Lavy, 1999). If we control for the potential influence

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

Table 2.1: 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-)equalisation 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.

of fiscal capacity in the estimation, we can separate out the differential treatment of the states.

2.2.2 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 city states of Hamburg, Bremen, and Berlin since there is no clear distinction between state and local level. The database contains information regarding 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 regarding the treatment of each state in the state-level 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.[8] 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 5.1 provides some descriptive statistics. The local tax rate is depicted by the *collection 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

[8] See section 1.1 for further details.

level and variation of debt service are much larger at the state as compared to the local level. State net-equalisation 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.

2.2.3 Results

Table 2.2 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 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 equalisation system including 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 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 as to 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 equalisation 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 equalisation 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 equalisation 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-

Table 2.2: 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)	
Standardised 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-)equalisation 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.

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 approximately .028 which has a similar magnitude in absolute terms as the effect of the net-equalisation 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.[9] 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 equalisation 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 the incentive effect of fiscal equalisation at the state level.

Taken together we can state that the empirical analysis provides partial confirmation of the above theoretical predictions.[10] 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 equalisation system.

2.3 Summary

Recent literature has emphasised that redistributive grant systems may tend to internalise fiscal externalities arising from tax competition (Bucovetsky and Smart, 2006; Koethenbuerger, 2002), at least to some extent. While the existence of redistributive grant systems might explain why local governments make use of distortive taxes despite tax competition (Smart, 1998; Buettner, 2006), it is difficult to derive policy recommendations. The reason for this 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

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

[10] Similar results have been obtained for Canadian provinces. Esteller-Moré and Solé-Ollé (2002) find that provinces which receive equalisation grants set higher personal income tax rates if the contribution rate to the equalisation system is increased. Karkalakos and Kotsogiannis (2007) show that an increase in the volume of federal grants received induces provinces to reduce their corporate income tax rates.

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, 2002; Wrede, 1997), attempts by 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 equalisation.

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 by 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 as to 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 its own policies and operates under conditions which cause inefficiencies at the state level.

Chapter 3

State Fiscal Equalisation and the Composition of Public Spending

The literature on fiscal competition has thus far mainly focused 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 fiscal externalities. The bottom line is an inefficiently low level of taxation and a relative underprovision of public goods (e.g., Zodrow and Mieszkowski, 1986; Wilson, 1986). Recent literature (e.g., Koethenbuerger, 2002; Bucovetsky and Smart, 2006) suggests that fiscal externalities arising from tax competition tend to be internalised by introducing fiscal equalisation schemes which inversely relate transfers to the local tax base.[1] Therefore, the perceived local marginal cost of raising public funds is reduced and governments increase their taxing effort to provide a higher level of public goods. Previous empirical research by Buettner (2006) and Egger, Koethenbuerger, and Smart (2007) supports the view that revenue sharing exerts a strong impact on local tax policy. The aim of the analysis in this chapter is to extend the existing theoretical and empirical literature on the "internalising" impact of capacity-based equalisation schemes to the case of local expenditure policies.[2] We use a standard model of fiscal competition where local governments compete for a mobile capital tax base via the provision of a productivity-enhancing public good and we analyse how the implementation of an intergovernmental grant scheme affects the local spending mix between public inputs such as infrastructure spending or education and public consumption. Finally, the theoretical model is taken to an empirical test focusing on state expenditure policies in Germany.

Our theoretical analysis builds on Keen and Marchand (1997) who extend the seminal paper by Zodrow and Mieszkowski (1986) and show that in the presence of a productivity-

[1] See section 1.2

[2] An earlier version of this chapter has already been circulated as a discussion paper. See Hauptmeier (2007a).

enhancing public good the composition of local public spending tends to be systematically biased towards a relative overprovision of a productivity-enhancing public good compared to public goods which are consumed directly by residents. Hindriks, Peralta, and Weber (2007) present a model suggesting that such compositional inefficiencies might be reversed in a dynamic setting. In their analysis, local governments face incentives to underinvest in stage one of a strategic game in order to alleviate second-stage tax competition. Related to our paper, the authors then show that under fiscal equalisation public investment is discouraged. Empirical contributions addressing the effect of public investment on the allocation of capital are scarce. Bénassy-Quéré, Gobalraja, and Trannoy (2007) show that both capital tax rates and public capital stocks help to explain FDI flows. More related to our analysis, Borck, Caliendo, and Steiner (2005) deal with strategic interaction of German local governments in different expenditure categories, suggesting that governments use public spending to attract mobile factors of production.

Given this background we extend the model of interjurisdictional fiscal competition presented in Keen and Marchand (1997) and, similar to Bucovetsky and Smart (2006), introduce a system of redistributive equalisation transfers. As the primary interest of our paper lies in the compositional spending inefficiencies arising from public input competition, we assume tax policy to be coordinated at the federal level. Therefore, local jurisdictions can only attract the mobile capital tax base by providing a productivity-enhancing public input and we are left with a framework of pure expenditure competition. In addition, we deviate from the analysis of Keen and Marchand (1997) by explicitly modelling the subnational governments' decision on the local expenditure structure, i.e. the ratio of spending on public inputs to overall public spending. This theoretical framework is then utilised to analyse how fiscal equalisation transfers affect the local spending mix. By analytically separating income and substitution effects resulting from exogenous changes in the marginal contribution rate to the equalisation scheme, we show that a higher degree of revenue sharing induces a "price-effect" which, from the viewpoint of a single jurisdiction, increases the relative cost of providing public inputs. Thus, a higher degree of redistribution within the intergovernmental revenue sharing system induces local governments to rebalance their budgets towards a lower budgetary share of the productivity-enhancing public input to production. The spending bias pointed out by Keen and Marchand (1997) is, therefore, (at least partially) corrected via the implementation of capacity-based equalisation transfers. To the best of our knowledge, our theoretical analysis is the first to show this result in a standard framework of fiscal competition.

The implications from our theoretical analysis are finally tested via 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 categories are set coordinately at the federal level while, on the other hand, states can rather freely decide on the composition of the spending side of their budgets. Germany is also characterised by a complex sys-

tem of fiscal equalisation among state governments. The results from our panel analysis strongly support the existence of an incentive effect of fiscal equalisation transfers on state expenditure policies. We observe that an increase in the marginal contribution rate to the German system of fiscal equalisation induces state governments to reduce the overall budgetary share of public spending on infrastructure and education. Thus, the theoretically predicted "price-effect" from an increase in the degree of redistribution within a capacity-based equalisation scheme is identified on the basis of our sample of German states. Moreover, note that we find this effect while controlling in a comprehensive way for shifts in the state governments' budget constraints.

The analysis in this chapter proceeds as follows. In section 3.1 we conduct the theoretical analysis and derive testable empirical implications. Section 3.2 then presents the empirical analysis of state expenditure policies in Germany. Conclusions are drawn in section 3.3.

3.1 Theoretical Analysis

3.1.1 The Model

Our theoretical analysis is based on a standard framework of fiscal competition as presented, for example, in Keen and Marchand (1997). We consider a federation where a numeraire output is produced in each state using immobile labour 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 labour and capital. The public input P is of the factor-augmenting type and raises the marginal productivity of the primary input factors, capital and labour. For analytical convenience labour is normalized to unity and we assume that firms in jurisdiction i produce according to the following (per labour unit) production technology:

$$f(k_i, P_i) \;=\; k_i^{\alpha}\, P_i^{\beta}, \quad \alpha + \beta \leq 1 \tag{3.1}$$

The impact of public inputs is modeled by introducing a shift-term, P_i^{β}, into the production function which captures total factor productivity.[3] Thereby, β labels the productivity impact of the publicly provided input to production. We assume that the production function exhibits non-increasing returns to scale, i.e. $\alpha + \beta \leq 1$.

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 cannot be altered by the individual jurisdiction. Free capital mobility and profit maximization by firms then yields

[3] For an overview on different treatments of public inputs in the literature see Feehan (1989) and Feehan (1998).

the following marginal productivity condition for local investment

$$\frac{\partial f(k_i, P_i)}{\partial k_i} \;=\; \alpha\, k_i^{\alpha-1}\, P_i^{\beta} \;=\; r + \bar{\tau}, \tag{3.2}$$

Note that equation 3.2 implies demand for capital $k_i = \phi(r + \bar{\tau}, P_i)$. By implicitly differentiating the profit maximization condition we can derive

$$\frac{\partial k_i}{\partial P_i} \;=\; -\frac{\partial^2 f(k_i, P_i)}{\partial k_i \partial P_i}\left[\frac{\partial^2 f(k_i, P_i)}{\partial k_i^2}\right]^{-1} \;=\; \frac{\beta}{1-\alpha} k_i P_i^{-1} > 0. \tag{3.3}$$

Therefore, an increase in the provision of the public input (P_i) increases the marginal productivity of capital and consequently broadens the local tax base.

Following Zodrow and Mieszkowski (1986), we assume that total supply of capital to the federation is fixed and given by the sum of individual capital endowments in all jurisdictions. Therefore the capital market equilibrium reads

$$\sum_i k_i \;=\; \sum_i s_i, \tag{3.4}$$

where s_i denotes per capita endowment with capital in jurisdiction i. Note that r, the after-tax return to capital, is equalized across jurisdictions due to the assumption of free capital mobility. As in Keen and Marchand (1997), we also assume that the individual state, being small compared to the overall size of the federation, treats r as fixed.

Let us assume that there exists a single household in each state deriving utility from a private good c_i and a public good Z_i. Preferences are quasi-linear according to the following utility function

$$u_i \;=\; c_i + v(Z_i), \tag{3.5}$$

where $v' > 0$ and $v'' < 0$. Consumers receive total factor income and therefore private consumption in jurisdiction i is given by

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

State governments use their capital tax revenue to provide both a purely consumptive public good (Z_i) and a productivity-enhancing public input (P_i). Moreover, local governments receive unconditional grants (g_i) from the federal level. The budget constraint then reads

$$b_i = Z_i + P_i \;=\; \bar{\tau} k_i + g_i. \tag{3.6}$$

As our primary concern is not so much with the levels of public spending on Z_i and P_i

but rather the public spending mix, we substitute $P_i = \lambda_i b$ and $Z_i = (1-\lambda_i)b_i$ into (3.5), where λ_i denotes the overall budgetary share of spending on the public input.[4]

This leads to the following unconstrained maximization problem:

$$\max_{\lambda_i} \; u_i \;=\; k_i^{\alpha} \; (\lambda_i b_i)^{\beta} - k_i \, (r + \bar{\tau}) + s_i \, r + v \, ((1-\lambda_i) \, b_i) \tag{3.7}$$

Assuming symmetric jurisdictions, the first order condition for the optimal expenditure structure λ_i^* can be written as

$$\begin{aligned} \frac{\partial u_i}{\partial \lambda_i} \quad &= \quad k_i^{\alpha} \beta P_i^{\beta-1} \left(b_i + \lambda_i \frac{\partial b_i}{\partial \lambda_i} \right) \\ &- \quad v' \left(b_i - (1-\lambda_i) \, \frac{\partial b_i}{\partial \lambda_i} \right) \; \stackrel{!}{=} \; 0, \end{aligned} \tag{3.8}$$

where $\frac{\partial b_i}{\partial \lambda_i}$ captures the budgetary effect of a marginal increase in the budgetary share of the public input. This derivative has a positive sign if $g_i > 0$, i.e. if federal grants play a role in financing local public good provision.[5] Note that, 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_i via the decision on the local spending mix. This expenditure competition is attributed to the productivity-enhancing characteristic of the public input which leads to a partial self-financing of P_i via its positive tax base effect.

Compositional Inefficiencies in Local Public Spending Rearranging (3.8) shows that the positive tax base effect of an increase in the expenditure structure λ_i results in a wedge between $k_i^{\alpha} \beta P_i^{\beta-1}$, the marginal product of P_i, and v', the marginal utility of Z_i:

$$\left(k_i^{\alpha} \beta P_i^{\beta-1} - v' \right) \left(b_i + \lambda_i \frac{\partial b_i}{\partial \lambda_i} \right) = -v' \frac{\partial b_i}{\partial \lambda_i} \tag{3.9}$$

From equation (3.9) one can immediately see that in the local government optimum the marginal product of the publicly provided input to production ($k_i^{\alpha} \beta P_i^{\beta-1}$) falls below the marginal utility of public consumption (v'). Compared to a first best situation under policy coordination where local governments provide public goods efficiently, i.e. $k_i^{\alpha} \beta P_i^{\beta-1} = v'$,[6] we observe a distortion of the local spending decision due to the positive tax base effect

[4] Similar to our approach, Buettner (1999) presents theoretical model of strategic policy interaction where local governments decide both on the tax rate on capital income and the expenditure structure, i.e. the division of public spending between consumption and investment.

[5] See Appendix A.3 for further details.

[6] This can easily be shown in the benchmark case of a benevolent social planner who maximises the aggregate welfare function of the federation with respect to λ_i. In this scenario, all fiscal externalities arising from local public input provision are taken into account and we are left with the following first order condition for the optimal expenditure structure, λ_i^*: $\left(k_i^{\alpha} \beta P_i^{\beta-1} - v' \right) b_i \stackrel{!}{=} 0$.

of public input provision. This finding is in line with Keen and Marchand (1997) who analyse 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. In fact, their finding can easily be reproduced within our setting as a revenue-neutral switch from P_i to Z_i, i.e. $dZ_i = -dP_i$, yields the following utility effect:

$$du_i = \left(k_i^{\alpha}\beta P_i^{\beta-1} - v'\right) dP_i > 0 \tag{3.10}$$

According to (3.10), the gap between the marginal productivity of P_i and the marginal utility of Z_i which in equilibrium arises from the productivity-enhancing impact of the public input, results in a positive welfare effect of a budget-compensated switch from public input provision to public consumption.

3.1.2 Introducing Fiscal Equalisation

In the equilibrium described above one observes compositional inefficiencies in local public spending due to fiscal externalities which arise from the productivity effect of public input provision and are not internalised by the individual juridiction. Therefore, in this section we address the question of whether, and how, the implementation of a redistributive equalisation scheme affects a state's provision of the tax-base-enhancing public input relative to its provision of the consumptive public good.[7] We build on recent literature (e.g., Koethenbuerger, 2002; Bucovetsky and Smart, 2006) suggesting that inefficiencies in local public finances resulting from capital tax competition are reduced or, under certain assumptions, even corrected for via the implementation of a capacity-based revenue sharing scheme. Intuitively, this effect arises as local jurisdiction, when lowering their capital tax rate, not only observe a capital inflow and a broadening of their tax base but also face increased contribution payments to the fiscal equalisation system. Therefore, negative fiscal externalities arising from capital tax competition are (at least) partially internalised by local governments which enhances their taxing effort and in turn results in a higher level of public good provision.

In line with the theoretical analysis presented in chapter 2, we introduce fiscal equalisation into our framework by setting a marginal contribution rate ϑ_i such that income from grants g_i constitutes a linear function of the tax base, i.e.

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

With this modification the state's budget constraint changes to

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

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

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

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 introduce the modified budget constraint and rearrange f.o.c. (3.9) in order to generate an implicit function $\Gamma(\lambda_i, \bar{\tau}, \vartheta_i, y_i) = 0$. Applying the implicit function theorem then yields the effects of variations in the fiscal equalisation parameters ϑ_i and y_i on the local expenditure structure λ_i:

$$\frac{d\lambda_i}{d\vartheta_i} = -\frac{\Gamma_{\vartheta_i}}{\Gamma_{\lambda_i}}, \qquad \frac{d\lambda_i}{dy_i} = -\frac{\Gamma_{y_i}}{\Gamma_{\lambda_i}}.$$

Assuming that the second order condition for the government optimisation problem holds, i.e. $\Gamma_{\lambda_i} < 0$, it is obvious that $sgn(\frac{d\lambda_i}{d\vartheta_i}) = sgn(\Gamma_{\vartheta_i})$ and $sgn(\frac{d\lambda_i}{dy_i}) = sgn(\Gamma_{y_i})$. Therefore, in the following comparative static analysis we will focus on the numerators when analyzing the impact of variations in the two parameters.

Income Effect of Fiscal Equalisation The first step is to analyse how an increase in unconditional federal transfers affects the state's expenditure structure λ_i. Derivation of the implicit function Γ with respect to y_i yields

$$\Gamma_{y_i} = \frac{\partial b_i}{\partial y_i}\left[\left(k_i^{\alpha}\beta P_i^{\beta-1} - v'\right) + \frac{(\alpha+\beta)-1}{1-\alpha}k_i\beta P_i^{\beta-2}\lambda_i\left(b_i + \lambda_i\frac{\partial b_i}{\partial \lambda_i}\right) - v''(1-\lambda_i)\left(b_i - (1-\lambda_i)\frac{\partial b_i}{\partial \lambda_i}\right)\right] + \frac{\partial^2 b_i}{\partial \lambda_i \partial y_i}\left[\lambda_i\left(k_i^{\alpha}\beta P_i^{\beta-1} - v'\right) + v'\right]. \quad (3.11)$$

According to (3.11), the marginal impact of higher federal transfers on the local expenditure structure consists of two terms, one arising from the direct budgetary effect of an increase in grants received from the federal level ($\frac{\partial b_i}{\partial y_i}$) and an additional indirect effect stemming from the respective reoptimisation of λ_i which alters its budgetary impact, i.e. $\frac{\partial^2 b_i}{\partial \lambda_i \partial y_i}$.

Starting with the direct budgetary impact of an increase in y_i, one observes from equation (3.11) that $\frac{\partial b_i}{\partial y_i}$, which has a positive sign, is multiplied with the gap between the marginal product of P_i and the marginal utility of Z_i (term 1 in upper square brackets). According to (3.9) this term is negative in the local government optimum which triggers an incentive to reduce the budgetary share of the public inputs when the federal government raises transfers y_i. In addition, higher spending on P_i lowers its marginal product (term 2 in upper square brackets) thereby further increasing downward pressure on λ_i. As $(1-\lambda_i)$ of the increase in federal transfers is also spent on Z_i, term 3 (in upper square brackets) indicates that the marginal utility of public consumption will also fall, leading to an adverse effect. Furthermore, the indirect effect of an increase in unconditional federal transfers

which arises from the reoptimization of λ_i cannot be determined as it is not possible to unambiguously sign $\frac{\partial^2 b_i}{\partial \lambda_i \partial y_i}$.[8] Therefore, the overall effect of an increase in federal transfers, y_i, on the local budgetary share of the public input to production is ambiguous.

Incentive Effect of Fiscal Equalisation In order to capture the incentive effect of fiscal equalisation we implicitly differentiate Γ with respect to the marginal contribution rate ϑ_i. This yields

$$\Gamma_{\vartheta_i} = -\eta b_i \left[\lambda_i \left(k_i^{\alpha} \beta P_i^{\beta-1} - v'\right) + v'\right] - k_i \Gamma_{y_i}, \tag{3.12}$$

where $\eta = \frac{1}{\frac{1-\alpha}{\beta} k_i^{-1} P_i - (\bar{\tau} - \vartheta_i)\lambda_i} > 0$ if $y_i \geq 0$. Note that an increase in the marginal contribution rate induces both, an income effect (term 2) due to higher contributions to the redistributive transfer system and a substitution effect (term 1) as public input provision becomes relatively more costly.[9] The substitution (or incentive) effect arises because the positive tax base effect of the public input is redistributed to a greater extent within the federation as the marginal contribution rate ϑ_i rises. In order to focus on this direct incentive effect of fiscal equalisation we analytically separated the income effect, which according to (3.11) cannot be signed unambiguously, from the substitution effect and assume 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 neutralises the second term on the RHS of equation (3.12) and we are left with term 1. Note that, as λ_i takes values between zero and unity one can immediately see that the term in square brackets is positive. Moreover, as shown in Appendix A.3, $\eta > 0$ if federal transfers play a role in financing local public goods. Therefore, a budget-compensated increase in the marginal contribution rate applies downward pressure on the optimal budgetary share of public inputs λ_i^*, i.e.

$$\left.\frac{\partial \lambda_i}{\partial \vartheta_i}\right|_{comp.} < 0. \tag{3.13}$$

The magnitude of this incentive effect of fiscal equalisation on local expenditure policies becomes larger as $\frac{\partial k_i}{\partial P_i}$, the positive tax base effect of the public input, increases. This is quite intuitive as fiscal competition becomes fiercer as the negative spending externality rises. On the other hand, decreasing marginal productivity of P_i consequently leads to a reduction of the magnitude of the incentive effect as the budgetary share of "productive" spending and the gap between the marginal productivity of P_i and the marginal utility of Z_i increase.

Proposition 4 (Incentive Effect of Fiscal Equalisation)
Starting from an interior solution, a budget-compensated increase in the marginal contri-

[8] See Appendix A.4
[9] See Appendix A.4 for further details on the computation of Equation (3.12).

bution rate ϑ_i to the fiscal equalisation system will induce local jurisdictions to rebalance their budget towards a lower budgetary share of the public input.

Note that, in line with Bucovetsky and Smart (2006), full equalisation, i.e. $\bar{\tau} = \vartheta_i$, establishes efficiency of local public finances as f.o.c. 3.8 reduces to

$$\frac{\partial u_i}{\partial \lambda_i} = \left(k_i^{\alpha} \beta P_i^{\beta-1} - v'\right) y_i \stackrel{!}{=} 0. \tag{3.14}$$

With full equalisation the gap between the marginal product of the public input and the marginal utility of public consumption vanishes which indicates an efficient provision of public goods, i.e. $k_i^{\alpha} \beta P^{\beta-1} = v' = 1$. Note that a necessary assumption for this result is that the aggregate tax base of the federation is not distorted by the implicit coordination of local spending policies.

Corollary 2 (Efficient Equalisation)
Unitary optimal spending policies can be decentralized by implementing full equalisation, i.e. $\vartheta_i = \bar{\tau}$ for all i.

3.2 Empirical Analysis

In the following, the theoretical model described above is taken to an empirical test based on a panel of German states. For a number of reasons, the German federation is a very interesting case to study in our context. The German states lack taxing autonomy in regard to their most important sources of revenue, i.e. income and corporate taxes as well as VAT. Respective tax rates are set coordinately at the federal level. In contrast, their competencies on the expenditure side of the budget are rather comprehensive. Furthermore, state public finances are strongly influenced by a complex system of vertical and horizontal intergovernmental transfers.

The empirical analysis will proceed as follows. In section 3.2.1, we define "productive" state spending categories used to compute the numerical counterpart of the local expenditure structure (λ_i). Then, the underlying data set and the estimation approach are described in section 3.2.2. Finally, the results are presented and discussed in section 3.2.3.

3.2.1 State productive spending

Our computation of expenditure structures for the German states is based on Thoene (2005) who provides an in-depth review of the empirical literature on the productivity-effects of different public spending categories. The insights from this literature overview are then applied to the German system of budgetary accounting to develop a quality

indicator for the spending composition at the different levels of state. Following Thoene (2005), we identify the spending items presented in Table (3.1) as being "productivity-enhancing". Our focus lies on educational and infrastructure spending. Note that, in order to compute the empirical counterpart of the expenditure structure, λ, from our theoretical model we first calculate the state-specific ratio of each expenditure item to primary spending and then aggregate to derive the overall (primary) budgetary share of "productive" spending. In the year 2003, this share averaged 33.6% indicating that German states, on average, devoted approximately one third of their primary expenditure to spending on education and infrastructure. Note that, as public finances at the state and municipal level are strongly interlinked in Germany we use aggregated spending data from the German Statistical Office to compute expenditure shares.

Table 3.1: State Productive Spending 2003

Spending item	% of Primary spending
Education and R&D:	
- Schools and pre-school education	15.16
- Universities	5.95
- Sponsorship of pupils, students, etc.	1.25
- Research and development (outside universities)	0.95
Infrastructure:	
- Streets	3.09
- Waterways and ports	0.09
- Rail and public transport	2.81
- Aviation	0.04
- Municipal services (sewer system, etc.)	4.28
Overall "productive" spending:	33.62

Source: German statistical office and own calculations.

3.2.2 Data and estimation approach

Our empirical analysis is based on an annual database of German states which covers the period between 1980 and 2003. Since the former eastern states have only been fully integrated into the state fiscal equalisation system since 1995 our dataset includes these states from 1995 onwards and our panel is therefore unbalanced. We us the following estimation equation to identify the determinants of state expenditure policies in Germany:

$$\lambda_{i,t} = \beta_1 \lambda_{i,t-1} + \beta_2 y_{i,t} + \beta_3 \vartheta_{i,t} + \beta_4 x_{i,t} + \chi_i + \psi_t + \varepsilon_{i,t} \tag{3.15}$$

Note that, as we assume the decision on the expenditure structure to constitute a dynamic adjustment process, we take into account the lagged dependent variable on the right-hand

side of our estimation equation. The database underlying our empirical analysis contains detailed information on the composition of state spending which we used to compute state expenditure structures as described in Section 3.2.1. According to Table 5.1, the mean value of the (primary) budgetary share of state "productive" spending amounted to approximately 34.2% in the period under consideration and varied between 22.6 and 41.3%. In addition, the database contains information regarding the treatment of each state within 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.[10] In order to control for income effects from intergovernmental transfers we include in our regression equation unconditional transfers, which are computed by summing up the fiscal equalisation related transfers presented in Table (1.1) in section 1.1, i.e. fiscal equalisation, federal and special requirement transfers. Note that in our sample the mean value of these transfers amounted to 391.5 € per capita with a maximum of 3017 and a minimum of -165.7 € per capita. Negative values result from the fact that states which are characterised by above average per capita tax revenues contribute to the equalisation system. The marginal contribution rate captures the incentives individual states face within the fiscal equalisation scheme. As described in further detail in section 1.1, it quantifies to which extent tax revenue increases in a specific state reduce its transfers received from or, in the case of a fiscally strong state, raise its contributions to the system of fiscal equalisation. Between 1980 and 2003 this marginal contribution rate averaged 68.6% with the standard variation of 27.8 pointing to significant cross-sectional and time variation. This indicates that on average only 30% of an increase in revenues remained in the state budget due to higher contributions to or lower transfers from the equalisation system. We also implement a set of control variables x_i which includes the relative fiscal capacity. It is calculated by relating a state's fiscal need, which basically depends on the respective population size, to its fiscal capacity, i.e. the sum of its tax revenues. The relative fiscal capacity is used as a control variable in our estimations to control for state differences in the taxing capacity. In the period under consideration, it varied between 67.8 and 125.8% , therefore revealing substantial variation. Note that a relative fiscal capacity of say 80% indicates that this particular state's taxing capacity, in per capita terms, amounts to 80% of the state-wide average. As shown in Table 5.1 we also employ a set of political dummy variables, capturing the partisan composition of state governments. The reasoning behind this is that the spending structure might also be affected by political preferences. We therefore created dummies for social-democratic (left) and christian-democratic (conservative) led governments as well as grand coalitions. Other control variables include the unemployment rate as well as the population size. Fixed effects, χ_i, are included to control for state heterogeneity and we implement a full set of time dummies, ψ_t.

[10] See section 1.1 for further details.

Table 3.2: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Fiscal variables:				
Expenditure structure (in %), λ	34.23	3.686	22.66	41.30
Marginal contribution rate (in %), ϑ	68.60	27.81	1.666	98.44
Unconditional transfers (€ per capita), y	391.5	591.6	-165.7	3017
Relative fiscal capacity (in %)	94.99	12.06	67.82	125.8
Debt Service (€ per capita)	314.5	174.5	73.92	949.0
Political dummy variables:				
Conservative government	.2619	.4404	0	1
Conservative coalition government	.1123	.3162	0	1
Left government	.2585	.4386	0	1
Left coalition government	.2551	.4367	0	1
Grand coalition	.1088	.3120	0	1
Other control variables:				
Unemployment rate (in %)	10.88	4.541	2.3	21.8
Population (in 1000)	5602	4863	655.8	18073

Number of observations: 294. Annual data for 10 western (6 eastern) German States in the period 1980-2003 (1995-2003).

A close inspection of regression equation (3.15) reveals some potential sources of endogeneity, one arising from the implementation of the lagged dependent variable. As we use a dynamic specification, the standard Least square dummy variable (LSDV) estimator might be inconsistent and result in biased parameter estimates. This is well-known from the literature on dynamic panel estimation and referred to as the 'Nickell bias'. Nickell (1981) derives a formula for the inconsistency of the LSDV estimator in models with a finite time dimension showing that the bias declines as T increases. Kiviet (1995) and Kiviet (1999) extend this result by analysing the small sample properties of the bias and present a method to correct the LSDV estimator (LSDVC). On the basis of Monte Carlo simulations, Judson and Owen (1999) show that when the cross-section dimension of a panel is only moderately large the LSDVC estimator outperforms standard GMM estimation techniques. Therefore, to ensure that our results do not suffer from the bias described above, we make use of a correction method for unbalanced panel data models which was developed by Bruno (2005).

Another potential source of endogeneity results from the fact that a state's "treatment" within the fiscal equalisation system depends on its relative fiscal capacity, which may be influenced by state expenditure policies. For example, infrastructure spending to attract private investment could exert a tax base broadening effect which would alter a state's fiscal capacity and, thereby, the amount of equalisation grants received. Therefore, our regression could suffer from simultaneity bias. Note that Egger, Koethenbuerger, and

Smart (2007), in the context of municipal fiscal equalisation in Germany, refer to this issue as a problem of self-selection which they address by exploiting a "natural experiment", i.e. a reform of the system of fiscal equalisation in the German state of Lower-Saxony, and performing, inter alia, differences-in-differences estimation. In our analysis, we make use of a simulation programme which enables us to calculate "standardised" values of the variables potentially causing the simultaneity bias. In particular, this concerns the marginal contribution rate as well as state and federal fiscal equalisation transfers. The idea is to separate potentially endogeneous variation in these variables, i.e. variation due to differences in the taxing capacity, from supposedly exogenous variation resulting, inter alia, from heterogenous population developments. Concretely, this is done by rerunning the simulation procedure for each state while assuming an average per capita taxing capacity. The resulting values for the equalisation variables will now only capture relative differences in the population size as well as a number of exogenous revenue sources and therefore should not cause the described problem of endogeneity in our estimations.

In addition, as discussed in Buettner (2006) in the context of local tax policy, a precise identification of the incentive effects of fiscal equalisation might be hindered due to difficulties in separating the "treatment effect" via the equalisation system from the impact of heterogeneous and possibly unobserved characteristics driving local fiscal conditions. This is due to the fact that both the marginal contribution rate as well as fiscal equalisation transfers depend on a state's relative fiscal capacity. Therefore, we follow Buettner (2006) and exploit the fact that incentives within the complex, however clearly defined, state fiscal equalisation system in Germany vary discontinuously with a state's relative fiscal capacity. Along the lines of regression discontinuity estimation (e.g., Angrist and Lavy, 1999; Van der Klaauw, 2002), we employ a number of non-linear specifications of the relative fiscal capacity in order to separate out the different treatment of the state within the equalisation system.

3.2.3 Results

Table 3.3 provides results from our baseline regression using the standard Least square dummy variable (LSDV) estimator. Specification (1) includes the basic set of explanatory variables while in specifications (2) and (3) we test for the impact of non-linear differences in the relative fiscal capacity along the lines of regression discontinuity estimation. Conditioning on the relative fiscal capacity in all specifications is important to make sure that the results capture the impact of the equalisation system rather than simply reflecting differences in taxing capacity. Note that the high significance of the lagged expenditure structure across all specifications supports our assumption that the decision on the state spending mix constitutes a dynamic adjustment process. Moreover, our results suggest a non-linear relationship between the relative fiscal capacity and the budgetary share of

"productive" spending. In particular, taking into account a quadratic and cubic polynomial as in specification (3) increases the fit of the empirical model.

Table 3.3: Determinants of State Expenditure Structures - baseline

Variable	(1) LSDV	(2) LSDV	(3) LSDV
Expenditure structure (λ), lag	.6706 ***	.6611 ***	.6599 ***
	(.0704)	(.0722)	(.0709)
Unconditional transfers (y)	-.0004	-.0004	-.0005
	(.0004)	(.0005)	(.0004)
Marginal contribution rate (ϑ)	-.0077 **	-.0082 **	-.0084 **
	(.0033)	(.0034)	(.0034)
Relative fiscal capacity	-.0324 *	.0902	-2.188
	(.0191)	(.1927)	(1.343)
Relative fiscal capacity (quadratic)		-.0006	.0230 *
		(.0009)	(.0134)
Relative fiscal capacity (cubic)			-.0001 *
			(.0000)
Debt service	-.0033 **	-.0031 **	-.0032 **
	(.0014)	(.0015)	(.0015)
Left government	.6047 **	.5941 **	.5056 **
	(.2456)	(.2484)	(.2323)
Observations	294	294	294
R-squared (adjusted)	.9364	.9363	.9373

Standard Lest square dummy variable (LSDV) estimator . All specifications include state-specific and time fixed effects. Robust standard errors in parentheses. If significant at 1%,5% or 10% level coefficients are marked with one star, two stars or three stars. Insignificant control variables are not reported and include population, unemployment rate and political variables.

Turning to the fiscal equalisation variables in Table (3.3) one can observe a negative sign on unconditional transfers throughout all specifications, suggesting a negative income effect of state and federal transfers. However, the coefficient is not statistically significant which is in line with the implications from our theoretical model as the impact of a marginal increase in y_i could not be determined unambiguously. Note that, controlling for unconditional transfers in addition to the relative fiscal capacity is important to make sure that income effects do not drive our results. This enables us to identify the pure incentive effect of fiscal equalisation by including the marginal contribution rate as a right-hand side variable. In line with Proposition 4 of our theoretical analysis, our results strongly support the existence of an incentive effect of fiscal equalisation transfers on state expenditure policies. The point estimate in specification (3) implies that an increase in the marginal contribution rate by one percentage point leads to a decrease in the share of spending on infrastructure and education by 0.0084 percentage points. Note that, this

effect is highly significant throughout all specifications reported in (3.3), suggesting that state fiscal equalisation in Germany discourages public investment spending at the state level. In addition, we find a statistically significant negative effect of the debt service which indicates that an increase in a state's debt burden tends to lower the budgetary share of spending on infrastructure and education. Moreover, the positive and statistically significant coefficient of the dummy variable capturing "left" governments suggests that there seems to be a tendency for social-democratically led governments to spend relatively more on infrastructure and education than conservative governments.

As discussed in section 3.2.2, the results presented in Table 3.3 might be biased due to potential inconsistency of the LSDV estimator in dynamic models. Therefore, we run additional estimations based on a bias-correction method proposed by Bruno (2005). Results are reported in Table 3.4. While the bias-correction does not change the results qualitatively, the coefficients and significance levels of our right-hand side variables are affected to some extent. In particular, the magnitude of the coefficient of the lagged dependent variable increases by some 0.1 percentage point in all specifications. As regards the fiscal equalisation variables, the coefficient of the unconditional transfers level is more or less unaffected and remains insignificant. While the impact of the marginal contribution rate is estimated somewhat less precisely, our central result is robust with respect to the use of the corrected LSDV estimator. Moreover, the inclusion of a quadratic and cubic polynomial of the relative fiscal capacity is confirmed, suggesting that the non-linearities from the German state fiscal equalisation system are picked up best when implementing specification (3). Furthermore, the coefficient on the debt service remains stable and significant. However, the impact of the left government dummy becomes insignificant in specification (3).

Overall, our empirical analysis provides strong evidence for the existence of an incentive effect of fiscal equalisation transfers on state expenditure policies in Germany. The results presented above are in line with Proposition 4 from our theoretical analysis as we observe that state governments who are facing higher marginal contribution rates within the German state fiscal equalisation system tend to be characterised by lower budgetary shares of "productive" spending on infrastructure and education.

3.3 Summary

The theoretical analysis presented in this chapter is based on 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 Keen and Marchand (1997), we show that, without coordination, the local public expenditure structure tends to be biased towards a relative overprovision of productivity-enhancing public inputs compared to purely consumptive public goods. The reason for this bias is that publicly provided inputs are

Table 3.4: Determinants of State Expenditure Structures - bias corrected

Variable	(1) LSDVC	(2) LSDVC	(3) LSDVC
Expenditure structure (λ), lag	.7506 ***	.7399 ***	.7392 ***
	(.0604)	(.0609)	(.0596)
Unconditional transfers (y)	-.0003	-.0004	-.0004
	(.0004)	(.0004)	(.0004)
Marginal contribution rate (ϑ)	-.0072 *	-.0075 *	-.0076 *
	(.0043)	(.0046)	(.0045)
Relative fiscal capacity	-.0294	.0500	-2.052 *
	(.0273)	(.1784)	(1.193)
Relative fiscal capacity (quadratic)		-.0004	.0214 *
		(.0009)	(.0124)
Relative fiscal capacity (cubic)			-.0001 *
			(.0000)
Debt service	-.0031 *	-.0031 *	-.0030 *
	(.0016)	(.0017)	(.0017)
Left government	.5107 *	.5109 *	.4274
	(.3012)	(.3023)	(.3015)

Bias corrected Least square dummy variable (LSDVC) estimator proposed by Bruno (2005). All specifications include state-specific and time fixed effects. Bootstrapped standard errors in parentheses. If significant at 1%,5% or 10% level coefficients are marked with one star, two stars or three stars. Insignificant control variables are not reported and include population, unemployment rate and political variables.

partially self-financing as they improve the productivity of local firms which induces a capital inflow, i.e. a broadening of the local tax base. The inefficiency in local public spending arises because this negative fiscal externality for other jurisdictions in the federation is not taken into account by the individual local government. Starting from this result, we show that, similar to the case of tax competition (see, e.g., Koethenbuerger, 2002; Bucovetsky and Smart, 2006), the implementation of a redistributive transfer system can increase or, in the case of full equalisation, even restore efficiency of local public finances. We find that a budget-compensated increase in the marginal contribution rate to the system of fiscal equalisation induces local governments to reduce the budgetary share of public inputs to production. Therefore, compositional inefficiencies on the spending side as pointed out by Keen and Marchand (1997) are alleviated by the introduction of capacity-based fiscal equalisation transfers. More intuitively, a higher degree of equalisation will make it less attractive for the individual jurisdiction to provide public inputs as positive tax base effects are redistributed to a higher extent among governments within the federation. This induces an internalisation of fiscal externalities at the local level which generates incentives for local governments to substitute public input provision by public consumption. In line with the theoretical implications, our empirical analysis strongly supports

the existence of an incentive effect of fiscal equalisation transfers on state expenditure policies in Germany. Controlling in a comprehensive way for income effects, we find that a higher marginal contribution rate to the state fiscal equalisation system induces state governments to reduce the budgetary share of spending on infrastructure and education. This suggests that capacity-based equalisation transfers exert a substitution effect, i.e. state governments which are facing higher transfer reduction rates within the equalisation scheme tend to put a higher weight on public consumption.

Chapter 4

The Impact of Fiscal Equalisation on Local Expenditure Policies

Building on the theoretical analysis presented in chapter 3, we now proceed with analysing the incentive effects of fiscal equalisation transfers on local public finances.[1] Unlike previously, we now explicitly assume that local jurisdiction have two policy instruments available to compete for the mobile capital tax base, i.e. the local capital tax rate and the provision of a productivity-enhancing public input to production. Again, we follow Keen and Marchand (1997) and use a static model of bi-dimensional fiscal competition. Introducing a redistributive grant scheme then allows us to analyse the incentive effects of fiscal equalisation transfers on local tax and spending decisions. As already shown, e.g., in Bucovetsky and Smart (2006), we find that fiscal capacity equalisation induces local jurisdictions to increase distortionary taxation of the mobile tax base. In addition, we show that increasing the degree of redistribution - while compensating for budgetary effects - induces local governments to rebalance their budget towards a lower budgetary share of the publicly provided input. Thus, in our analysis the implementation of a system of fiscal equalisation alleviates both tax and expenditure competition. Moreover, in the case of full equalisation of tax bases, the compositional inefficiencies in local spending pointed out by Keen and Marchand (1997) vanish when assuming inelastic supply of capital. Compared to our theoretical analysis in chapter 2, the result that fiscal equalisation transfers discourage public input provision relative to purely consumptive public goods is shown in a more general setting where local jurisdictions engage in simultaneous tax and public input competition.

While two recent studies (Buettner, 2006; Egger, Koethenbuerger, and Smart, 2007) have analysed the incentive effects of fiscal equalisation grants on local tax policy in Germany, the empirical analysis presented in this paper, to the best of our knowledge,

[1] An earlier version of this chapter has already been circulated as a discussion paper. See Hauptmeier (2007b).

is the first that focuses on local public spending. The estimations are based on a panel of German municipalities in the state of Baden-Wuerttemberg. As municipalities, within their self-administration responsibilities decide on infrastructure spending on the local street network as well as spending on local schools, Germany is an interesting case to study in our context. Following Buettner (2006) we make use of non-linearities in the grant scheme and implement a regression discontinuity estimator to identify the incentive effect of fiscal equalisation transfers. We find that, in line with the theoretical predictions, jurisdictions that are facing higher marginal contribution rates to the municipal system of fiscal equalisation are characterised by lower budgetary shares of public investment in the fields of street infrastructure and education.

In this chapter we proceed as follows. In section 4.1 we conduct the theoretical analysis and derive testable empirical implications. Section 4.2 then describes the empirical analysis of local expenditure policies in Germany. Conclusions are drawn in section 4.3.

4.1 Theoretical Analysis

As previously mentioned, the model in this chapter builds on the theoretical analysis in chapter 3. Again, we use a standard framework of fiscal competition (e.g., Zodrow and Mieszkowski, 1986; Keen and Marchand, 1997) and consider a federation with a set of n local jurisdictions, labelled $i = 1, ..., n$. In each jurisdiction a competitive firm produces a homogenous private good 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:

$$f(k_i, P_i) \;=\; k_i^{\alpha}\, P_i^{\beta}, \quad \alpha + \beta \leq 1$$

The impact of public inputs is modelled by introducing a shift-term, P_i^{β}, into the production function which captures total factor productivity. By assumption, the production function exhibits non-increasing returns to scale, i.e. $\alpha + \beta \leq 1$.

Each jurisdiction levies a source based tax (τ_i) on locally installed capital. Profit maximisation and free capital mobility imply an equal net rate of return to capital r across jurisdictions which is given by the after tax marginal product of capital

$$r \;=\; f_{k_i} - \tau_i.$$

The profit maximisation condition implies per-capita demand for capital $k_i = \phi(r + \tau_i, P_i)$

and implicit differentiation yields

$$\frac{\partial k_i}{\partial \tau_i} = \frac{1}{f_{k_i k_i}} < 0, \quad \frac{\partial k_i}{\partial P_i} = -\frac{f_{k_i P_i}}{f_{k_i k_i}} > 0.$$

Therefore, a higher local tax rate reduces capital demand in jurisdiction i while an increase in the provision of the productivity-enhancing public good raises it.

The representative consumer in jurisdiction i derives utility from private (c_i) and public (Z_i) consumption according to a well behaved and quasi linear utility function

$$u_i \quad = \quad c_i + v(Z_i).$$

Note that v constitutes an increasing and strictly concave function. As we assume that the representative consumer in jurisdiction i owns the local firm, per-capita private consumption equals the firm's profits plus capital income:

$$c_i \quad = \quad k_i^{\alpha}(\lambda_i b_i)^{\beta} - k_i(r + \tau_i) + s_i r,$$

Note that s_i labels capital endowment per-capita in jurisdiction i.

Turning to the public sector, the budget of the local government i which is used to finance public consumption and the public input provision reads

$$b_i \quad = \quad \tau_i k_i + g_i = Z_i + P_i,$$

where g_i constitutes grants from the federal government. Again, we assume that the upper level government administers a system of local fiscal equalisation by setting a marginal contribution rate (ϑ_i) such that income from grants (g_i) can be represented as a linear function of the tax base

$$g_i = y_i - \vartheta_i k_i. \tag{4.1}$$

Unconditional transfers[2] from the upper level government are labelled y_i. In order to close the model we assume that the capital market equilibrium is given by

$$\sum_j k_j \quad = \quad \sum_j s_j,$$

so that total capital demand in the federation is satisfied by total capital endowment. Similar to Zodrow and Mieszkowski (1986), we assume that the number of jurisdictions n in the national economy is large and therefore the (net) interest rate effect of variations in either policy instrument is not taken into account by local governments.

[2]These are the transfers a jurisdiction would receive if its tax base were actually zero.

Local jurisdictions simultaneously choose their policy instruments τ_i and λ_i given the optimal choices of the other jurisdictions while neglecting the external impacts of their policies. Here, we extend the theoretical model presented in chapter 3 by explicitly assuming that local jurisdictions have fiscal autonomy, both with respect to the revenue and the spending side of their budget. Therefore, given free capital mobility in the federation, local governments will engage in simultaneous tax and public input competition for the capital tax base. This can be shown by setting up the following unconstrained maximisation problem of jurisdiction i.

$$\max_{\tau_i,\lambda_i} \; u_i(\tau_i,\lambda_i) \;=\; k_i^{\alpha}\,(\lambda_i b_i)^{\beta} - k_i\,(r+\tau_i) + s_i\,r + v\,((1-\lambda_i)\,b_i) \tag{4.2}$$

Note that again we substitute Z_i and P_i by their respective budgetary shares times the budget, i.e. $Z_i = (1-\lambda_i)b_i$ and $P_i = \lambda_i b_i$. Maximising with respect to the tax rate (τ_i) and the budgetary share of the public input (λ_i) yields the first order conditions from the perspective of jurisdiction i.

$$\frac{\partial u_i}{\partial \tau_i} \;=\; -k_i + \left(k_i^{\alpha}\beta(\lambda_i b_i)^{\beta-1} - v'\right)\left(\lambda_i \frac{\partial b_i}{\partial \tau_i}\right) + v'\frac{\partial b_i}{\partial \tau_i} \;\stackrel{!}{=}\; 0 \tag{4.3}$$

$$\frac{\partial u_i}{\partial \lambda_i} \;=\; \left(k_i^{\alpha}\beta(\lambda_i b_i)^{\beta-1} - v'\right)\left(b_i + \lambda_i \frac{\partial b_i}{\partial \lambda_i}\right) \;+\; v'\frac{\partial b_i}{\partial \lambda_i} \;\stackrel{!}{=}\; 0 \tag{4.4}$$

From (4.4) one can immediately observe that in the local government optimum the marginal product of the publicly provided input to production ($k_i^{\alpha}\beta(\lambda_i b_i)^{\beta-1}$) falls below the marginal utility of public consumption (v').[3] This result has already been discussed in the theoretical section of chapter 3. Compared to a first best situation under policy coordination where governments provide public goods efficiently, i.e. $k_i^{\alpha-\gamma}\beta(\lambda_i b_i)^{\beta-1} = v' = 1$, we observe a distortion of the local spending decision due to the productivity-enhancing effect of public input provision. In line with Keen and Marchand (1997), we observe that the public input to private production is relatively overprovided compared to the purely consumptive public good (see section 3.1 for further details).

In order to generate further insights into the efficiency consequences of capital mobility in our model of tax and public input competition, we can solve both first order conditions (4.3) and (4.4) for $\left(k_i^{\alpha}\beta(\lambda_i b_i)^{\beta-1} - v'\right)$ and equate them. This leaves us with

$$v' \;=\; \frac{k_i}{k_i + (\tau_i - \vartheta_i)\,\frac{\partial k_i}{\partial \tau_i}}. \tag{4.5}$$

[3] Note that rearranging equation 4.4 yields $\left(k_i^{\alpha}\beta(\lambda_i b_i)^{\beta-1} - v'\right) = -\frac{v'\,\frac{\partial b_i}{\partial \lambda_i}}{\left(b_i + \lambda_i \frac{\partial b_i}{\partial \lambda_i}\right)} < 0$. This follows from $\frac{\partial b_i}{\partial \lambda_i} > 0$ which can be shown by implicitly differentiating the local governments budget constraint with respect to λ_i (see Appendix A.3).

Equation 4.5 constitutes the usual optimality condition that the marginal rate of substitution (MRS) between public and private consumption (v') equals the marginal rate of transformation (MRT) which captures the marginal cost of raising public funds (MCPF).[4] As the marginal contribution rate ϑ_i enters the RHS of equation (4.5) the redistributive grant system allows the federal government to adjust the local cost of raising public funds.[5] One can immediately observe that by implementing full equalisation, i.e. $\tau_i = \vartheta_i$, the MCPF reduce to one. This is in line with Bucovetsky and Smart (2006) who, in a pure tax competition setting, show that if saving is inelastic full equalisation establishes efficiency of local public finances. In addition, setting $\tau_i = \vartheta_i$ in either of the first order conditions (4.3) and (4.4) leads to the fact that the gap between the marginal product of the public input ($k_i^{\alpha}\beta(\lambda_i b_i)^{\beta-1}$) and the marginal utility of public consumption (v') vanishes. Therefore, full equalisation corrects both externalities arising from tax as well as expenditure competition in the presence of a publicly provided input to production. When fiscal equalisation is only partial, i.e. $\tau_i > \vartheta_i$, underprovision of the public consumption good occurs as MCPF exceeds one. This is apparent from equation 4.5 as the RHS exceeds one due to the marginal tax base effect of an increase in the tax rate ($\frac{\partial k_i}{\partial \tau_i} < 0$).

Comparative static analysis of variations in the marginal contribution rate ϑ_i generates further insights into how the federal government can affect the local MCPF by inducing jurisdictions to adjust their policy parameters λ_i and τ_i. We solve equations 4.3 and 4.4 for $\left(k_i^{\alpha}\beta(\lambda_i b_i)^{\beta-1} - v'\right)$ and mutually substitute the derived expressions. Thereby we take into account the fact that in a local government optimum both conditions, 4.3 and 4.4, need to be fulfilled. The resulting optimality conditions for the two policy parameters read

$$\Gamma^{\lambda_i}\left(\tau_i, \lambda_i, \vartheta_i, y_i\right) \;=\; \frac{k_i}{k_i + \left(\tau_i - \vartheta_i\right)\frac{\partial k_i}{\partial \tau_i}} - v' \;=\; 0, \tag{4.6}$$

$$\Gamma^{\tau_i}\left(\tau_i, \lambda_i, \vartheta_i, y_i\right) \;=\; -\Gamma^{\lambda_i}\left(\tau_i, \lambda_i, \vartheta_i, y_i\right) = 0. \tag{4.7}$$

In order to derive the comparative static effects of a change in the marginal contribution rate ϑ_i on the two policy parameters, the next step is to apply the implicit function theorem on Γ^{τ_i} and Γ^{λ_i} which yields

$$\frac{d\lambda_i}{d\vartheta_i} = -\frac{\frac{\partial \Gamma^{\lambda_i}}{\partial \vartheta_i}}{\frac{\partial \Gamma^{\lambda_i}}{\partial \lambda_i}}. \tag{4.8}$$

[4] See appendix A.5. for computational details on the derivation of equation 4.5.
[5] See section 1.2.

$$\frac{d\tau_i}{d\vartheta_i} = -\frac{\frac{\partial \Gamma^{\tau_i}}{\partial \vartheta_i}}{\frac{\partial \Gamma^{\tau_i}}{\partial \tau_i}}, \tag{4.9}$$

Assuming that the second order conditions of the unconstrained maximisation problem 4.2 hold ensures that $\frac{\partial \Gamma^{\tau_i}}{\partial \tau_i} < 0$ and $\frac{\partial \Gamma^{\lambda_i}}{\partial \lambda_i} < 0$. Therefore, the enumerators on the RHS of equations 4.9 and 4.8 will determine the signs of the comparative static effects. Differentiating Γ^{λ_i} and Γ^{τ_i} with respect to ϑ_i yields

$$\begin{aligned} \frac{\partial \Gamma^{\lambda_i}}{\partial \vartheta_i} &= \underbrace{\frac{\partial b_i}{\partial \vartheta_i}\left[\frac{\beta}{1-\alpha}\frac{(\tau_i-\vartheta_i)\,\frac{\partial k_i}{\partial \tau_i}}{b_i\left(k_i+(\tau_i-\vartheta_i)\,\frac{\partial k_i}{\partial \tau_i}\right)}v' - (1-\lambda_i)\,v''\right]}_{=k_i\frac{\partial \Gamma^{\lambda_i}}{\partial y_i}} \\ &- \frac{v'}{k_i^{\alpha}\beta P_i^{\beta-1}}\frac{k_i\frac{\partial k_i}{\partial P_i}}{\alpha\left(k_i+(\tau_i-\vartheta_i)\,\frac{\partial k_i}{\partial \tau_i}\right)}, \end{aligned} \tag{4.10}$$

$$\frac{\partial \Gamma^{\tau_i}}{\partial \vartheta_i} = -\frac{\partial \Gamma^{\lambda_i}}{\partial \vartheta_i}. \tag{4.11}$$

According to equation 4.10, the overall impact of a marginal increase in ϑ_i on the optimal expenditure structure chosen in jurisdiction i can be separated into a "substitution" and an "income" effect. This result has already been discussed in the theoretical analysis presented in chapter 3. The first term on the RHS of equation (4.10) captures the pure "income effect" which cannot be signed unambiguously as the term in square brackets comprises two counteracting effects. Ceteris paribus, a decrease in public funds directly reduces public consumption as well as public input provision according to the respective budgetary shares. This in turn leads to an increased marginal utility of Z_i but also to a higher marginal productivity of P_i. The adjustment of the endogenous budgetary structure then depends on the specification of the utility function, which is general in our case, and the assumptions concerning production technology. The substitution or "incentive effect" (term 2 on RHS of equation 4.10), however, puts downward pressure on the local expenditure structure, inducing local governments to reduce the provision of the public input P_i relative to the purely consumptive good Z_i. This results from the fact that positive tax base effects due to an increase in the budgetary share of the public input λ_i are now "shared" to a greater extent by all jurisdictions within the system of fiscal equalisation. Note that this effect becomes stronger as the gap between the marginal utility of public consumption and the marginal product of the public input $\left(k_i^{\alpha}\beta(\lambda_i b_i)^{\beta-1} - v'\right)$, which arises in the local government optimum due to the productivity effect of P_i[6], increases. Furthermore, the impact of an increase in the degree of redistribution within the equali-

[6] See first order condition 4.4.

sation scheme depends on the elasticity of the tax base with respect to the public input. This result is quite intuitive as the positive tax base effect of public input provision, i.e. $\frac{\partial k_i}{\partial P_i}$, leads to a partial self-financing of P_i. An increase in the marginal contribution rate, however, increases the perceived local cost of providing the input to production and this effect becomes stronger as the tax base effect increases. Note that incentive effect of a marginal increase ϑ_i on local tax policy operates in the opposite direction, indicating that fiscal externalities arising from variations in the local tax rates tend to be internalised by redistributive transfer schemes. More concretely, if a jurisdiction increases its tax rate to generate additional public funds, the resulting adverse tax base effect will be partly compensated via higher transfer payments from the equalisation system, i.e. the MCPF perceived at the local level decrease as the degree of redistribution within the system increases.

Unfortunately, as shown above, the ambiguity in the direction of the income effect of equalisation transfers impede clear-cut theoretical predicitions. One can imagine however, a scenario where the federal government imposes a budget-neutral reform of the local fiscal equalisation system so that local revenue losses resulting from an increase in the marginal contributions rate are fully compensated by corresponding increases in unconditional transfers y_i, i.e. $db_i = -k_i \, d\vartheta_i + dy_i \stackrel{!}{=} 0$. Such a budget-compensated reform of the local equalisation scheme would neutralise the income effect described above and exert an isolated "price effect". Therefore, we can conclude that a marginal increase in ϑ_i, if compensating for budgetary losses by a corresponding increase in transfers from the upper-level government, yields the following budget-compensated comparative static effects:

$$\left.\frac{\partial \lambda_i}{\partial \vartheta_i}\right|_{comp.} < 0, , \quad \left.\frac{\partial \tau_i}{\partial \vartheta_i}\right|_{comp.} > 0 \tag{4.12}$$

Therefore, a budget-compensated increase in the marginal contribution rate induces local jurisdictions to increase the tax rate on mobile capital. This finding is in line with the theoretical literature which states that fiscal capacity based equalisation tends to decrease the marginal cost of raising public funds, thereby generating incentives for participating governments to increase their tax effort and raise distortionary taxation. Efficiency of local public finances is enhanced despite the presence of tax competition for a mobile tax base (Koethenbuerger, 2002; Bucovetsky and Smart, 2006). While this tax rate effect is well documented, we also show that by increasing the marginal contribution rate the upper-level government is able to implicitly affect the composition of local public spending as a higher degree of redistribution induces jurisdictions to lower the budgetary share of the productivity-enhancing public input. Thus, compositional inefficiencies in local spending as suggested by Keen and Marchand (1997) are (at least partially) corrected.

4.2 Empirical Analysis

The following empirical analysis tests for the existence of incentive effects of fiscal equalisation transfers on local public finances in Germany. In order to do so, we exploit a rich data set of municipalities in the major German state of Baden-Wuerttemberg. In our context, Germany is a very interesting case to study as the municipal system of fiscal equalisation, which is administered by the states, is characterised by substantial redistribution of fiscal resources. Moreover, within their self-administration responsibilities, municipalities decide on spending on local streets and schools, two expenditure categories which can be classified as "productive" spending.

In the following we will first present the underlying data and describe the estimation approach in chapter (4.2.1). In Section (4.2.2) the results are presented.

4.2.1 Data and Estimation Approach

Our empirical analysis is based on an annual database for the 1111 municipalities in the German state of Baden-Wuerttemberg. It covers the period between 1990 and 2003 as some of the expenditure data is not available for the most recent fiscal year 2004. For our estimations we reduce this sample in two ways. Firstly, we restrict our attention to municipalities with a population of more than 10000. The reason for this is that revenues from the municipal business tax, which constitutes a tax on the profits of local firms, are subject to significant fluctuations. The instability of the tax base is apparent especially in small municipalities, which are often characterised by a relatively homogenous economic structure. Secondly, there exist 9 independent cities in the state of Baden-Wuerttemberg, which do not belong to a county and therefore face different incentives within the municipal system of fiscal equalisation. We also exclude these observations. Table 5.1 gives an overview of the underlying data for the reduced sample.

The local expenditure structure (λ_i) is calculated as the primary expenditure share of spending on basic schools and municipal roads. In line with the empirical analysis of state spending policies presented in chapter 3, we assume that these two spending categories capture local "investment spending". The mean value of the expenditure structure is approximately 9.6 %, i.e. about 9.6 % of municipal spending (net of debt service) relates to basic education and street infrastructure. Moreover, the data set comprises a set of variables capturing the treatment of local jurisdictions within the municipal system of fiscal equalisation. First of all, as described in further detail in section 1.1, the marginal contribution rate quantifies to what extent increases in the local tax base increase contribution payments to the municipal equalisation scheme. In our sample period from 1990 to 2003, this contribution rate averaged 12.8%, with a minimum value of approximately 4.5% and a maximum of 14.5%. Moreover, municipalities received unconditional transfers amounting to approximately 297 € per capita. In addition to further general grants, municipalities

Table 4.1: Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max
Expenditure structure (λ_i)	in %	9.632	3.286	1.675	49.33
Fiscal equalisation variables:					
Marginal contribution rate (ϑ_i)	in %	12.77	1.487	4.445	14.50
Unconditional transfers (y_i)	€ per capita	296.9	50.00	123.5	373.7
Other grants (general)	€ per capita	4.818	9.258	0	101.3
Specific grants	€ per capita	18.61	31.00	0	252.0
Other control variables:					
Population	in 1000	24.68	16.80	10.24	112.0
Population density	per km^2	576.1	434.7	68.23	2494

Sample size: 2758 observations - 197 municipalities over 14 years (1990-2003).

also received specific grants to fulfil their self-administered spending responsibilities. In our context two types of specific grants are of particular interest: Firstly, within the so called "traffic and transport burden sharing" ("Verkehrslastenausgleich"), municipalities receive general as well as lump-sum grants depending on the length of the road network and the size of the municipal area respectively. Secondly, in the course of "school burden sharing" ("Schullastenausgleich"), municipalities receive transfers depending on the number of pupils. Overall, these specific grants amounted to approximately 19 € per capita in our sample period.

The basic estimation equation is given in (4.13).

$$\lambda_{i,t} = \lambda\left(\vartheta_{i,t}, y_{i,t}\ ;\ x_{i,t}, \phi_i, \psi_t\right) \tag{4.13}$$

We estimate the determinants of the local expenditure structure $\lambda_{i,t}$. The marginal contribution rate to the municipal fiscal equalisation system ($\vartheta_{i,t}$) denotes the key variable on the RHS of estimation equation (4.13). Its coefficient is assumed to capture the incentive effect of fiscal equalisation on local expenditure policies. To ensure that no "income effects" drive the results we control for unconditional transfers $y_{i,t}$.[7] In addition, specific grants as well as other general grants from the state and the federal level are included as control variables in $x_{i,t}$. Finally, we control for population size as well as population density.

We use panel estimation techniques and impose regional fixed effects ϕ_i to avoid an omitted variable bias due to unobserved local heterogeneity. We also control for common

[7] See section 1.1 for details on the computation of unconditional grants.

time shocks by implementing time fixed effects (ψ_t).

As previously pointed out by Buettner (2006) in the context of local tax policy in Germany, a potential problem of endogeneity could hinder the identification of incentive effects of equalisation transfers as it is difficult to disentangle the "treatment effect" of the equalisation scheme and the impact of heterogenous and possibly unobserved characteristics driving local fiscal conditions. As both variables capturing the impact of equalisation, i.e. the marginal contribution rate and unconditional transfers, depend on a municipality's relative fiscal capacity it is not clear which effect is measured when estimating equation (4.13). In the light of these difficulties, Buettner (2006) proposes an identification strategy which exploits the fact that incentives within the municipal equalisation system vary discontinuously with the relative fiscal capacity. Figure 4.1 illustrates these discontinuities. Simulating marginal contribution rates at average revenue sharing and county contribution rates for the year 2003 reveals discontinuous "jumps" at the threshold levels of relative fiscal capacity defined by law.[8] The observed "step function" is separated into three areas according to whether a jurisdiction is characterised as having "low", "medium" or "high" fiscal capacity. Municipalities with a fiscal capacity below 60% of fiscal need, on average, face the highest marginal contribution rates leading to an average equalisation rate ($\frac{\vartheta_i}{\tau_i}$) amounting to 85%.[9] The respective values for the "medium" and "high" capacity regime are 77% and 61%.

The fact that small differences in relative fiscal capacity can lead to significant asymmetries concerning the incentives faced by municipalities allows us to attempt to identify the incentive effects of fiscal equalisation by using a regression discontinuity estimator. The "regression discontinuity approach" was first established by Campbell (1969). The idea behind this approach is to identify the causal effect of a treatment that is assigned as a deterministic function of an observed covariate, which is also related to the outcome of interest. Recent applications of the regression discontinuity design include Angrist and Lavy (1999), Van der Klaauw (2002) and Buettner (2006).

In our case the fiscal equalisation parameters ϑ_i and y_i depict deterministic functions of the municipal relative fiscal capacity which are defined by law. We therefore specify the following estimation equation:

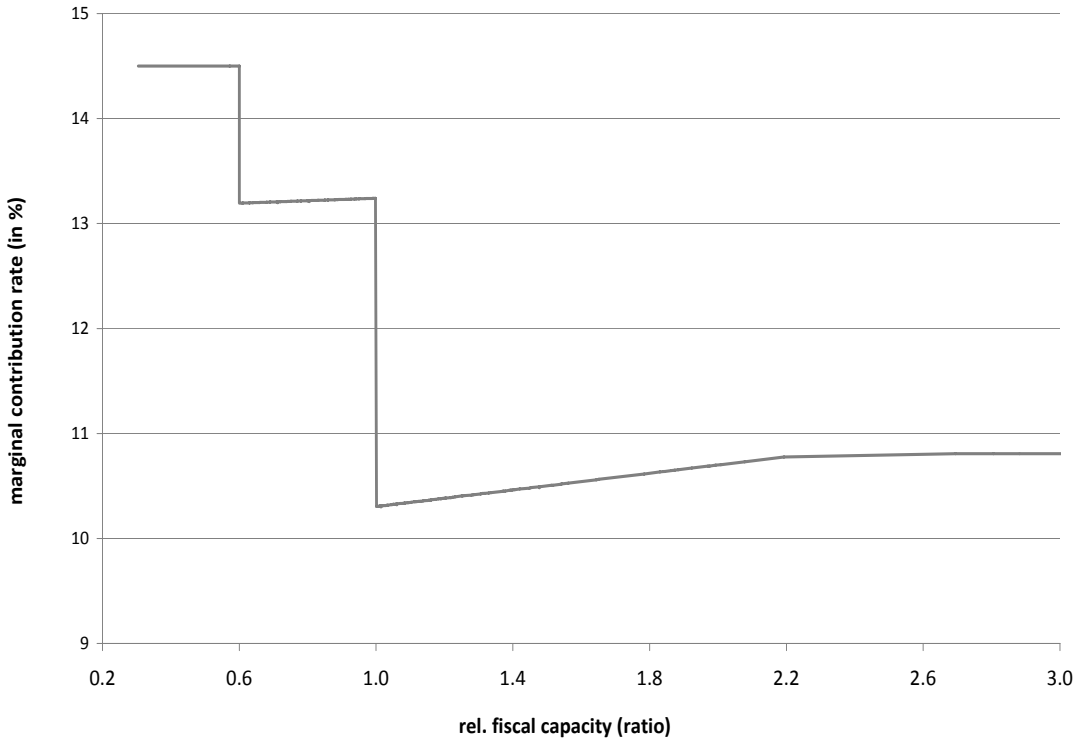
$$\lambda_{i,t} = \beta_1 \vartheta_{i,t} + \beta_2 y_{i,t} + \beta_3 \varphi(\gamma_{i,t}) + \beta_4 x_{i,t} + \phi_i + \psi_t + \epsilon_{i,t} \tag{4.14}$$

Note that the impact of relative fiscal capacity ($\gamma_{i,t}$) on the local expenditure structure is captured by a function $\varphi(\gamma_{i,t})$. By controlling for $\gamma_{i,t}$ we ensure that fiscal capacity differences do not drive the results and only discontinuities are exploited to identify the

[8] Note that unconditional transfers y_i reveal a very similar pattern also characterised by discontinuous "jumps" at the thresholds 0.6 and 1.

[9] Equalisation rates are calculated by taking the ratio of the marginal contribution rate ϑ_i and the statutory business tax rate τ_i.

Figure 4.1: Discontinuities in municipal fiscal equalisation



- marginal contribution rate simulated at average revenue sharing and county contribution rate 2003

effects of the fiscal equalisation parameters on local spending policies. As the specification of $\varphi(\gamma_{i,t})$ is key to identification, we employ several alternatives in order to capture possible non-linearities in the fiscal equalisation system. In addition to linear, quadratic and cubic specifications in the relative fiscal capacity we therefore also employ a linear spline. This is accomplished by interacting relative fiscal capacity with regime dummies, i.e. "low", "medium" and "high" capacity.

Another important aspect one should consider when analyzing the determinants of the local expenditure structure is that previous decisions might affect contemporary spending policies, i.e. the expenditure structure might follow a partial adjustment process. The inclusion of the lagged dependent variable on the RHS would be a means of capturing this intertemporal policy aspect. However, in the context of a "regression discontinuity approach" estimating a partial adjustment model is not straightforward as conditioning on $\varphi(\gamma_{i,t})$ implies that only the fiscal equalisation parameters necessarily exhibit a behavioral interpretation. Therefore, including lagged values of the covariates and estimating a reduced form equation conceptually constitutes a prudential way of taking into account

past policy decisions in our framework. Heckman and Robb (1986) suggest this procedure as an alternative to an explicit dynamic specification.

4.2.2 Results

Table (4.2) gives an overview of the basic regression results. Specifications (1) - (3) include general and specific grants as well as linear and quadratic specifications in the population size and density as conditioning variables. In addition to controlling for regional and time fixed effects we impose alternative specifications concerning the relative fiscal capacity.[10]

In all specifications we estimate a significant and negative effect of the marginal contribution rate on the local expenditure structure. This is in line with the theoretical predictions from the model described in section (5.1), i.e. a higher marginal contribution rate should be associated with a lower budgetary share of "productive" spending on basic schools and the local street network.

Note that while the fit of the model is more or less unaffected by using alternative specifications of the relative fiscal capacity, the magnitude of the coefficients of the marginal contribution rate varies between specifications (1) - (3). In particular, conditioning on the linear spline and thereby explicitly taking into account the three fiscal capacity regimes defined by law leads to a stronger effect of the marginal contribution rate. A one percentage point increase coincides with a 0.29 percentage point decrease of the local expenditure structure compared to values of -0.21 and -0.19 in specification (1) and (2) respectively. In addition, unconditional transfers which exert a significant and positive impact on the local expenditure structure in the first two specifications turn insignificant when controlling for the linear spline. It is also noteworthy that, when switching to the spline specification, the significance and the magnitude of the effects of the remaining conditioning variables are basically unaffected. Quite intuitively, specific grants in the field of basic schools and road infrastructure exert a significant and positive effect on the respective budgetary share. In addition, this share increases as the population size rises while the population density exerts a negative and significant effect on the local expenditure structure.

As discussed in section 4.2.1 intertemporal policy aspects might play a role when analyzing the determinants of the local budgetary structure. Therefore, Table (4.3) reports results including lags of the covariates as further conditioning variables.

Taking into account dynamic effects marginally improves the R^2 compared to the specifications without lags in time whereas specification (2) reveals a slightly better fit. Most noticeable, the contemporary marginal contribution rate becomes insignificant when conditioning on a cubic polynomial in the relative fiscal capacity while we observe a lagged response of the expenditure structure. The positive "income effect" through unconditional

[10] Note that the linear specification is not reported as results resemble those of specification (1) while featuring a lower R^2.

Table 4.2: Determinants of Municipal Expenditure Structures - baseline

Variable / Specification	(1)	(2)	(3)
Marginal contribution rate	-0.2132 ***	-0.1885 ***	-0.2883 ***
	(0.0695)	(0.0707)	(0.0931)
Unconditional grants, per capita	0.0614 ***	0.0599 ***	0.0323
	(0.0191)	(0.0192)	(0.0235)
Other grants (general), per capita	0.0955	0.0990	0.0908
	(0.1591)	(0.1612)	(0.1577)
Specific grants, per capita	0.3526 ***	0.3523 ***	0.3526 ***
	(0.0333)	(0.0332)	(0.0332)
Population, in 1000	0.0047 ***	0.0047 ***	0.0048 ***
	(0.0017)	(0.0017)	(0.0017)
Population, squared	-0.0000 **	-0.0000 **	-0.0000 **
	(0.0000)	(0.0000)	(0.0000)
Population density	-0.0290 ***	-0.02910***	-0.02940 ***
	(0.0077)	(0.0077)	(0.0077)
Population density, squared	0.0009 ***	0.0009 ***	0.0009 ***
	(0.0002)	(0.0002)	(0.0002)
Relative fiscal capacity	squared	cubic	linear spline
Sample size		2758	
Mean of dep. var.		0.0959	
R-squared (adjusted)	0.5993	0.5998	0.5995

All specifications include regional and time fixed effects as well as controls for relative fiscal capacity as denoted. If significant at 1% (5%) level coefficients are marked with three stars (two stars).

transfers is now only weakly significant. Including lags in time in the linear spline specification leaves the contemporary effect of the marginal contribution rate unaffected in terms of magnitude though the coefficient is less precisely estimated. Again contemporary unconditional transfers do not exert a significant impact on the local budgetary structure but we find a weakly significant and positive lagged response.

Overall, the regression analysis confirms the presence of an incentive effect of fiscal equalisation grants as suggested by theory. The coefficient of the marginal contribution rate has a negative sign in all reported estimations and the effect is statistically significant with the exception of specification (1) in table 4.3. Here we only observe a lagged response. Notwithstanding, it must be highlighted that the magnitude of the incentive effect is sensitive to the specification of relative fiscal capacity, the conditioning variable in the context of the regression discontinuity approach. However, as capturing the nature of discontinuity is key to identification when using discontinuity estimators, implementing

Table 4.3: Determinants of Municipal Expenditure Structures - dynamic

Variable	(1)	(2)
Marginal contribution rate	-0.1531	-0.2877 **
	(0.1063)	(0.1472)
Unconditional grants, per capita	0.0502 *	0.0016
	(0.0294)	(0.0374)
Other grants (general), per capita	0.0033	0.0068
	(0.1280)	(0.1293)
Specific grants, per capita	0.3376 ***	0.3382 ***
	(0.0342)	(0.0341)
Population, in 1000	0.0300 ***	0.0304 ***
	(0.0090)	(0.0084)
Population, squared	-0.0000 ***	-0.0000 ***
	(0.0000)	(0.0000)
Density	-0.1241 ***	-0.1258 ***
	(0.0374)	(0.0372)
Density, squared	0.0027 ***	0.0028 ***
	(0.0008)	(0.0008)
Marginal contribution rate, lag	-0.1990 **	-0.1827
	(.0910)	(0.1234)
Unconditional grants, per capita, lag	0.0270	0.0609 *
	(0.0275)	(0.0370)
Relative fiscal capacity	cubic	linear spline
Sample size	2561	
Mean of dep. var.	0.0969	
R-squared (adjusted)	.60578	.60598

All specifications include regional and time fixed effects as well as controls for relative fiscal capacity as denoted. Covariates are also employed as lagged values. If significant at 1%, 5% or 10% level coefficients are marked with one star, two and three stars.

the linear spline specification and thereby explicitly taking into account the three fiscal capacity regimes defined by law is a commendable approach. While differences are small, the dynamic specification combined with a linear spline in fiscal capacity also reveals the best fit.

Results for the "income effect" of the grant system are mixed. While the theoretical analysis in section (4.1) did not yield a clear-cut prediction as to how a marginal increase in unconditional transfers should affect the local expenditure composition, we observe a highly significant and positive effect of these transfers in specifications (1) - (3) of the static estimations. The significance of this effect completely disappears when conditioning

on the linear spline. Switching to the dynamic specification reduces the significance of the "income effect" when controlling for the cubic polynomial while we observe a positive and significant effect of lagged unconditional transfers.

4.3 Summary

While the literature on the internalising impact of redistributive grant systems has thus far mainly focused on the aspect of tax competition, we present a model of two-dimensional fiscal competition in taxes and public inputs to analyse the incentive effects of fiscal equalisation transfers. Our theoretical findings are in line with previous theoretical analyses suggesting that the implementation of capacity based equalisation induces local governments to increase distortionary taxation of a mobile capital tax base. In addition, the analysis in this chapter extends the existing literature by pointing out that inefficiencies in local public spending, as stated by Keen and Marchand (1997), are reduced while the degree of redistribution within a system of fiscal equalisation rises. The mechanism behind this result is that a higher degree of equalisation will make it less attractive for the individual jurisdiction to provide public inputs as positive tax base effects are redistributed to a higher extent among governments within the federation. This induces an internalisation of fiscal externalities at the local level which generates incentives for governments to substitute public input provision by public consumption.

The theoretically predicted incentive effect of fiscal equalisation transfers on local expenditure policies has then been tested on the basis of a rich data set of German municipalities. Using a regression discontinuity approach and controlling in a comprehensive way for income effects from fiscal equalisation transfers, we find that a higher marginal contribution rate to the redistributive grant system induces local governments to reduce their budgetary share of infrastructure spending on the local road network and basic school expenditures. This suggests that capacity-based equalisation transfers exert a substitution effect, i.e. local governments which are facing higher transfer reduction rates within the equalisation scheme tend to put a higher weight on public consumption.

Chapter 5

Tax and Public Input Competition

It has long been recognized that governments may use various instruments to attract mobile factors. With regard to capital, two of these instruments, business taxes and public infrastructure investment, have received special attention in this book. While it seems natural to think of governments' choices regarding tax rates and public input provision as being closely interrelated, the empirical literature on fiscal competition has in most cases treated them separately. The analysis presented in this chapter is an attempt to overcome this deficiency. We derive general reaction functions of local governments from a model of tax and public input competition. Using data from a large sample of German municipalities, we estimate an empirical counterpart of the system of fiscal reaction functions, thereby providing evidence on fiscal competition by way of a model treating taxes and spending on infrastructure as jointly determined endogenous variables.

Early theoretical literature on fiscal competition pointed to the role of public inputs as means of attracting private investment, focusing on the problem of overprovision. Taylor (1992) models a race between jurisdictions which compete for capital by building infrastructure more rapidly than their neighbors. Bucovetsky (2005) argues that public inputs, by attracting mobile factors, may create scale economies, and that governments tend to invest too much when choosing their level of spending on infrastructure. The literature has also addressed the link between taxes and public inputs in games of fiscal competition. Zodrow and Mieszkowski (1986) deal with local jurisdictions which compete for a mobile capital tax base by setting the tax rate and by providing a public input to production. Keen and Marchand (1997) extend the analysis, showing that in the presence of a productivity-enhancing public good the composition of local public spending tends to be systematically biased towards a relative overprovision of public inputs compared to public goods which are consumed directly by residents. Hindriks, Peralta, and Weber (2007) present a model suggesting that such compositional inefficiencies might be reversed in a dynamic setting. In their model, local governments face incentives to underinvest in stage one of the game in order to alleviate second-stage tax competition. In an international

context, Haufler and Schjelderup (1999) analyse public input provision in the presence of internationally integrated firms which engage in profit shifting. Assuming taxation of pure corporate profits according to the source principle, the authors find that public inputs will be unambiguously underprovided.

In contrast to the theoretical literature, empirical work on governments competing for mobile capital has in most cases treated fiscal competition as pure tax competition. The standard argument states that governments competing for mobile capital neglect the fiscal externality of their tax policy, resulting in an inefficiently low level of taxation and an underprovision of public goods in equilibrium. Based on the work of Mintz and Tulkens (1986), Zodrow and Mieszkowski (1986), Wilson (1986) and Wildasin (1988), a number of empirical studies have shown that the tax setting behavior of local governments in many countries seems to be well in line with the predictions of the theoretical tax competition literature. Buettner (1999) and Buettner (2001) identify local business tax competition among German municipalities. Brueckner and Saavedra (2001) estimate a property-tax reaction function for U.S. cities and find a non-zero slope and Hayashi and Boadway (2001) analyze provincial corporate income taxes in Canada.[1] Empirical contributions addressing the joint effect of taxes and public inputs on the allocation of capital are scarce. In one of the few studies available, Bénassy-Quéré, Gobalraja, and Trannoy (2007) show that both capital tax rates and public capital stocks help to explain FDI flows. In a recent working paper, Gomes and Pouget (2008) provide some related evidence on OECD countries.

As in Keen and Marchand (1997), our theoretical analysis is based on a model of fiscal competition with two instruments. Local jurisdictions compete for a mobile tax base by setting the capital tax rate and by providing a productivity-enhancing public input to production. As both taxes and inputs affect the tax base, the determination of optimal local taxing and spending decisions is substantially more complex than in a model with just a single policy instrument. We use the theoretical framework to highlight the forces that drive the strategic behavior of local governments when setting tax rates and public inputs. In particular, we demonstrate that governments react to taxes as well as to the level of public inputs provided by other jurisdictions when choosing each of their own policy instruments.

We then proceed with an empirical investigation of tax and public input competition among municipalities in Germany. As mentioned previously, German municipalities have autonomy in setting the local business tax rate and, within their self-administration responsibilities, decide on spending on the local infrastructure. Therefore, Germany is an interesting and appropriate case to study. Building on recent work of Kelejian and Prucha (2004), we estimate a system of equations allowing for the joint determination of the municipalities' business tax rate as well as their level of spending on local infrastructure. From

[1] For further references on strategic tax setting of local jurisdictions see Brueckner (2003) as well as Revelli (2005).

a methodological point of view, our approach is related to Revelli (2002) and Allers and Elhorst (2007). While Revelli (2002) estimates a tax equation and an equation for local jurisdictions' overall expenditures separately, Allers and Elhorst (2007) use an estimation approach that accounts for the simultaneity in government choices regarding several spending categories. In contrast to the aforementioned studies, we focus on competition for mobile capital as the source for strategic behavior of governments, and delineate our empirical approach from an explicit theoretical model of tax and public input competition.

To the best of our knowledge, our application is the first attempt to extend the canonical empirical model of tax competition to account for public inputs as a second policy instrument. The picture of local government behavior that emerges from our estimations is much more complex than suggested by the earlier empirical literature on fiscal competition. Across various specifications, our findings point to simultaneous tax and public input competition for mobile capital. In addition to the well-known positive interaction effect in local business tax rates, we find a positive and statistically significant effect of neighboring communities spending on infrastructure on a community's own spending level. Furthermore, we find that a municipality's level of spending on public inputs is also affected by the tax rates of neighboring jurisdictions. Treating taxes and public inputs as alternative means to attract capital thus reveals that local governments react to competition from other jurisdictions in a rather flexible way. Municipalities experiencing a boost in local infrastructure investment in neighboring communities will, on average, raise the level of public input provision, too. If neighbors choose to lower the tax burden on locally installed capital, municipalities not only adjust their own tax rates, but also increase their spending on infrastructure.

The paper proceeds as follows. In Section 5.1 we introduce our theoretical framework. Section 5.2 describes our estimation approach and presents the evidence on local tax and public input competition in Germany. Conclusions are drawn in Section 5.3.

5.1 Theoretical Considerations

Our theoretical analysis of strategic interaction of taxes and public inputs with capital mobility extends the standard approach to model strategic tax competition by allowing for public inputs as a second policy instrument that affects a jurisdiction's tax base (e.g., Buettner, 1999; Brueckner and Saavedra, 2001; Buettner, 2003). Our aim is to characterise the functions describing a jurisdiction's reaction to taxes and inputs set by a competing jurisdiction.

We consider a federation of two symmetric jurisdictions, labeled $i = 1, 2$. In each jurisdiction a competitive firm produces a homogenous private good using immobile labor, perfectly mobile capital and a publicly provided input. As in Keen and Marchand (1997), the public input P is of the factor-augmenting type and raises the marginal productivity

of the primary input factors. For ease of exposition, we normalise labor supply to unity and assume the common production technology to take the form

$$f(k_i, P_i) = \alpha k_i P_i - \frac{1}{2}\beta k_i^2, \tag{5.1}$$

where k_i is the capital-labor ratio and P_i is the public input. Each jurisdiction levies a unit source based tax τ_i on locally installed capital. Profit maximization and capital mobility imply an equal net rate of return to capital r across jurisdictions which is given by the after tax marginal product of capital. The supply of capital is assumed to be fixed, $k_i + k_j = \overline{k}$. Moreover, we assume home ownership of capital. Capital demand in jurisdiction i is then given by

$$k_i = k^* + \frac{\alpha\left(P_i - P_j\right) + \left(\tau_j - \tau_i\right)}{2\beta}, \tag{5.2}$$

where $k^* = \overline{k}/2$ is the equal capital endowment in both jurisdictions. Equation 5.2 shows that local governments can attract capital from the other jurisdiction by lowering the tax rate or by spending more on public inputs.

Each jurisdiction is inhabited by a representative consumer deriving utility from private (c_i) and public (Z_i) consumption,

$$u(c_i, Z_i) = c_i + v(Z_i). \tag{5.3}$$

We assume $v' > 0$ and $v'' < 0$. Private consumption equals the income of the immobile factor, $c_i = f(k_i, P_i) - k_i\left(\tau_i + r\right) + k^* r$. The jurisdictions maximise the utility of their representative consumer subject to the budget constraint

$$Z_i + P_i \quad = \quad \tau_i k_i. \tag{5.4}$$

We assume that both jurisdictions treat the tax rate and the public input as their strategic variables, i.e. they treat the other jurisdiction's tax rate and public input as given and optimise against these variables. Public consumption is thus a residual variable that ensures a balanced budget.[2]

Assuming a symmetric equilibrium with $k_i = k^*$, we denote the first order conditions with respect to τ_i and P_i as

$$\omega_{\tau_i} \equiv -k_i + v'\left[k_i + \tau_i \frac{\partial k_i}{\partial \tau_i}\right] \stackrel{!}{=} 0 \tag{5.5}$$

[2]Wildasin (1991) provides a discussion of alternative assumptions regarding the choice of strategic variables in a model with taxation and public consumption.

$$\omega_{P_i} \equiv \alpha k_i + v' \left[\tau_i \frac{\partial k_i}{\partial P_i} - 1 \right] \stackrel{!}{=} 0. \tag{5.6}$$

Equations 5.5 and 5.6 implicitly define jurisdiction i's tax and public input reaction functions. Generally, these functions are of the form $\tau_i = \tau(\tau_j, P_j)$ and $P_i = P(\tau_j, P_j)$. Note that, even with the simple functional form of the production technology assumed here, it is not possible to derive the reaction functions explicitly. However, it is possible to derive the 'slopes' of the reaction functions by totally differentiating the first order conditions. From

$$\begin{pmatrix} \omega_{\tau_i\tau_i} & \omega_{\tau_i P_i} \\ \omega_{P_i\tau_i} & \omega_{P_i P_i} \end{pmatrix} \begin{pmatrix} d\tau_i \\ dP_i \end{pmatrix} = - \begin{pmatrix} \omega_{\tau_i\tau_j} & \omega_{\tau_i P_j} \\ \omega_{P_i\tau_j} & \omega_{P_i P_j} \end{pmatrix} \begin{pmatrix} d\tau_j \\ dP_j \end{pmatrix} \tag{5.7}$$

we obtain

$$\frac{d\tau_i}{d\tau_j} = \frac{-\omega_{P_iP_i}\omega_{\tau_i\tau_j} + \omega_{\tau_iP_i}\omega_{P_i\tau_j}}{D} \tag{5.8}$$

$$\frac{d\tau_i}{dP_j} = \frac{-\omega_{P_iP_i}\omega_{\tau_iP_j} + \omega_{\tau_iP_i}\omega_{P_iP_j}}{D} \tag{5.9}$$

$$\frac{dP_i}{d\tau_j} = \frac{-\omega_{P_i\tau_j}\omega_{\tau_i\tau_i} + \omega_{\tau_i\tau_j}\omega_{P_i\tau_i}}{D} \tag{5.10}$$

$$\frac{dP_i}{dP_j} = \frac{-\omega_{P_iP_j}\omega_{\tau_i\tau_i} + \omega_{\tau_iP_j}\omega_{P_i\tau_i}}{D}, \tag{5.11}$$

where $D = \omega_{P_iP_i}\omega_{\tau_i\tau_i} - \omega^2_{\tau_iP_i} > 0$ from the second order condition. It is straightforward to show that the sign of all slopes is ambiguous.[3] Thus, our analysis extends the finding of Brueckner and Saavedra (2001) who, in a framework of pure tax competition, show that the tax reaction function can only be signed unambiguously when applying strong parameter restrictions on the production technology and consumer preferences. Introducing a public input to production as a second strategic variable further augments the scope for fiscal policy interaction. Hence, clear-cut theoretical predictions regarding the response by governments to other jurisdictions' choices are no longer possible. We therefore leave it to the subsequent empirical analysis to yield evidence on fiscal policy interactions resulting from simultaneous tax and public input competition.

[3]Note that we have $\omega_{P_iP_i} < 0$ and $\omega_{\tau_i\tau_i} < 0$ from the SOC, $\omega_{\tau_i\tau_j} = \frac{1}{2\beta}(v' - 1) + v''\frac{\tau_i}{2\beta}(k_i - \frac{\tau_i}{2\beta}) \gtrless 0$, $\omega_{\tau_iP_i} = \omega_{P_i\tau_i} = \frac{\alpha}{2\beta}(v' - 1) + v''(\frac{\alpha\tau_i}{2\beta} - 1)(k_i - \frac{\tau_i}{2\beta}) > 0$, $\omega_{\tau_iP_j} = -\frac{\alpha}{2\beta}(v' - 1) - v''\frac{\alpha\tau_i}{2\beta}(k_i - \frac{\tau_i}{2\beta}) \gtrless 0$, $\omega_{P_i\tau_j} = \frac{\alpha}{2\beta} + v''\frac{\tau_i}{2\beta}(\frac{\alpha\tau_i}{2\beta} - 1) > 0$, and $\omega_{P_iP_j} = -\frac{\alpha^2}{2\beta} - v''\frac{\alpha\tau_i}{2\beta}(\frac{\alpha\tau_i}{2\beta} - 1) < 0$.

5.2 Empirical Analysis

5.2.1 Estimation Approach

A valid empirical test of tax and public input competition between jurisdictions should take into account the fact that the choice of the tax rate and the provision of infrastructure are interrelated. In the following, we suggest an estimation approach that is flexible enough to allow for tax rates and public inputs to be determined simultaneously. Moreover, the design of our empirical model accounts for the interdependence of all jurisdictions' choices regarding taxes and inputs, i.e. each jurisdiction's tax rate as well as the level of inputs provided to attract mobile capital are allowed to depend on both taxes and inputs of all other jurisdictions.

Our structural empirical model builds on the reaction functions of the tax and public input competition model. To facilitate estimation, we make use of linearised versions of the general form reaction functions and define the following system of equations,

$$\tau_i = \theta_\tau P_i + \lambda_\tau \tau_{-i} + \varphi_\tau P_{-i} + \beta_\tau X_{\tau\, i} + u_i \tag{5.12}$$

$$P_i = \theta_P \tau_i + \lambda_P \tau_{-i} + \varphi_P P_{-i} + \beta_P X_{P i} + v_i, \tag{5.13}$$

where $\tau_{-i} = \sum_j w_{ij}\tau_j$ and $P_{-i} = \sum_j w_{ij} P_j$ indicate the average tax rate and average inputs of other jurisdictions, weighted by the predetermined weights $w_{i1}, \ldots, w_{iN}$, and $X_{\tau\, i}$ and $X_{P\, i}$ denote vectors of control variables in the tax and input equation, respectively. The variables entering both $X_{\tau\, i}$ and $X_{P\, i}$ are subsets of a set of exogenous variables, $X_i = (x_{1i}, \ldots, x_{Ki})$. Note that in specifying our system of equations and including P_i among the right-hand side variables of the tax equation and τ_i as an explanatory variable in the input equation, we deviate from the usual approach which uses counterparts of reduced-form reaction functions when estimating models of fiscal competition with more than one choice variable (see Devereux, Lockwood, and Redoano, 2008; Egger, Pfaffermayr, and Winner, 2007). We do this because we want the empirical model to allow for the possibility that governments are not always free to adjust both instruments to optimal levels. For instance, governments may face political costs when frequently changing the business tax rate, and prefer to keep the tax rate constant if the difference between the optimal rate and the rate actually implemented is sufficiently small. The optimal choice of public inputs should then be modeled as being conditional on a given business tax rate. Another reason for governments to deviate from jointly optimal levels of taxes and public inputs is the political process. Due to inertia in the decision-making process, it may not always be possible to set fiscal variables to preferred levels.

In addition to modeling the tax rates and inputs of different jurisdictions to be interrelated, we also allow for the presence of spatial auto-correlation in the disturbances u and

v,

$$u_i = \rho_u u_{-i} + \epsilon_i \quad \text{and} \quad v_i = \rho_v v_{-i} + \varepsilon_i, \tag{5.14}$$

where $u_{-i} = \sum_j w_{ij} u_j$ and $v_{-i} = \sum_j w_{ij} v_j$. The innovation vectors ϵ and ε are assumed to be identically and independently distributed with zero mean. Hence, we require that the innovations are free of spatial correlation. Note, however, that we allow for contemporaneous cross-equation correlation among innovations of the same cross-sectional unit.

While our specification of the empirical reaction functions is more flexible than the commonly employed reduced-form version, it also makes the estimation of the parameters of interest more involved. In fact, treating the choice variables as explanatory variables increases the number of endogenous regressors from two to four. To account for all endogeneity problems and to achieve efficient estimation, we use the spatial system estimator proposed by Kelejian and Prucha (2004). In the following, we briefly outline the four step estimation procedure.

In the first step, we run a two-stage least squares (2SLS) procedure on the tax rate and the input equation, treating τ_i, P_i, τ_{-i} and P_{-i} as endogenous regressors. We use the same set of instruments in both estimations, containing $x_{1i}, \ldots, x_{Ki}$ as well as the corresponding first and second order spatial lags. In matrix notation, they can be written as $WX_1, \ldots, WX_K, WWX_1, \ldots, WWX_K$, where W denotes the N-dimensional square matrix of weights.[4]

Using the residuals of the first stage, in the second step of the procedure the spatial auto-regressive parameters ρ_u and ρ_v are estimated by the generalised moments method originally suggested by Kelejian and Prucha (1999). The estimates of the spatial auto-regressive parameters are then used in the third step to perform a Cochrane-Orcutt-type transformation of the structural equations to remove the spatial error correlation and to re-run 2SLS on the transformed system. Finally, in the fourth step we apply the systems instrumental variable estimator suggested by Kelejian and Prucha (2004). It is efficient relative to the first and third stage single-equations estimators because it utilises the full system information and accounts for potential cross-equation correlation in the innovation vectors.

For several reasons, the systems estimation approach outlined above seems to be the ideal choice for estimating our tax and public input competition model. First of all, the procedure takes into account the fact that both taxes and public inputs are determined simultaneously. Secondly, in a very general way, it allows for contemporaneous interaction between jurisdictions. In addition, it is easily implemented even in large samples, which provides a clear advantage over maximum likelihood procedures.

The evidence reported in this study is derived from cross-sectional estimations. There

[4] As usual, we require that W has zeros on the main diagonal and that $\sum_j w_{ij} = 1$. Details on the specification of W are reported in Section 5.2.3

are several reasons why panel estimations do not constitute a feasible option. First of all, the systems estimator of Kelejian and Prucha (2004) is designed for cross-sectional data. A straightforward way to account for unobserved heterogeneity would be to apply the estimation routine to panel data and to include a series of jurisdiction-specific constants as ordinary regressors. With more than 1,000 cross-sectional units, however, computational limitations hindered us to estimate panels with a reasonable time dimension. Based on short panels of up to four years, we were unable to identify the coefficients of interests with reasonable precision. The likely reason is that many variables, including the tax rate, show only limited variation over time. As in many applications, it is thus difficult to achieve identification in a fixed effects framework with a small number of cross-sections.

5.2.2 Data

The data used to estimate our empirical model of tax and public input competition come from a sample of 1100 German municipalities in the state of Baden-Wuerttemberg, covering the period 1998 - 2004. Note that we exclude independent cities from the sample (10 cross-sectional units), which face different incentives within the municipal system of fiscal equalisation. As we will observe, the treatment within this redistributive grant system exerts a strong impact on local tax and spending decisions. In the following, we briefly comment on the data which are summarised in Table 5.1.

As already pointed out, German municipalities have taxing autonomy with respect to the business tax (Gewerbesteuer), essentially a tax on local business earnings. In the time period under consideration, the statutory tax rate in the state of Baden-Wuerttemberg averaged 0.167 and varied between 0.145 and 0.21. Besides revenues from the local business tax, grants and federal tax revenue sharing play an important role in municipal financing. In our context of tax and public input competition, fiscal equalisation grants deserve special attention as redistributive grant systems affect the incentive of local governments with respect to tax and expenditure policies. The theoretical literature on the internalising effects of fiscal capacity based equalisation suggests that the implementation of redistributive grant systems tends to weaken tax competition (e.g., see Koethenbuerger, 2002; Bucovetsky and Smart, 2006). Recent empirical evidence for Germany (Buettner, 2006; Egger, Koethenbuerger, and Smart, 2007) supports the view that tax rates tend to rise when the degree of equalisation increases. Moreover, the empirical analysis presented in chapter 4 of this book suggests that fiscal equalisation transfers exert a significant incentive effect on municipal spending policies. We therefore include the marginal contribution rate to the municipal system of fiscal equalisation as well as unconditional transfers in our regressions to account for substitution and income effects of equalisation grants. For the period between 1998 and 2004 the average marginal contribution rate was 13.2% with a maximum value of 14.5% and a minimum of 8.8%. Relating the marginal contribution

Table 5.1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Statutory tax rate, τ	0.167	0.006	0.145	0.210
Spending for local roads, P^a	130	92.8	0.815	1739
Marginal contribution rate	0.132	0.011	0.088	0.145
Unconditional transfers[a]	300	50.3	96.5	447
Fiscal capacity	0.714	0.272	0.276	6.35
Specific grants for local roads[a]	27.3	53.7	-76.5	1730
Other specific grants[a]	57.4	33.0	-3.92	282
Debt service[a]	10.6	35.2	-858	280
Population (1,000s)	7.81	10.7	0.101	112
Population density[b]	0.300	0.302	0.017	2.50
Unemployment	0.062	0.013	0.025	0.127
% population <16 years	0.181	0.022	0.101	0.300
% population >65 years	0.155	0.027	0.071	0.347
% church members	0.891	0.053	0.706	1.04

[a] per capita; [b] (total population)/1000 per square kilometer; Nob=7700 (1100 municipalities from 1998 to 2004, independent cities excluded); Fiscal variables in € (prices of 2000). Source: Statistical Office of Baden-Wuerttemberg and own calculations.

rate to the tax rate reveals an average equalisation rate of around 80%. As a means to control for pure income effects we include unconditional transfers capturing the amount of transfers a municipality would receive if its tax base were actually zero. This includes equalisation transfers and the municipal share of statewide income and value added taxes.

Furthermore, since differences in taxing capacity may affect local tax and expenditure policies, we account for a municipality's relative fiscal capacity. This variable is calculated by relating a municipality's fiscal capacity (comprising the local business tax base as well as other revenue sources, in particular the share of statewide income and value added taxes) to its fiscal need, which is crucially dependent on the population size. The relative fiscal capacity shows values between 28% and 635% with an average value of 71.4%.[5]

In our analysis, public input provision is defined as spending on the municipal road network. Between 1998 and 2004, municipalities have spent, on average, 130 € per capita (at 2000 levels) on the construction and maintenance of local roads. A standard deviation of 93 € per capita indicates substantial variation in this expenditure category. As municipalities receive grants in order to fulfill their self-administered spending responsibilities, we explicitly control for specific transfers in the spending category 'local roads'. This includes grants within the so called 'traffic and transport burden sharing' (Verkehrslastenausgleich), which depend on the length of the road network and the size of the municipal area. In addition, we include other specific grants independent of the tax base in order to control for the corresponding income effects. Other conditioning variables capturing local

[5]For further details on the municipal system of fiscal equalisation in the state of Baden-Wuerttemberg see 1.1.

characteristics include debt service, population size and population density as well as the population share of the young (less than 16 years) and the elderly (above 65 years). Furthermore, we also include the unemployment rate as a proxy for the general demand for spending on social services. Finally, drawing on Buettner (2001), we include the share of the population that is affiliated with one of the three major Christian churches (Catholic, Protestant State, and Protestant Free Church) as well as two variables that interact this proportion with the rate of unemployment and the share of elderly people, respectively.[6] The inclusion of these variables is warranted as the religious orientation of the population may indicate preferences regarding the provision of local public goods and, in particular, social services and welfare. The interactions account for the possibility that, depending on the strength of religious orientation, an increase in the number of potential welfare recipients may have different effects on the socially preferred level of social services.

5.2.3 Specification of spatial weights and exclusion restrictions

Before turning to the estimation results, we need to discuss some further details of our empirical specification. In particular, we motivate the choice of spatial weights and comment on the exclusion restrictions imposed on our system of equations.

As pointed out in the previous section, we define the weights used to construct neighbors' average tax rates and spending levels based on geographical distance and relative population size. There is one aspect of the different weighting schemes that seems to be of particular importantce. As shown in the descriptive statistics, the cross-sectional variation of the tax rate is limited. Taking averages over neighboring jurisdictions' tax rates will, of course, give a variable with even smaller variation. This problem can be expected to become more severe as more municipalities are, on average, defined as neighbors for a given community. In fact, with sufficiently many communities included in the calculation of neighbors' taxes, τ_{-i} will quickly converge towards the regional (or even the statewide) average of taxes. Defining many municipalities as neighbors for a given community will thus result in τ_{-i} becoming a poor measure for the tax effort of nearby municipalities. A quick inspection of Table 5.2 confirms this presumption. It displays descriptive statistics for neighbors' average tax rates (τ_{-i}) and neighbors' expenditures on infrastructure (P_{-i}) for the year 2000 according to different weighting schemes.

The first four rows depict statistics for weighting schemes that include either the municipalities within a distance of up to 15km, or the 10 geographically closest municipalities, to be neighbors of a given municipality. Irrespective of whether the weights are chosen to be uniform or to decrease with distance, the variable capturing the average tax rate of

[6] Data on religious affiliation is available only for 1987. The slight imprecision in the count of church members relative to overall population (10 municipalities with a reported share of church members higher than one) is known from other studies using the same data. Excluding municipalities with implausible figures does nothing to our estimation results.

Table 5.2: Neighbors' average tax rates and infrastructure spending per capita for different weighting schemes, year=2000

	Mean		Std. Dev.		Min		Max	
Weighting scheme	τ_{-i}	P_{-i}	τ_{-i}	P_{-i}	τ_{-i}	P_{-i}	τ_{-i}	P_{-i}
$WD15$	0.167	140	0.0030	31.3	0.160	76.3	0.177	253
$WD15INV$	0.167	139	0.0032	33.6	0.159	68.8	0.182	329
$WN10$	0.167	139	0.0034	37.4	0.157	66.0	0.181	332
$WN10INV$	0.167	139	0.0036	40.6	0.156	66.9	0.182	465
$WD15P$	0.171	147	0.0068	28.9	0.160	83.7	0.198	281
$WN10P$	0.169	146	0.0066	35.4	0.156	72.0	0.204	326

Notes on weighting schemes: $WD15$: Municipalities with distance up to 15km defined as neighbors, weights of neighbors uniform; $WD15INV$: Municipalities with distance up to 15km defined as neighbors, weights of neighbors based on inverse distance; $WN10$: 10 geographically closest municipalities defined as neighbors, weights of neighbors uniform; $WN10INV$: 10 geographically closest municipalities defined as neighbors, weights of neighbors based on inverse distance; $WD15P$: Municipalities with distance up to 15km defined as neighbors, weights of neighbors based on relative population size. $WN10P$: 10 geographically closest municipalities defined as neighbors, weights of neighbors based on relative population size. All weight matrices are row-standardised.

neighbors shows very limited variation. With uniform weights assigned to municipalities within a distance up to 15km, for instance, the variation in neighbors' average tax rate is actually modest, with a minimum of 0.16 and a maximum of 0.177. Table 5.2 also suggests a straightforward way to circumvent the problem of insufficient variation in τ_{-i}. The schemes $WD15P$ and $WN10P$ define weights based on the geographical distance as before, but in addition assign higher weights to larger municipalities. This is done by setting

$$w_{ij} = \frac{n_{ij}\, pop_j}{\sum\limits_{k \neq i} n_{ik}\, pop_k},$$

where n_{ij} is an indicator for neighbors of i and pop_j is j's population. As can be observed from Table 5.2, both schemes that account for asymmetries in population size are characterised by a variation in the resulting series that is significantly higher compared to the weighting schemes discussed previously. Also notable is the fact that assigning weights according to relative population size is supported by the literature on asymmetric tax competition (e.g., see Bucovetsky, 1991; Haufler and Wooton, 1999). Note that, due to higher variation in local expenditures per capita, neighbors' spending on infrastructure does not apear to be affected by the problem of quick convergence towards regional or statewide averages. Based on the preceding discussion, we expect the estimates regarding the impact of τ_{-i} to critically depend on the choice of the weighting scheme. In contrast, the estimates regarding the coefficient of P_{-i} should be more robust to the definition of neighbors.

A further important issue regarding the specification is the choice of exclusion restrictions. Note that both the tax rate and public inputs appear as explanatory variables in our system of equations. The exclusion restrictions must be set carefully, as they will provide

us with the opportunity to use some of the exogenous characteristics as instruments for the endogenous fiscal variables. An exclusion restriction for the tax equation is suggested by the system of specific grants. As specific grants for the construction and maintenance of local roads amount, on average, to only 1.2% of overall expenditures, the business tax rate should be independent of the level of these grants. To the contrary, we expect grants for local roads to significantly affect actual spending on the local road network. Consequently, we include specific grants in the public input equation, but exclude it from the tax equation. Note that other specific grants amount to 57.4 € per capita, twice as much as specific grants for local roads. We therefore include other specific grants in both equations to account for potential income effects.

Regarding the exclusion restrictions for the public input equation, note first that local roads are not only used as public inputs by firms, but are also consumed by private households. A change in infrastructure spending will therefore have direct as well as indirect effects on the utility of residents. In contrast, a change in the business tax rate will affect households only indirectly. This suggests exclusion of the variables describing the religious orientation of the local population and related preferences regarding spending on social services from the input equation. We thus assume that a stronger preference for spending on social services and welfare may affect the preferred level of local taxation, but that the level of municipal spending on physical infrastructure is independent of residents' religious orientation.

The quality of the instruments obtained from imposing our exclusion restrictions is also an empirical question. In particular, to identify public inputs in the tax equation, we need the specific grants for local roads to show a strong partial correlation with spending on local roads. Furthermore, the identification of the local business tax rate in the input equation rests on the partial correlations between the tax rate and the proportion of church members as well as the related interaction terms. We will discuss the quality of the instruments when addressing the estimation outcomes.

5.2.4 Results

Table 5.3 and 5.4 present detailed estimation results for the system estimations on tax and public input competition. Based on the preceding discussion, we focus on weighting schemes *WD15P* and *WN10P*. Results based on different schemes are summarised in Table 6. As mentioned above, we report results from cross-sectional estimations. To check for the robustness across years, the tables depict regressions for different years. Furthermore, we also report results for estimations after a between-transformation, i.e. after taking averages across periods.

After excluding the 10 independent cities from the sample, we are left with 1100 cross-sectional observations. Note that the sample restriction is applied after taking spatial

Table 5.3: Tax and Public Input Competition - System Estimation, $W = WD15P$

Cross section	1998		2000		2002		2004	
Dependent variable	τ	P	τ	P	τ	P	τ	P
τ_{-i}	0.196***	-731*	0.207***	-1055*	0.278***	68.4	0.314***	60.0
	(0.049)	(350)	(0.049)	(427)	(0.055)	(559)	(0.058)	(480)
P_{-i}	-0.000	0.178*	-0.000	0.507***	0.000	0.237*	0.000	0.148
	(0.000)	(0.095)	(0.000)	(0.096)	(0.000)	(0.124)	(0.000)	(0.108)
Own tax rate	-	3190***	-	2396***	-	-2176*	-	-171
		(801)		(924)		(1057)		(772)
Own public input	0.000***	-	0.000***	-	0.000	-	-0.000	-
	(4D-06)		(4D-06)		(0.000)		(0.000)	
Marg. contr. rate	0.098***	-810***	0.091***	-523	0.065*	342	0.088***	-469*
	(0.029)	(302)	(0.026)	(318)	(0.030)	(426)	(0.030)	(276)
Uncond. transfers	-0.000***	0.241***	-0.000***	0.175*	-0.000***	0.199*	-0.000***	0.215***
	(7D-06)	(0.070)	(6D-06)	(0.075)	(7D-06)	(0.097)	(8D-06)	(0.075)
Fiscal capacity	-0.001	46.0***	-0.002*	87.7***	-0.002*	95.7***	-0.004***	52.8***
	(0.001)	(13.5)	(0.001)	(14.4)	(0.001)	(15.7)	(0.001)	(10.5)
Specific grants	-	0.995***	-	1.05***	-	1.30***	-	1.12***
for local roads		(0.044)		(0.051)		(0.047)		(0.037)
Other specific	0.000*	-0.005	0.000	0.025	0.000	0.010	0.000*	0.004
grants	(7D-06)	(0.071)	(0.000)	(0.073)	(0.000)	(0.078)	(7D-06)	(0.060)
Debt service	0.000***	-0.112	0.000***	-0.153*	0.000***	-0.100	0.000***	-0.116*
	(6D-06)	(0.072)	(6D-06)	(0.074)	(5D-06)	(0.078)	(5D-06)	(0.049)
Unemployment	-1.01***	194	-1.27***	265	-1.50***	-70.3	-1.23***	166
	(0.266)	(147)	(0.316)	(200)	(0.344)	(280)	(0.337)	(186)
Population	0.000***	0.119	0.000***	0.309	0.000***	1.02*	0.000***	0.625*
(1,000s)	(0.000)	(0.272)	(0.000)	(0.308)	(0.000)	(0.418)	(0.000)	(0.274)
Pop. density	0.000	-22.1*	0.001	-18.1*	0.000	-6.59	0.000	-7.80
	(0.000)	(9.25)	(0.001)	(10.1)	(0.000)	(11.6)	(0.000)	(8.17)
% pop. <16 years	-0.005	-42.8	-0.004	25.6	-0.005	40.6	-0.015	212*
	(0.012)	(120)	(0.012)	(138)	(0.012)	(165)	(0.014)	(127)
% pop. >65 years	-0.272*	-37.8	-0.187*	-112	-0.075	50.4	-0.089	140
	(0.111)	(98.3)	(0.111)	(109)	(0.111)	(124)	(0.118)	(88.2)
% church members	-0.132***	-	-0.114***	-	-0.115***	-	-0.109***	-
	(0.028)		(0.026)		(0.029)		(0.032)	
% church members×	1.07***	-	1.32***	-	1.57***	-	1.28***	-
unemployment	(0.295)		(0.352)		(0.383)		(0.374)	
% church members×	0.308*	-	0.219*	-	0.108	-	0.107	-
% pop. >65 years	(0.123)		(0.123)		(0.123)		(0.130)	
R^2	0.20	0.37	0.20	0.37	0.20	0.43	0.17	0.49
F-tests of excluded IVs:								
τ_{-i}	110.3	215.7	105.4	199.6	73.6	133.9	94.1	115.0
P_{-i}	77.7	91.2	95.6	104.1	68.0	65.4	49.8	54.7
Own tax rate	-	5.0	-	5.8	-	6.9	-	5.4
Own public input	7.3	-	8.7	-	7.7	-	16.6	-

Sample includes all municipalities up to independent cities, Nob=1100. Weighting scheme for constructing τ_{-i} and P_{-i} is $WD15P$ (see notes in Table 5.2 for details). Standard errors in parentheses. R^2 is from the third step of the estimation procedure (2SLS after taking account of spatial error correlation). F-tests of excluded IVs are from first-stage regressions of the 2SLS estimation in the third step of the estimation procedure.
* significant at 10% level; * significant at 5% level; *** significant at 1% level.

lags. Hence, while all municipalities are included in the computation of τ_{-i} and P_{-i}, the IV estimations at the first, third and fourth step of the system estimation approach are based on the restricted sample.

Let us now turn to the estimation outputs summarised in Table 5.3. For each year, we report two columns, the left showing estimated coefficients and corresponding standard errors for the tax equation, and the right one depicting the results for the public input equation. The coefficients of our variables of interest are shown in the first rows. We note that the coefficient of neighbors' taxes is positive and highly significant in all reported

cross-sections, ranging from 0.20 to 0.31. These results suggest that the municipalities in our sample react to the tax policies of their neighbors by adjusting their own business tax rate towards the level chosen in nearby jurisdictions. Note that this finding is well in line with the evidence presented in Buettner (2001). However, our results also reveal that there are several other effects at work, suggesting that the behavior of local governments is much more complex than described in the earlier empirical tax competition literature. In particular, we find a positive and statistically significant effect of neighbors' spending on infrastructure on a community's own spending level in three out of four cross-sections. The coefficients indicate that a one-Euro increase in neighbors' average spending per capita triggers an increase in a municipality's own per-capita spending on infrastructure between 18 and 51 Cents. Hence, our findings suggest that the municipalities engage in simultaneous tax and public input competition for mobile capital. A second effect that has not been analyzed in the literature to date is that of neighbors' taxes on a municipality's own level of spending on public inputs. In two out of four cross-sections, we find a negative and statistically significant effect, pointing to local governments increasing their per-capita spending on infrastructure by approximately 7 to 11 € per capita in reaction to a one percentage point decrease of their neighbors' average tax rate. Finally, our results also point to direct interaction between fiscal variables within a community: a one percentage point increase in the statutory tax rate triggers an increase of spending per capita of 32 € in 1998 and of 24 € in 2000, while in the 2002 cross-section we find a negative effect of about 22 € . Moreover, for 1998 and 2000 there is a positive partial effect of public inputs on taxation, indicating that an increase in spending of 100 € per capita would result in a tax rate increase of 0.1 to 0.2 percentage points.

Besides the evidence on tax and public input competition, there are additional findings that are worth mentioning. Confirming our expectations, the marginal contribution rate positively affects the tax rate, while unconditional transfers exert a negative impact on local taxes. Both findings are in line with Buettner (2006) and support the view that a higher degree of redistribution within a system of fiscal equalisation alleviates business tax competition. In addition, there is evidence for a negative impact of the marginal contribution rate on public input provision in two out of four cross-sections. This suggests that fiscal equalisation counteracts both tax and public input competition. Furthermore, unconditional transfers are found to positively affect public inputs. An increase of these transfers by one Euro per capita brings about an increase in infrastructure spending per capita of 0.18 to 0.24 € . Regarding relative fiscal capacity, our expectations are also confirmed: municipalities with higher capacity set lower tax rates and spend more on public inputs. With respect to the variables that are excluded in one of our equations, we note that spending on local roads strongly reacts to the amount of specific grants received for that purpose. In addition, we find at least two highly significant variables capturing the

religious orientation of the population in all cross-sections.[7] Finally, we note the positive impact of debt service on local taxes, and the negative impact on public input provision, and the negative (positive) effect of unemployment (population) on the tax rate.

Regarding the quality of the instruments, we first note that τ_{-i} and P_{-i} are identified by a strong partial correlation with first and second-order spatial lags of exogenous community characteristics, resulting in F-tests of excluded instruments in the corresponding first-stage regressions larger than 50 in general.[8] Hence, we are confident that our identification approach with respect to the spatial effects does not suffer from a weak instruments problem.[9] With respect to a community's own tax rate and public input as endogenous explanatory variables, we initially checked the performance of the instruments in the first stage regression in terms of statistical significance. The specific grants-variable is always highly significant in the first-stage regression of public inputs on the set of instruments, with t-statistics around 10. In the first-stage regression of the tax rate, both the proportion of church members and the interaction with the rate of unemployment are generally significant at the 1% level. However, since the F-tests for a community's own tax rate and public input are relatively small, we also checked the critical values for the Stock-Yogo weak identification test (Stock and Yogo, 2005). We were able to reject the null that the bias of our IV estimation exceeds 20% of the bias in the corresponding OLS estimation in all cases, lending further support to our identification strategy.

The weighting scheme used in the estimations reported in Table 5.3 assigns 23 neighbors on average to each municipality. In addition, there is substantial variation in the number of neighbors, ranging from one to 54. As a robustness check of our findings with respect to the definition of "neighborliness" among municipalities, Table 5.4 reports results of the same estimations as before, with $WN10P$ as the weighting scheme. As mentioned above, scheme $WN10P$ assigns as neighbors the 10 nearest communities (in terms of geographical distance) to each municipality, weighted by population.

All main effects from Table 5.3 are robust to the change in the weighting scheme. The effect of neighbors' taxes on a municipality's own tax rate is estimated to be significantly positive but somewhat smaller than before, ranging from 0.16 to 0.21. The impact of neighbors' spending on infrastructure on local provision of public inputs is of similar size as before, with estimated coefficients ranging from 0.22 to 0.39. The results also confirm the finding that the municipalities take into account the level of taxes among neighbors when choosing their level of spending on the local road network. Even with respect to the strength of the interaction, we do not find any significant difference compared to the results reported in Table 5.3. A brief inspection of the evidence regarding the control

[7] Note, however, that the quality of the instruments should be evaluated based on the first stage regressions of the corresponding 2SLS estimations. We comment on this below.

[8] We refer to the 2SLS estimation that is performed as the third step of the estimation procedure.

[9] See Staiger and Stock (1997) for a general discussion and practical guidance for avoiding weak instruments.

Table 5.4: Tax and Public Input Competition - System Estimation, $W = WN10P$

Cross section	1998		2000		2002		2004	
Dependent variable	τ	P	τ	P	τ	P	τ	P
τ_{-i}	0.158***	-678*	0.177***	-796*	0.212***	-604	0.213***	-1412***
	(0.041)	(398)	(0.040)	(481)	(0.040)	(503)	(0.044)	(373)
P_{-i}	-0.000	0.086	0.000	0.389***	0.000*	0.134	-0.000	0.217***
	(0.000)	(0.072)	(0.000)	(0.075)	(7D-06)	(0.086)	(0.000)	(0.080)
Own tax rate	-	3039***	-	1276	-	-560	-	3283***
		(821)		(923)		(1066)		(800)
Own public input	0.000***	-	0.000*	-	0.000	-	0.000	-
	(4D-06)		(4D-06)		(0.000)		(0.000)	
Marg. contr. rate	0.089***	-774*	0.080***	-470	0.089***	120	0.098***	-763***
	(0.028)	(303)	(0.025)	(323)	(0.029)	(433)	(0.029)	(289)
Uncond. transfers	-0.000***	0.225***	-0.000***	0.170*	-0.000***	0.265***	-0.000***	0.304***
	(7D-06)	(0.071)	(6D-06)	(0.073)	(7D-06)	(0.09)	(8D-06)	(0.080)
Fiscal capacity	-0.001	45.7***	-0.003*	85.2***	-0.003*	100***	-0.004***	61.9***
	(0.001)	(13.4)	(0.001)	(14.2)	(0.001)	(15.5)	(0.001)	(10.6)
Specific grants	-	0.999***	-	1.05***	-	1.30***	-	1.10***
for local roads		(0.045)		(0.051)		(0.047)		(0.038)
Other specific	0.000*	-0.004	0.000*	0.064	0.000*	0.003	0.000*	-0.060
grants	(7D-06)	(0.071)	(6D-06)	(0.073)	(6D-06)	(0.078)	(7D-06)	(0.062)
Debt service	0.000***	-0.096	0.000***	-0.089	0.000***	-0.153*	0.000***	-0.194***
	(6D-06)	(0.072)	(6D-06)	(0.074)	(5D-06)	(0.077)	(5D-06)	(0.048)
Unemployment	-0.961***	189	-1.10***	187	-1.18***	93.7	-0.913***	425***
	(0.264)	(140)	(0.312)	(183)	(0.334)	(248)	(0.316)	(157)
Population	0.000***	0.169	0.000***	0.315	0.000***	0.585	0.000***	0.027
(1,000s)	(0.000)	(0.267)	(0.000)	(0.275)	(0.000)	(0.3759)	(0.000)	(0.272)
Pop. density	0.000	-26.8***	0.000	-22.8*	-0.000	-12.7	-0.000	-11.9
	(0.000)	(8.45)	(0.000)	(9.29)	(0.000)	(10.5)	(0.000)	(7.56)
% pop. <16 years	-0.003	-9.84	-0.000	51.8	-0.001	80.9	-0.007	241*
	(0.012)	(118)	(0.011)	(136)	(0.012)	(163)	(0.014)	(128)
% pop. >65 years	-0.248*	-7.39	-0.198*	-52.5	-0.094	77.1	-0.025	115
	(0.110)	(97.0)	(0.110)	(107)	(0.109)	(120)	(0.112)	(87.8)
% church members	-0.124***	-	-0.106***	-	-0.100***	-	-0.077*	-
	(0.027)		(0.026)		(0.028)		(0.030)	
% church members×	1.02***	-	1.16***	-	1.25***	-	0.965***	-
unemployment	(0.294)		(0.349)		(0.372)		(0.351)	
% church members×	0.280*	-	0.229*	-	0.126	-	0.037	-
% pop. >65 years	(0.122)		(0.122)		(0.121)		(0.124)	
R^2	0.21	0.38	0.22	0.39	0.22	0.45	0.21	0.48
F-tests of excluded IVs:								
τ_{-i}	77.0	76.1	76.3	63.2	69.0	63.4	88.6	93.7
P_{-i}	72.6	78.7	67.1	63.9	38.9	33.7	37.5	36.8
Own tax rate	-	4.9	-	5.8	-	5.7	-	4.1
Own public input	6.9	-	9.5	-	7.1	-	14.7	-

Sample includes all municipalities up to independent cities, Nob=1100. Weighting scheme for constructing τ_{-i} and P_{-i} is $WN10P$ (see notes in Table 5.2 for details). Standard errors in parentheses. R^2 is from the third step of the estimation procedure (2SLS after taking account of spatial error correlation). F-tests of excluded IVs are from first-stage regressions of the 2SLS estimation in the third step of the estimation procedure.
* significant at 10% level; * significant at 5% level; *** significant at 1% level.

variables reveals that the effects mentioned above are highly robust to the change in the weighting scheme, too.

To some extent, the evidence on tax and public input competition depends on which cross-sections are used for estimation, and it might therefore be useful to examine average effects. Table 5.5 reports estimation results after applying a between-transformation to our system of estimation equations. Using $t = 1, \ldots, T$ as the index of time periods, the

Table 5.5: Tax and Public Input Competition - System Estimation after Between-Transformation (years 1998, 2000, 2002, 2004),

Weighting scheme	WD15P		WN10P	
Dependent variable	τ	P	τ	P
τ_{-i}	0.263 ***	-387	0.211 ***	-505 *
	(0.050)	(352)	(0.039)	(263)
P_{-i}	-0.000	0.328 ***	-0.000	0.215 ***
	(0.000)	(0.081)	(0.000)	(0.060)
Own tax rate	-	1658 ***	-	1591 *
		(568)		(632)
Own public input	0.000 ***	-	0.000 ***	-
	(5D-06)		(5D-06)	
Marginal contribution rate	0.098 ***	-372	0.093 *	-438
	(0.037)	(278)	(0.036)	(282)
Unconditional transfers	-0.000 ***	0.261 ***	-0.000 ***	0.259 ***
	(7D-06)	(0.054)	(7D-06)	(0.057)
Fiscal capacity	-0.002	87.7 ***	-0.003 *	84.7 ***
	(0.002)	(11.7)	(0.001)	(11.8)
Specific grants for local roads	-	1.17 ***	-	1.17 ***
		(0.044)		(0.044)
Other specific grants	0.000 *	0.016	0.000 *	0.019
	(7D-06)	(0.047)	(6D-06)	(0.048)
Debt service	0.000 ***	-0.166 ***	0.000 ***	-0.153 ***
	(6D-06)	(0.050)	(6D-06)	(0.050)
Unemployment	-1.41 ***	179	-1.15 ***	232 *
	(0.314)	(147)	(0.306)	(134)
Population (1,000s)	0.000 ***	0.133	0.000 ***	0.198
	(0.000)	(0.203)	(0.000)	(0.228)
Pop. density	0.000	-8.43	0.000	-15.8 *
	(0.000)	(6.38)	(0.000)	(6.19)
% pop. <16 years	-0.010	90.6	-0.004	109
	(0.013)	(94.7)	(0.013)	(94.6)
% pop. >65 years	-0.141	-4.47	-0.135	25.8
	(0.108)	(70.3)	(0.107)	(69.6)
% church members	-0.127 ***	-	-0.109 ***	-
	(0.028)		(0.027)	
% church members×unemployment	1.47 ***	-	1.21 ***	-
	(0.349)		(0.340)	
% church members×% pop. >65 years	0.165	-	0.158	-
	(0.120)		(0.118)	
R^2	0.22	0.48	0.22	0.39
F-tests of excluded IVs:				
τ_{-i}	108.2	149.1	81.2	91.1
P_{-i}	124.0	123.8	83.5	79.9
Own tax rate	-	6.3	-	6.0
Own public input	15.9	-	16.5	-

Sample includes all municipalities up to independent cities, Nob=1100. Standard errors in parentheses. R^2 is from the third step of the estimation procedure (2SLS after taking account of spatial error correlation). F-tests of excluded IVs are from first-stage regressions of the 2SLS estimation in the third step of the estimation procedure. * significant at 10% level; * significant at 5% level; *** significant at 1% level.

transformed system reads

$$\bar{\tau}_i = \theta_\tau \bar{P}_i + \lambda_\tau \bar{\tau}_{-i} + \varphi_\tau \bar{P}_{-i} + \beta_\tau \bar{X}_{\tau\, i} + \bar{u}_i \tag{5.15}$$

$$\bar{P}_i = \theta_P \bar{\tau}_i + \lambda_P \bar{\tau}_{-i} + \varphi_P \bar{P}_{-i} + \beta_P \bar{X}_{Pi} + \bar{v}_i, \tag{5.16}$$

where $\bar{\tau}_i = T^{-1} \sum_t \tau_{it}$, $\bar{X}_i = T^{-1} \sum_t X_{it}$, $\bar{\tau}_{-i} = \sum_j w_{ij} \bar{\tau}_j$, etc. The between-estimations confirm the presence of direct strategic interaction in the choice of taxes and public inputs. The results regarding the impact of neighbors' taxes on own spending on infrastructure is

mixed: the null of no interaction cannot be rejected under the weighting scheme *WD15P*, but it is rejected under *WN10P* at the 10% level of significance. However, the magnitude of the estimated effect is rather small.

The results discussed thus far have been derived under various assumptions and practical considerations regarding the appropriateness of the weighting schemes and the selection of years reported. To provide an overview on the impact of these choices on the key outcomes, Table 6 displays estimates for our coefficients of interest for a number of different specifications and cross-sections.

With regard to the different weighting schemes, we note that using $WD15$, $WD15INV$, $WN10$ and $WN10INV$ results in very large estimates of λ_τ compared to $WD15P$ and $WN10P$. This is well in line with our expectations, as the variation in τ_{-i} tends to be low (recall that, with the weight matrix approaching a matrix of uniform weights for *all* other municipalities, τ_{-i} becomes a constant measuring the average tax rate among all communities). Note that for our system of equations to be stable, λ_τ is required to be smaller than one in absolute value. There are two estimations based on the 2004 cross-section where this requirement is barely met, adding further doubt regarding the appropriateness of weighting schemes that define 'large' sets of neighbors and that do not account for the municipalities' relative population size. It is also worth mentioning that the estimate for the interaction effect in public input provision, φ_P, is much more robust to changes regarding the weighting scheme. Noting that the variation in spending on infrastructure is much higher than the variation in tax rates, and that defining composite neighbor jurisdictions from a large set of communities should therefore be less of a technical problem, it is reassuring that the conclusions regarding public input competition are not affected by the choice of a weighting scheme that defines either smaller or larger sets of neighbors.

5.3 Conclusions

The empirical literature on local governments competing for mobile capital has thus far focused on the role of the tax rate, thereby neglecting the fact that governments may also try to attract private investment by the provision of public inputs to production. This paper is an attempt to overcome this deficiency. We derive general reaction functions from a standard model of tax and public input competition and estimate an empirical counterpart of the system of fiscal reaction functions. Based on a rich data set of 1100 German municipalities, we employ the spatial system estimator developed by Kelejian and Prucha (2004). The estimator allows for the joint determination of a municipality's business tax rate and the level of spending on the local road network and for general interaction effects across equations.

Our main findings suggest that the behavior of local jurisdictions is much more com-

Table 6: Selected parameter estimates for different weighting schemes

WD15							WD15INV						
Year	λ_τ	φ_τ	θ_τ	λ_P	φ_P	θ_P	Year	λ_τ	φ_τ	θ_τ	λ_P	φ_P	θ_P
1998	0.68 ***	-	0.00001 ***	-3643 ***	0.22 *	5307 ***	1998	0.73 ***	-	0.00001 ***	-2497 *	0.20 *	3584 ***
1999	0.72 ***	-	-	-	0.32 ***	-	1999	0.73 ***	-	-	-	0.31 ***	-
2000	0.77 ***	-	0.00001 *	-3225 *	0.53 ***	4127 ***	2000	0.74 ***	-	-	-	0.53 ***	-
2001	0.72 ***	-	-	-3389 *	0.38 ***	4194 *	2001	0.75 ***	-	-	-	0.32 ***	3105 *
2002	0.85 ***	-	-	-	0.38 ***	-	2002	0.87 ***	-	-	-	0.31 ***	-
2003	0.71 ***	0.00001 *	-	-7091 ***	-	6658 ***	2003	0.77 ***	0.00001 *	-	-10092 ***	-	9554 ***
2004	0.94 ***	-	-	-6560 ***	0.21 *	7378 ***	2004	0.93 ***	-	-	-7963 ***	-	8549 ***
WN10							WN10INV						
Year	λ_τ	φ_τ	θ_τ	λ_P	φ_P	θ_P	Year	λ_τ	φ_τ	θ_τ	λ_P	φ_P	θ_P
1998	0.57 ***	-	0.00001 *	-	-	-	1998	0.55 ***	-	0.00001 *	-	-	-
1999	0.54 ***	-	-	-	0.19 ***	-	1999	0.53 ***	-	-	-	0.17 ***	-
2000	0.54 ***	-	-	-	0.46 ***	-	2000	0.53 ***	-	-	-	0.42 ***	-
2001	0.56 ***	0.00001 *	-	-	0.24 ***	-2505 *	2001	0.57 ***	0.00001 *	-	-	0.20 ***	-
2002	0.70 ***	0.00001 *	-	-	0.22 ***	-	2002	0.71 ***	0.00001 *	-	-	0.21 ***	-
2003	0.58 ***	0.00001 *	0.00001 *	-	-	-2765 *	2003	0.60 ***	0.00001 *	-	-	-	-
2004	0.77 ***	-	0.00001 *	-6812 ***	0.18 *	7703 ***	2004	0.78 ***	-	0.00001 *	-8853 ***	0.13 *	9613 ***
WD15P							WN10P						
Year	λ_τ	φ_τ	θ_τ	λ_P	φ_P	θ_P	Year	λ_τ	φ_τ	θ_τ	λ_P	φ_P	θ_P
1998	0.19 ***	-	0.00001 ***	-731 *	0.17 *	3190 ***	1998	0.15 ***	-	0.00001 ***	-678 *	-	3039 ***
1999	0.20 ***	-	0.00001 ***	-741 *	0.25 ***	-	1999	0.14 ***	-	0.00001 *	-	0.14 *	-
2000	0.20 ***	-	0.00001 ***	-1005 *	0.50 ***	2396 ***	2000	0.17 ***	-	0.00001 *	-796 *	038 ***	-
2001	0.22 ***	-	-	-862 *	0.37 ***	1702 *	2001	0.15 ***	-	-	-	0.25 ***	-
2002	0.27 ***	-	-	-	0.23 *	-2176 *	2002	0.21 ***	0.00001 *	-	-	-	-
2003	0.22 ***	-	-	-	0.40 ***	-	2003	0.18 ***	-	-	-	-	-
2004	0.31 ***	-	-	-	-	-	2004	0.21 ***	-	-	-1412 ***	0.21 ***	3283 ***

For definitions of weighting schemes, see Table 5.2. Bars (-) indicate that the coefficient is not statistically different from zero at the 10% level of significance. * significant at 10% level; * significant at 5% level; *** significant at 1% level.

plex than described by the earlier empirical literature on fiscal competition. In particular, the estimation results of our system of interrelated equations show that the municipalities engage in simultaneous tax and public input competition. Firstly, in accordance with earlier research, in particular Buettner (2001), we find a positive and significant direct interaction effect in the local business tax rate. Municipalities facing competition from low-tax jurisdictions thus set lower taxes than municipalities with high-tax neighbors. Secondly, the local governments also adjust their level of spending on infrastructure towards the average level among neighboring jurisdictions. For our preferred specifications, the direct interaction effect in public input provision is statistically different from zero in 10 out of 14 cross-sections, and it tends to be larger than the direct interaction effect in taxes. Moreover, treating taxes and public inputs as alternative means to attract capital reveals that the municipalities react to competition in a rather flexible way. If neighbors lower their taxes, a municipality not only adjusts its own tax rate, but also increases its level of public input provision. Finally, we have demonstrated that our results depend on the choice of the spatial weighting scheme in a predictable way, and that all main results are robust across various cross-sections.

Chapter 6

Concluding Remarks

This book sheds further light on the functioning of federal systems and, in particular, the impact of fiscal equalisation on subnational public finances. Both the theoretical and empirical analyses presented herein indicate that the efficiency consequences of intergovernmental transfers in the presence of competition for mobile tax bases are more complex than suggested by the existing literature. To date, theoretical analyses have dealt with the impact of fiscal equalisation transfers on local tax policy putting forward the argument that capacity-based equalisation schemes work as corrective devices for inefficiencies arising from decentralised tax setting (e.g., Koethenbuerger, 2002; Bucovetsky and Smart, 2006). In particular, they find that, if intergovernmental transfers are inversely related to a jurisdiction's tax base, local governments are induced to increase their tax effort and provide a higher level of public goods. In the case of full equalisation of tax bases this leads to efficient decentralised tax policies. Recent empirical work provides evidence for the existence of an incentive effect of fiscal equalisation transfers on local tax policies (e.g., Buettner, 2006; Egger, Koethenbuerger, and Smart, 2007).

However, a theoretical analysis by Keen and Marchand (1997) suggests that inefficiencies in local public finances resulting from fiscal competition for mobile tax bases are not limited to the revenue side of the budget. Using a standard model of interjurisdictional fiscal competition, they show that, if governments, in addition to public consumption, provide a public input to production which attracts local investment, the local spending mix tends to be biased towards a relative overprovision of the prodactivity-enhancing public good. Therefore, inefficiencies resulting from local fiscal competition occur both on the revenue and expenditure side. The analyses presented in chapters 3 and 4 of this book start from this result. We extend the model used in Keen and Marchand (1997) by implementing a system of intergovernmental transfers to analyse the impact of fiscal equalisation transfers on local spending policies. Our theory suggests, that, similar to the case of pure tax competition, capacity-based equalisation induces governments to alleviate public input competition for the mobile tax base. More concretely, local governments

increasingly rebalance their budget towards a higher share of public consumption as the degree of redistribution within the equalisation scheme rises. The mechanism behind this result is that a higher degree of equalisation will make it less attractive for the individual jurisdiction to provide public inputs as positive tax base effects are redistributed to a higher extent among governments within the federation. This induces an internalisation of fiscal externalities at the local level which generates incentives for governments to substitute public input provision by public consumption. If tax bases are fully equalised, local spending policies turn out to be efficient. The empirical analyses in chapters 3 and 4 provide strong evidence for this incentive effect of fiscal equalisation transfers on local spending policies, both for the state as well as the local government level in Germany.

Overall, the theoretical literature on the "internalising" impact of capacity-based fiscal equalisation schemes suggests that such transfer systems tend to increase the efficiency of local public finances, therefore serving both equity and efficiency objectives. However, when judging the actual welfare effects of fiscal equalisation one has to take into account the fact that government objectives play a crucial role. Therefore, if one deviates from the assumption that benevolent governments seek to maximise residents' utility, political economy aspects come into play. The public choice literature, for example, argues that tax competition may well increase welfare, as the size of government might be excessive in the absence of such competition. In such a scenario, capacity-based equalisation would alleviate beneficial competitive behavior and actually reduce welfare. A recent theoretical analysis by Kotsogiannis and Schwager (2006) puts forward the argument that equalisation programs can lead to perverse fiscal incentives if political accountability is reduced. This may hold true, especialy in countries characterised by a pronounced fiscal federalism such as Germany. Therefore, taking into account political incentives and possible inefficiencies in the public sector when analysing institutional issues in a fiscal competition context deserves further attention. In addition, the specific design of federal systems is of critically importance when judging the welfare effects of redistributive grant systems. Our analysis presented in chapter 2 suggests that in a multi-level government setting, deviations in the objectives of upper and lower level governments tend to undermine the efficiency-improving impact of equalisation transfers. We provide first evidence on the interrelation of state and local public finances for the case of the German federation, however further research should be devoted to the investigation of federal systems and the impact of their design on local public finances.

Finally, our empirical analysis in chapter 5 provides evidence on the existence of simultaneous tax and public input competition among local governments in Germany. Our application extends the canonical empirical model of tax competition to account for public inputs as a second policy instrument. While our results suggest that local governments act in a competitive way when setting their tax and expenditure policies, it would be interesting to further explore empirically the nature of this competition observed in the data. In

particular, future empirical work should attempt to differentiate between different models and provide evidence on the question of whether local governments in Germany actually engage in fiscal competition for mobile tax bases or, alternatively, in political "yardstick competition".

Appendices

Appendix A: Mathematical appendix

A.1: Equivalence of (2.4) and (2.9)

Since $\frac{\partial \tau_i}{\partial \vartheta_i} \neq 0$, the expression in brackets in (2.9) must be zero in an optimum. Computing

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

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 (2.9) is so equivalent to

$$-k_i + (s_i - k_i)\frac{\partial r}{\partial \tau_i} + \lambda^2\left(k_i + (\tau_i - \vartheta_i)\left(\frac{\partial k_i}{\partial \tau_i} + \frac{\partial k_i}{\partial r}\frac{\partial r}{\partial \tau_i}\right)\right) \quad (1)$$

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

Close inspection of (1) reveals that the terms involving the contribution rates ϑ_i and ϑ_j cancel out. Hence, since from (2.7), $\lambda^2 = \alpha_i \frac{\partial v}{\partial z_i} = \alpha_j \frac{\partial v}{\partial z_j}$ for all i, j, we are back with the first best optimality condition (2.4).

A.2: Calculation of the optimal contribution rate

Inserting the optimality condition from the perspective of the individual jurisdiction (2.5) in (2.4), 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 (2.10).

A.3: The budgetary effect of public input provision

In order to derive the budgetary effects of a marginal increase in the budgetary share of the public input, λ_i, one has to apply the implicit function theorem to the government budget constraint which can be rewritten as follows

$$b_i - \bar{\tau}\phi(r + \bar{\tau}, \lambda_i b_i) - g_i = 0 \tag{2}$$

Implicit differentiation w.r.t λ_i yields

$$\frac{db_i}{d\lambda_i} = \frac{\bar{\tau}\frac{\partial k_i}{\partial P_i} b_i}{1 - \bar{\tau}\frac{\partial k_i}{\partial P_i}\lambda_i} = \frac{\bar{\tau} b_i}{\left(\frac{\partial k_i}{\partial P_i}\right)^{-1} - \bar{\tau}\lambda_i}. \tag{3}$$

Substituting $\frac{\partial k_i}{\partial P_i} = \frac{\beta}{1-\alpha} k_i P_i^{-1}$ in (3) then leaves us with

$$\frac{db_i}{d\lambda_i} = \frac{\bar{\tau} b_i}{\frac{1-\alpha}{\beta} P_i k_i^{-1} - \bar{\tau}\lambda_i}. \tag{4}$$

Therefore, in order to ensure that $\frac{db_i}{d\lambda_i} > 0$, the denominator of (4) must have a positive sign ,i.e. $\bar{\tau}\lambda_i < \frac{1-\alpha}{\beta} P_i k_i^{-1}$. Further rearrangements yield the following condition

$$g_i > \bar{\tau} k_i \left(\frac{(\alpha + \beta) - 1}{1 - \alpha} \right). \tag{5}$$

As our assumptions regarding the production technology imply that $(\alpha + \beta) \leq 1$, $g_i > 0$ is a sufficient condition for $\frac{db_i}{d\lambda_i} > 0$ to hold, i.e. federal grants need to play a role in financing local public good provision.

A.4: Analytical separation of income and incentive effects

In order to derive the budget-compensated effect of a marginal increase in the marginal contribution rate we first calculate the overall derivative of the implicit function Γ w.r.t. y_i and ϑ_i:

$$\begin{aligned} \Gamma_{y_i} &= \frac{\partial b_i}{\partial y_i}\left[\left(k_i^{\alpha}\beta P_i^{\beta-1} - v'\right) + \frac{(\alpha+\beta)-1}{1-\alpha} k_i \beta P_i^{\beta-2}\lambda_i \left(b_i + \lambda_i \frac{\partial b_i}{\partial \lambda_i}\right) - v''(1-\lambda_i)\left(b_i - (1-\lambda_i)\frac{\partial b_i}{\partial \lambda_i}\right)\right] \\ &+ \frac{\partial^2 b_i}{\partial \lambda_i \partial y_i}\left[\lambda_i\left(k_i^{\alpha}\beta P_i^{\beta-1} - v'\right) + v'\right] \end{aligned} \tag{6}$$

$$\begin{aligned} \Gamma_{\vartheta_i} &= \frac{\partial b_i}{\partial \vartheta_i}\left[\left(k_i^{\alpha}\beta P_i^{\beta-1} - v'\right) + \frac{(\alpha+\beta)-1}{1-\alpha} k_i \beta P_i^{\beta-2}\lambda_i \left(b_i + \lambda_i \frac{\partial b_i}{\partial \lambda_i}\right) - v''(1-\lambda_i)\left(b_i - (1-\lambda_i)\frac{\partial b_i}{\partial \lambda_i}\right)\right] \\ &+ \frac{\partial^2 b_i}{\partial \lambda_i \partial \vartheta_i}\left[\lambda_i\left(k_i^{\alpha}\beta P_i^{\beta-1} - v'\right) + v'\right] \end{aligned} \tag{7}$$

Note that, as explained in further detail in section 3.1, an increase in the marginal contribution rate induces both, an income and an incentive effect. Therefore, the next step is to analytically separate these two effects. First, we need to compute the budgetary impacts of variations in y_i and ϑ_i

$$\frac{\partial b_i}{\partial y_i} = \eta \left(\frac{\partial k_i}{\partial P_i} \right)^{-1} \text{ and } \frac{\partial b_i}{\partial \vartheta_i} = -k_i \frac{\partial b_i}{\partial y_i},$$

where $\eta = \frac{1}{\frac{1-\alpha}{\beta} k_i^{-1} P_i - (\bar{\tau} - \vartheta_i)\lambda_i} > 0$ if $y_i \geq 0$[1]. Moreover, the cross derivatives read

$$\frac{\partial^2 b_i}{\partial \lambda_i \partial y_i} = \eta \left[\frac{\partial b_i}{\partial y_i} \left((\bar{\tau} - \vartheta_i) - \frac{1-(\alpha+\beta)}{\beta} \frac{\partial b_i}{\partial \lambda_i} \frac{\lambda_i}{k_i} \right) \right] \text{ and}$$
$$\frac{\partial^2 b_i}{\partial \lambda_i \partial \vartheta_i} = \eta \left[-b_i + \frac{\partial b_i}{\partial \vartheta_i} \left((\bar{\tau} - \vartheta_i) - \frac{1-(\alpha+\beta)}{\beta} \frac{\partial b_i}{\partial \lambda_i} \frac{\lambda_i}{k_i} \right) \right]$$

Using these derivatives, we can now transform equation (7) as follows:

$$\Gamma_{\vartheta_i} = -\eta b_i \left[\lambda_i \left(k_i^{\alpha} \beta P_i^{\beta-1} - v' \right) + v' \right] - k_i \Gamma_{y_i} \tag{8}$$

A.4: Implicit differentiation of the local government budget constraint

In order to derive the budgetary effects of marginal variations in the policy parameters τ_i and λ_i, one has to apply the implicit function theorem to the local government budget constraint which can be rewritten as follows.

$$b_i - (\tau - \vartheta_i)\, \phi(r + \tau, \lambda_i b_i) - y_i = 0 \tag{9}$$

Implicit differentiation w.r.t τ_i and λ_i yields

$$\frac{db_i}{d\tau_i} = \frac{k_i + (\tau_i - \vartheta_i) \frac{\partial k_i}{\partial \tau_i}}{1 - (\tau_i - \vartheta_i) \frac{\partial k_i}{\partial P_i} \lambda_i}, \tag{10}$$

$$\frac{db_i}{d\lambda_i} = \frac{(\tau_i - \vartheta_i) \frac{\partial k_i}{\partial P_i} b_i}{1 - (\tau_i - \vartheta_i) \frac{\partial k_i}{\partial P_i} \lambda_i}. \tag{11}$$

It follows from optimality condition 4.5 that $k_i + (\tau_i - \vartheta_i) \frac{\partial k_i}{\partial \tau_i} > 0$. Therefore, in order to show that $\frac{db_i}{d\tau_i} > 0$ and $\frac{db_i}{d\lambda_i} > 0$, it must hold that $1 - (\tau_i - \vartheta_i) \frac{\partial k_i}{\partial P_i} \lambda_i > 0$. This can be shown by substituting $\frac{\partial k_i}{\partial P_i} = \frac{\beta}{1-\alpha} k_i P_i^{-1}$ and rearranging which leaves us with

$$y_i > (\tau_i - \vartheta_i)\, k_i \left(\frac{(\alpha + \beta) - 1}{1 - \alpha} \right). \tag{12}$$

Therefore, as our assumptions regarding the production technology imply that $(\alpha+\beta) \leq 1$, $y_i > 0$ is a sufficient condition for $\frac{db_i}{d\tau_i} > 0$ and $\frac{db_i}{d\lambda_i} > 0$ to hold, i.e. federal grants need to play a role in financing local public good provision.

[1] This can be shown analogous to the calculations in Appendix A.3.

A.5: Derivation of optimality condition 4.5

In order to derive the optimality condition 4.5 both first order conditions, (4.3) and (4.4), are solved for $\left(k_i^{\alpha}\beta(\lambda_i b_i)^{\beta-1} - v'\right)$ and then equated. This yields

$$v' = \frac{k_i}{\frac{\partial b_i}{\partial \tau_i}} \; + \; \lambda_i \frac{k_i}{b_i} \frac{\frac{\partial b_i}{\partial \lambda_i}}{\frac{\partial b_i}{\partial \tau i}}. \tag{13}$$

The next step is to substitute $\frac{\partial b_i}{\partial \tau_i} = \frac{k_i + (\tau_i - \vartheta_i)\frac{\partial k_i}{\partial \tau_i}}{1-(\tau_i-\vartheta_i)\frac{\partial k_i}{\partial P_i}\lambda_i}$ and $\frac{\partial b_i}{\partial \lambda_i} = \frac{(\tau_i-\vartheta_i)\frac{\partial k_i}{\partial P_i}b_i}{1-(\tau_i-\vartheta_i)\frac{\partial k_i}{\partial P_i}\lambda_i}$ which, after rearrangement, leaves us with

$$\begin{aligned} v' &= \frac{k_i}{k_i + (\tau_i - \vartheta_i)\frac{\partial k_i}{\partial \tau_i}} \left(1 + \frac{(\tau_i - \vartheta_i)\frac{\partial k_i}{\partial P_i}\lambda_i}{1 - (\tau_i - \vartheta_i)\frac{\partial k_i}{\partial P_i}\lambda_i}\right)\left(1 - (\tau_i - \vartheta_i)\frac{\partial k_i}{\partial P_i}\lambda_i\right) \\ &= \frac{k_i}{k_i + (\tau_i - \vartheta_i)\frac{\partial k_i}{\partial \tau_i}}. \end{aligned} \tag{14}$$

Appendix B: Data Sources and Definitions

B.1: Chapter 2

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 equalisation 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 equalisation 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 equalisation 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/.

B.2: Chapter 3

The underlying dataset consists of annual data for Germany in the period 1980 until 2003. Data for the former East German states are incorporated as of 1995. The detailed data on the composition of **state spending**, the **population data** and the data on state specific **unemployment rates** are obtained from the German federal statistical office (Statistisches Bundesamt). **Fiscal equalisation transfers**, **marginal contribution rates** and **relative fiscal capacity** are obtained from a full implementation of the fiscal equalisation law and further relevant statutory definitions for each year in the period 1980-2003. Federal fiscal equalisation rules (Finanzausgleichsgesetz - FAG) are obtained from the Bundesgesetzblatt. Data for calculating the states' fiscal capacity (Finanzkraftmesszahl) and fiscal need (Ausgleichsmesszahl) are taken from the annual enactments to implement the fiscal equalisation law (Zweite Verordnung zur Durchführung des Gesetzes über den Finanzausgleich zwischen Bund und Ländern in den Ausgleichsjahren 1980 - 2003). These enactments are also obtained from the Bundesgesetzblatt. The **relative fiscal capacity** is defined as the ratio of fiscal capacity to fiscal need. Data on the **special requirement**

transfers ("Sonderbedarfs-Bundesergänzungszuweisungen") are taken from the FAG. The information on the **partisan composition of state governments** are obtained from http://www.election.de/.

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