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The Incentive Effect of Fiscal Equalization Transfers on Tax Policy[†]

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Abstract: A theoretical analysis considers the impact of a typical system of redistributive "fiscal equalization" transfers on the taxing effort of local jurisdictions. More specifically, it shows that the marginal contribution rate, *i.e.* the rate at which an increase in the tax base is reducing those transfers, might be positively associated with the local tax rate while the volume of grants received is likely to be inversely related to the tax base. These predictions are tested in an empirical analysis of the tax policy of German municipalities. In order to identify the incentive effect the analysis exploits discontinuities in the rules of the fiscal equalization system as well as policy changes. The empirical results support the existence of an incentive effect, suggesting that the high marginal contribution rates induce the municipalities to raise their business tax rates significantly.

Key Words: Fiscal Equalization; Tax Competition; Fiscal Federalism; Incentive Effect of Taxation; Regression Discontinuity

JEL Classification: H71; H77

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1 Introduction

Redistributive fiscal transfers between jurisdictions are a common feature of many federal countries with local taxing autonomy such as Canada, Germany, and Switzerland. Irrespective of whether explicitly labelled "fiscal equalization" or embedded in a system of revenue sharing, the common characteristic is that transfers are inversely related to the tax base or some corresponding measure of "fiscal capacity". As a consequence, those schemes will tend to compensate jurisdictions for the adverse impact of higher taxing efforts on the tax base. To put it differently, redistributive transfer schemes tend to lower the marginal cost of raising funds and might, therefore, induce governments to raise even possibly distorting taxes (Smart, 1998, and Dahlby, 2002). This incentive effect is not only important for the design of redistributive transfer systems, but is discussed also in the context of tax competition. Standard models of tax competition argue that in a decentralized setting the mobility of the tax base will tend to increase the marginal cost of raising public funds for each individual jurisdiction with adverse consequences for the supply of public services. Since redistributive fiscal transfers might have the opposite impact on the marginal cost of raising public funds, recent theoretical research suggests that a redistributive system of interjurisdictional transfers might help to restore efficiency in an otherwise inefficient equilibrium of tax competition (Bucovetsky and Smart, 2002, Koethenbuerger, 2002).

However, beyond theoretical considerations little is known about the significance and strength of incentive effects from fiscal equalization on the taxing policy of local jurisdictions. A paper by Baretti, Huber, and Lichtblau (2002) is concerned with the case of German states. As these states lack taxing autonomy, the study focuses on the related issue of revenue collection and finds a significant adverse effect of fiscal equalization. Snoddon (2003) investigates the incentive effect of fiscal equalization in Canada. Facing complex interactions in the Canadian system of intergovernmental transfers the empirical analysis focuses on policy reforms and finds support for incentive effects of fiscal equalization. However, the analysis is concerned with tax revenue, which is only an indirect measure of tax policy. The direct impact of fiscal equalization on tax policy is considered by Dahlby and Warren (2003) using a small dataset of eight Australian states and territories. They find some limited support for an incentive

effect on taxing decisions.

This paper adds to the literature by providing an empirical investigation of the incentive effect of fiscal equalization on the local choice of the business tax rate in a dataset of German municipalities. For several reasons German municipalities offer a promising case to study. While the jurisdictions experience taxing autonomy mainly in choosing the local rate of the business tax, a substantial amount of fiscal resources is redistributed among local governments. At the same time, autonomy is restricted to the choice of the tax rate since tax bases are defined uniformly across the country and tax collection is centralized at the state level. Even though empirical evidence is lacking, the potential incentive towards higher tax rates is noticed regularly in debates about the equalization system in Germany's state legislatures (*e.g.*, Hardt and Schmidt, 1998: 160), and, occasionally, used even as a motivation for tax reform.[1] Also previous research on the impact of local tax rates on revenue indicates potentially important incentive effects, as local tax rates are shown to exert quite strong tax base effects, which point to an unusually high taxing effort of German municipalities (Buettner, 2003).

The following theoretical section discusses the choice of the local tax rate on capital in presence of redistributive transfers. The model explicitly introduces a system of fiscal transfers such that taxing decisions are made conditional upon the rules determining the (net) contribution to the transfer system. The subsequent empirical investigation basically tests whether the properties of the first-order conditions of the optimal policy are consistent with the data. The empirical analysis employs a panel dataset of municipalities in a major German state over a period of 21 years. A special advantage of the dataset is that the system of fiscal equalization differs across subregions (counties) as well as across the time-period covered by the data allowing us to pursue different identification strategies and to compare their results. The first approach taken in the paper exploits the fact that incentives are discontinuous functions of relative fiscal capacity which allows to employ regression discontinuity estimation techniques (*e.g.*, Van der Klauw, 1999, and Angrist and Lavy, 2002). The second approach exploits the

[1] A good example is the 1980 reform in the state of Baden-Württemberg. This reform reduced the contribution rate determining the amount of tax revenue to be transferred into the system, where the legislator explicitly pointed at the incentive effect: *"Um den Gemeinden eine Absenkung der Gewerbesteuerhebesätze zu erleichtern, hat der Gesetzgeber den Anrechnungshebeseatz für die Gewerbesteuer im Finanzausgleich ab 1982 auf 290 % abgesenkt"*, cited from Bronner, Faiss and Fürth (1998: 81).

variation of incentives due to changes in the system over time. Regardless of the identification approach taken the empirical results support the predictions of the theoretical analysis. In particular, the marginal contribution rate is found to exert a significant positive impact on the local tax rate whereas the volume of grants received is inversely associated with taxing effort.

The paper proceeds as follows. The following theoretical section derives the main predictions. Section 3, then, provides a discussion of the investigation approach including a stylized description of the equalization system. Section 4 gives an account of the dataset and is concerned with some specification issues. Section 5 reports the results. Section 6 provides conclusions.

2 Theoretical Considerations

Consider a standard model of tax competition (see Wilson, 1999, for a survey), where the local government levies a tax on capital. Assuming capital mobility, gross return to capital will obey the following arbitrage condition between jurisdictions i and j

$$f'(k_i) - \tau_i = f'(k_j) - \tau_j, \tag{1}$$

where k_i is the capital-labor ratio, τ_i is tax rate on capital, and f is a production function. For simplicity, let us assume that each jurisdiction has the same number of residents normalized such that $l_i = 1$. Let the budget constraint of the government in per-capita terms be

$$z_i = \tau_i k_i + g_i, \tag{2}$$

where z_i is public spending and g_i is inter-governmental revenue which may or may not be dependent on local policies. The government is assumed to maximize the utility of a representative individual, which is determined by a quasi-linear utility function

$$u_i = c_i + \alpha_i v(z_i), \quad \text{where } v' > 0,\ v'' < 0, \tag{3}$$

and c_i is private consumption. While it is quite restrictive, this particular choice of the utility function will allow us to focus on a setting where the impact of fiscal equalization on the production possibility frontier in terms of public vs. private consumption is dominating tax policy. Assuming absentee capital-owners, private consumption is determined by the marginal productivity of labor

$$c_i = f(k_i) - k_i f'(k_i). \tag{4}$$

In this setting private consumption is decreasing in the amount of public services provided. More specifically, if the tax base elasticity is increasing in the tax rate, the production possibility frontier is strictly convex.[2] The optimum choice of the tax rate from the perspective of the individual government is determined by the familiar condition that the marginal rate of substitution between public and private consumption equals the marginal rate of transformation or, equivalently, the marginal cost of raising public funds

$$\alpha_i v'(z_i) \stackrel{!}{=} \frac{k_i}{k_i + \tau_i \frac{\partial k_i}{\partial \tau_i} + \frac{\partial g_i}{\partial \tau_i}}. \tag{5}$$

Consider the standard case where grants are provided irrespective of the local tax policy ($\frac{\partial g_i}{\partial \tau_i} = 0$). In this case the right hand side is larger than unity to an extent depending on the elasticity of capital supply. If the impact of taxes on the tax base arises from the mobility of capital between jurisdictions the cost of raising public funds from the perspective of the federation is (Wildasin, 1989)

$$\alpha_i v'(z_i) \stackrel{!}{=} \frac{k_i}{k_i + \tau_i \frac{\partial k_i}{\partial \tau_i} + \sum_{j \neq i} \tau_j \frac{\partial k_j}{\partial \tau_i}}.$$

The positive third term in the denominator of the right hand side reflects the fiscal externality exerted on other jurisdictions. Given the simple utility function, the federal optimality condition implies a higher level of spending and taxation than the individual optimality condition does, which is a common result in the tax competition literature. In this situation, the federal

[2]Whether or not the tax base elasticity is increasing depends basically on the third derivative of the production function. In order to ensure an increasing elasticity, it needs to have a value below some positive threshold.

government could raise taxing effort of local jurisdictions by conditioning grants on local tax policy. Wildasin (1989) shows that the optimal, Pigouvian remedy fulfills

$$\frac{\partial g_i}{\partial \tau_i} = \sum_{j \neq i} \tau_j \frac{\partial k_j}{\partial \tau_i}.$$

As noticed in Smart (1998) many federal countries provide intergovernmental transfer systems, which tend to provide similar incentives for lower level governments to raise taxing efforts even though local taxes are perceived to be distortive by the local jurisdiction. Consider a simple "fiscal equalization" transfer system where the provision of grants depends on the local tax base or "fiscal capacity"

$$g_i = y_i - \vartheta_i k_i. \tag{6}$$

y_i can be referred to as virtual intergovernmental revenue determined by the equalization system or "virtual equalization grants", *i.e.* the amount of grants the jurisdiction would receive if its tax base were actually zero. For any non-negative amount of the tax base ϑ_i determines the marginal contribution into the equalization system. Given this equalization system the above optimality condition for the tax policy of a local jurisdiction (5) becomes

$$\alpha_i v'(z_i) \stackrel{!}{=} \frac{k_i}{k_i + (\tau_i - \vartheta_i)\frac{\partial k_i}{\partial \tau_i}}. \tag{7}$$

Obviously, under full equalization, *i.e.* at a marginal contribution rate equal to the tax rate $\vartheta_i = \tau_i$ the marginal cost of raising public funds would be reduced to unity. This would restore efficiency, if coordinated capital taxation were non-distortive. Of course, as emphasized by Bucovetsky and Smart (2002), it is generally not the case that full equalization is efficient. Since, if coordinated capital taxation is distortive, for instance, because of its impact on the total amount of capital invested in the federation,[3] the sum of the tax base effects of local tax increases may be negative

$$\tau_i \frac{\partial k_i}{\partial \tau_i} + \sum_{j \neq i} \tau_j \frac{\partial k_j}{\partial \tau_i} \; < \; 0.$$

[3]Bucovetsky and Smart (2002) base their argument on the impact of taxation on savings.

Then, the marginal cost of raising public funds from the perspective of the federation is above unity, and only partial equalization with $\vartheta_i < \tau_i$ would be efficient.

Given partial equalization the model implies that the fiscal equalization transfer system provides incentives on the taxing effort. We can summarize this effect by the following proposition:

Proposition 1 (Incentive Effect of Fiscal Equalization)
In case of partial fiscal equalization an increase in the marginal contribution rate will lower the marginal cost of raising public funds. Given the separable utility function (3) and if the own taxbase elasticity is non-decreasing, the local government will set a higher tax rate.

To see this, note that the RHS of (7) defining the marginal cost of raising public funds is decreasing in ϑ_i. If the own taxbase elasticity is increasing the RHS is increasing in τ_i. With partial equalization and assuming a rational tax policy the overall revenue effect of a higher tax rate is positive ($\frac{\partial z_i}{\partial \tau_i} > 0$). Given the quasi-linear utility function and $v'' < 0$ the MRS on the LHS of (7) is decreasing in the tax rate. As a consequence, upon an increase in ϑ_i optimality can only be restored at a higher tax rate.

We can also derive a proposition with regard to the impact of virtual equalization grants on tax policy.

Proposition 2 (Impact of Virtual Equalization Grants)
Given the separable utility function (3) and partial fiscal equalization, and if the own taxbase elasticity is non-decreasing, an increase in virtual equalization grants y_i will tend to be associated with a lower tax rate.

This proposition follows from the fact that the LHS of (7) is decreasing in y_i as public spending is increasing ($\frac{\partial z_i}{\partial y_i} > 0$). In order to restore optimality we need an increase in the LHS and a decrease in the RHS, which is both associated with a lower tax rate.

Regardless of the existence of the fiscal equalization system, as long as there is less than

complete equalization, tax policy behaves as usually expected in a setting of tax competition. In particular, we can still derive reaction functions in tax competition and can predict that higher preference for public services is associated with higher tax rates.

Proposition 3 (Existence of a Reaction Function)
Suppose jurisdiction j is a competing location such that the tax base of i is increasing in the tax rate of j. An increase in the tax rate at j will tend to be associated with a change in the tax rate at i.

If it reduces the elasticity on the RHS of (7), the higher tax rate at j will tend to lower the marginal cost of raising public funds. As we have seen, this could be offset by a higher tax rate at i. However, there is a second impact on the LHS of (7) which tends to reduce the MRS since $\frac{\partial z_i}{\partial \tau_j} > 0$. As this could be offset by a lower tax rate, the sign of the response is ambiguous.

Proposition 4 (Impact of Preferences)
Given the separable utility function (3) and partial fiscal equalization, a higher preference for the public good is associated with a higher tax rate.

To see this, note that the LHS of (7) is increasing in α_i. In order to restore optimality we need a decrease in the LHS and an increase in the RHS, which is both associated with a higher tax rate.

3 Investigation Approach

The previous section has extended the standard model of tax competition by fiscal equalization grants. It has shown that the presence of fiscal equalization transfers alters the budget set of local jurisdictions such that the marginal cost of raising public funds are reduced. Under certain conditions, we might, therefore, expect an impact of fiscal equalization on taxing

effort. The empirical investigation below aims at testing the predictions of the theoretical analysis using a panel dataset of municipalities in a German state.

In order to analyze the incentive effect of fiscal equalization empirically, it is essential to specify the main determinants of the position and curvature of the budget set. As indicated by the above theoretical discussion, a key determinant of the curvature is the marginal contribution rate of the fiscal equalization system ϑ_i. Moreover, it is important to capture the endowment with fiscal resources independent of tax policy as given by virtual equalization grants y_i. Taken together, in the light of the theoretical analysis, local capital taxation will obey

$$\tau_i = \tau\,(\,y_i\,,\,\vartheta_i\,,\alpha_i\,;\,x_i\,)\,,$$

where α_i captures preferences and x_i is a vector of conditioning variables capturing further conditions faced by each municipality. The current investigation basically employs a sample of municipalities in order to estimate this equation. However, the pure cross-sectional relationship is plagued with a host of difficult measurement problems and it would be very difficult to control for all local conditions. But if one is willing to assume that unobserved local determinants of tax policy (including preferences α_i) are time-invariant, a possible solution is to pool observations for different periods and to estimate the tax equation using panel data. Accordingly, the empirical analysis is concerned with the relationship

$$\tau_{i,t} \;\;=\;\; \tau\,(\;y_{i,t}\,,\,\vartheta_{i,t}\,;\,x_{i,t}\,,\;\psi_i\,,\,\phi_t\,)\,, \tag{8}$$

where ψ_i captures a location-specific and ϕ_t a time-specific effect.

Note that the level of virtual equalization grants and the marginal contribution rate are both indexed with the local jurisdiction, which is reflecting the dependence on local conditions. Since these conditions might well be correlated with the tax rate, investigating the relationship (8) empirically raises questions about the identification of incentive effects. In order to highlight sources for identification in the present context, the following subsection briefly summarizes the German system of fiscal equalization among municipalities before the identification approach is discussed in more detail.

3.1 Elements of Municipal Fiscal Equalization in Germany

Following the classification by Boadway (2004) the system of municipal fiscal equalization in Germany can be characterized as a "gross scheme" involving not just the redistribution of revenue among municipalities but also significant transfers from the state level.[4] Thus, there is no explicit horizontal budget constraint on the transfer system. Two basic elements can be distinguished

1. fiscal equalization grants, and

2. fiscal capacity dependent contributions.

1. Fiscal equalization grants are designed to reduce the difference between what the system considers as fiscal need and as fiscal capacity. While fiscal need is basically a non-linear transformation of population size, fiscal capacity is determined by the tax base of the local business tax and other revenue sources, mainly the local share of the statewide income tax revenue. For simplicity, let us abstract from the differences between the business tax, which is actually more like a capital income tax,[5] and the above stylized capital tax. With this simplification we can formalize fiscal equalization grants by[6]

$$g_i^{equal} = \xi_i n_i - \vartheta_i^{equal}\gamma_i, \qquad \gamma_i \equiv (\tau_0 k_i + \zeta q_i), \tag{9}$$

where n_i is fiscal need and γ_i is fiscal capacity. It consists of taxing capacity $\tau_0 k_i$, where τ_0 is a standardized tax rate, and other sources of revenue q_i, which are considered to augment fiscal capacity at the rate ζ. ϑ_i^{equal} is the marginal contribution rate and ξ_i may be referred to as the marginal distribution rate. Note that these rates are decreasing in relative fiscal capacity. Formally we can distinguish three regimes of fiscal equalization:

[4]While some of the institutional details vary between states the basic structure is very similar across states. In the following, we focus on the case of Baden-Wuerttemberg.

[5]A short English description of the business tax and the German tax system is provided in International Bureau of Fiscal Documentation (2003).

[6]In this short exposition we neglect adjustment lags in the system and focus on the long-run properties.

$$\xi_i = 0.88 \quad \vartheta_i^{equal} = 1.00 \quad \text{if} \quad 0 \quad < \gamma_i < \quad 0.6 \qquad (\text{“low capacity”})$$

$$\xi_i = 0.70 \quad \vartheta_i^{equal} = 0.70 \quad \text{if} \quad 0.6 \quad < \gamma_i < \quad 1 \quad (\text{“medium capacity”})$$

$$\xi_i = 0.00 \quad \vartheta_i^{equal} = 0.00 \quad \text{if} \quad 1 \quad < \gamma_i \qquad (\text{“high capacity”}).$$

According to equation (9), conditional on fiscal need fiscal equalization grants are declining in fiscal capacity, and, thus, in the tax base. Furthermore, note that the system also bears a regressive element, since across the different regimes the marginal contribution rate ϑ_i^{equal} is strongly decreasing in fiscal capacity.

2. Whether receiving fiscal equalization grants or not, municipalities have to make several contributions out of their local tax revenues. More specifically, municipalities have obligations to contribute the amount of

$\tau_0\, k_i\, \vartheta^{rs}$	to the revenue sharing with state and federal level
$\tau_0\, k_i\, \vartheta_i^{local}$	to the respective county, and
$\tau_0\, k_i\, \vartheta_i^{state}$	to the state.

Note that while the first item involves a uniform contribution rate for all municipalities, in the second and the third case there is variation between jurisdictions. The contribution rate to the county is varying across counties, and the contribution rate to the state has some progressive element, *i.e.* it is higher for municipalities with a high relative tax capacity.[7]

Though the basic structure is simple, the combined effect of the different elements is not straightforward. This is due, in particular, to the fact that grants and contributions are to some extent taken into account in the definition of fiscal capacity; in other words: grants and contributions will affect q_i in (9). For the purpose of the present analysis, the system has been fully implemented in the database, which enables us to summarize the system by means of descriptive statistics. Table 1 provides corresponding statistics for the year 2000. Fiscal need shows modest variation. Conversely, fiscal capacity and, in particular, taxing

[7] In order to keep the exposition simple let us abstract from the details.

Table 1: Descriptive Statistics for the Equalization Transfer System in 2000

			Mean	Std Dev	Min	Max
Fiscal need	€ per capita	n_i	782	59	740	1368
Fiscal capacity	€ per capita	$\tau_0 k_i + \zeta q_i$	537	205	258	3556
Tax capacity	€ per capita	$\tau_0 k_i$	145	174	1	2861
Tax to fiscal capacity	share	$\tau_0 k_i / [\tau_0 k_i + \zeta q_i]$	.230	.134	.004	.845
Rel. fiscal capacity	ratio	$\gamma_i \equiv [\tau_0 k_i + \zeta q_i] / n_i$	.685	.250	.349	4.26
Low fiscal capacity	binary		.401	.490	0	1
Medium fiscal capacity	binary		.532	.499	0	1
High fiscal capacity	binary		.066	.249	0	1
Marginal contribution rates						
Rev. sharing contribution	%	ϑ^{rs}	4.15	0	4.15	4.15
County contribution	%	ϑ_i^{local}	4.23	.685	.000	5.37
State contribution	%	ϑ_i^{state}	3.04	.135	2.97	3.99
Total contribution rate	%	ϑ_i	13.4	1.24	8.92	14.5
Statutory tax rate	%	τ_i	16.7	1.24	14.5	21.5
Rate of equalization	share	ϑ_i / τ_i	.800	.078	.500	.967

Sample size consists of 1024 jurisdictions in the state of Baden-Wuerttemberg.

capacity shows strong variation across jurisdictions. Many jurisdictions show a fiscal capacity below fiscal need, and, thus, are recipients of fiscal equalization grants. More than every third jurisdiction has fiscal capacity even below the threshold of 60 % of fiscal need and hence will have particularly large marginal contribution rates. The upshot of the equalization system is provided in the last three rows. Throughout the sample, the marginal contribution rate is varying significantly between almost 9 % and 14.5 %. The statutory tax rate is generally higher, such that the rate of equalization (ϑ_i/τ_i) in the sample is between 50 % and 96.7 %.

While the figures presented in Table 1 point to substantial cross-sectional variation, it should be noted that the underlying parameters show variation also over time. This refers, first of all, to revenue sharing (ϑ^{rs}) and the county contribution (ϑ_i^{local}) where marginal contribution rates vary from year to year either at state or at county level. Moreover, in the period between 1980 and 2000, which is the focus of the empirical analysis, there have been several reforms and changes in the law, which refer to all aspects of the complex system such as the definition of low fiscal capacity jurisdictions, the inclusion of other fiscal revenue into fiscal capacity, the level of the standardized tax rate, or the contributions to the state and the progressivity of the respective contribution rate.

3.2 Identification of Fiscal Incentives

As the brief description of the system of fiscal equalization among German municipalities has shown, there are basically three sources of empirical variation in the incentives:

1. The incentives faced by an individual jurisdiction are varying with local fiscal conditions. Therefore, incentives vary across jurisdictions and time.

2. Some parameters of the system of intergovernmental transfers vary across groups of jurisdictions (counties) implying different incentives across groups and time.

3. Reforms in the system of intergovernmental transfers create changes in the incentives over time, which tend to affect jurisdictions differently depending on their initial fiscal conditions.

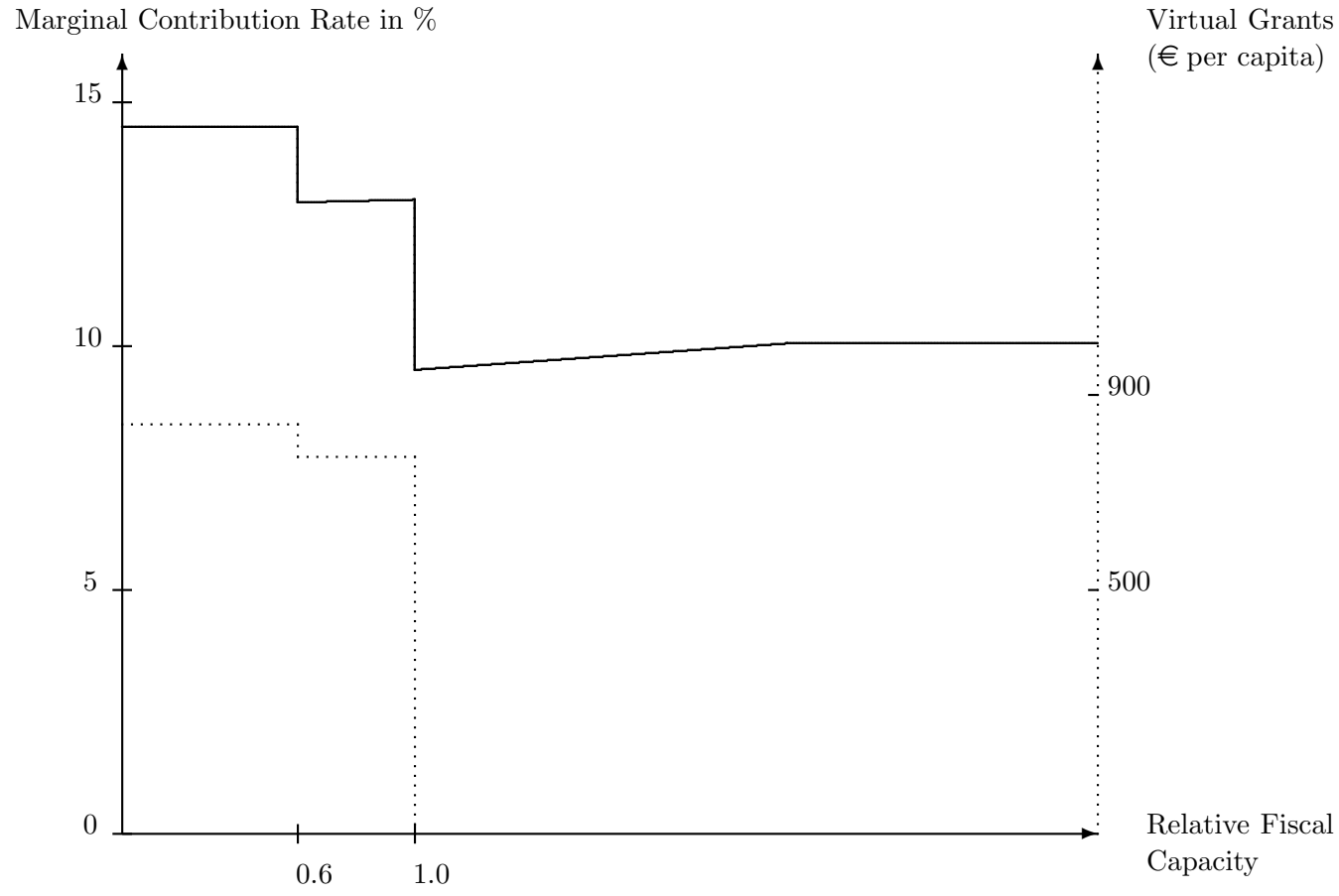
The first source raises the issue of how one could separate the incentive effect of the fiscal equalization system from other characteristics which drive tax policy but are possibly unobserved. In the present case, this creates a situation where differences in incentives cannot be treated as exogenous, statistically, because they could reflect other relevant variation in the determinants of tax policy. In other words, jurisdictions, which have high tax rates for whatever reason, are more likely to have a low tax base, and face a higher marginal contribution rate and higher virtual equalization grants. If we are unable to control for all determinants of tax policy, a simultaneity bias arises. A useful interpretation of this bias is provided by the literature on labor market programs, where the key problem is to control for the self-selectivity of program participants (for a survey see Heckman, Lalonde, and Smith, 1999). Accordingly, in the present context, we might consider the incentive effect of the fiscal equalization system as a "treatment effect". Given the impact of local policies on the fiscal conditions, jurisdictions might show systematic differences across the three different regimes of fiscal equalization. Thus, if jurisdictions vary in their tax policy across the different regimes, without further assumptions it is not possible to assess to what extent this difference is due to the "treatment effect" from fiscal equalization or, alternatively, whether it is reflecting other differences between jurisdictions in the three regimes. The second and the third source of empirical variation in incentives are less problematic as it is not a change in local fiscal conditions which is driving the variation in incentives.

In this situation, depending on the source of empirical variation two alternative approaches are followed in order to gain identification. A first approach exploits the fact that the incentives vary discontinuously with the underlying fiscal conditions. A second approach treats discontinuities as nuisance and focuses on the variation of incentives due to changes in policy.

3.2.1 Exploiting the Differences across Regimes

As we have seen above, even within a county and within a year the incentives created by the system of fiscal incentives are not uniform but vary strongly with local fiscal conditions. An important characteristic is that both the level of virtual equalization grants and the marginal contribution rate vary discontinuously with relative fiscal capacity. This is depicted in Fig-

Figure 1: Relative Fiscal Capacity and Marginal Contribution Rate



—— marginal contribution rate simulated at revenue sharing rate and average county contribution rate in 2000.

····· virtual equalization grants simulated using averages for fiscal need and fiscal capacity at zero business tax base in 2000.

ure 1 which reports simulated figures using parameters for 2000. Accordingly, the marginal contribution rate follows a "saw tooth" pattern showing discontinuous drops at the threshold levels of relative fiscal capacity while increasing slightly or staying constant within the regimes. The level of virtual equalization grants is simply differing between regimes. What is particularly noteworthy is that we can distinguish three regimes which introduce discontinuities in marginal contribution rate and virtual equalization grants as relative taxing capacity is gradually increasing. Thus, at the threshold levels of taxing capacity even a tiny change in relative fiscal capacity results in strongly different incentives, which is precisely a situation where regression discontinuity estimators could yield identification. This approach, originally proposed by Campbell (1969), has recently been reintroduced in applied econometric work by van der Klaauw (1999) and Angrist and Lavy (2002). In our case, there are two major discontinuities since below a certain upper threshold a jurisdiction is considered as favorably endowed with fiscal capacity, whereas below a lower threshold jurisdictions are considered as particularly weak in terms of fiscal capacity. Note that the rules of the fiscal equalization system precisely define the threshold levels of relative fiscal capacity. This suggest to follow a "sharp design" in specifying the estimation problem.

Consider the following specification of the above tax equation

$$\tau_{i,t} = \beta_1 y_{i,t} + \beta_2 \vartheta_{i,t} + \beta_3 S(\gamma_{i,t}) + \beta_4 x_{i,t} + \psi_i + \phi_t + \epsilon_{i,t}. \tag{10}$$

The possible impact of relative fiscal capacity on tax policy is captured by some potentially nonlinear function $S(\gamma_{i,t})$. While $y_{i,t}$ and $\vartheta_{i,t}$ are also determined by $\gamma_{i,t}$, the control for $\gamma_{i,t}$ and potentially non-linear transformations ensures that only the discontinuities are used to identify the impact of fiscal incentives. Intuitively, in controlling for other differences between jurisdictions including fiscal capacity we make tax policy of jurisdictions comparable. Despite of their similarity the discontinuities ensure that the jurisdictions are nevertheless subject to very different regimes in the equalization system which allows us to estimate the impact of fiscal equalization on tax policy.

A separate issue is whether the incentive faced by the government as the optimizing agent is

directly dependent on its own choice.[8] Such a direct impact could certainly undermine a causal interpretation, even though the selection into one of the three regimes of fiscal equalization is done on the basis of the much broader concept of fiscal capacity, which is made up of several components of revenue. However, the selection into the three regimes of fiscal equalization is not based on actual figures of fiscal capacity but on capacity as reported two years before. Of course, even though capacity is predetermined, the analysis could potentially still suffer from simultaneity bias, due to some combination of higher order autocorrelation in tax policy and slow adjustment in the tax base. However, basically, this type of bias is not conceptually different from the above identification problem of how to separate the incentive effect from other characteristics of jurisdictions and can be dealt with within the current regression discontinuity approach.[9] As we will see below, the results are, in fact, robust against the inclusion of lags among the conditioning variables.

3.2.2 Exploiting the Changes within Regimes

The regression discontinuity approach focuses on the differences in fiscal incentives across regimes, irrespective of whether these reflect temporary variation in fiscal capacity due to some cyclical effects or medium or long-term developments, which represent lasting changes in fiscal conditions. As it seems possible that temporary switches between the regimes may have less clear-cut responses than the above static theory necessarily suggests, we also follow an alternative approach exploiting significant changes in the equalization system over time.

A way to focus on changes of incentives within each of the three regimes is to sweep out the regional effects in equation (10) by means of first differences

$$\begin{aligned} \Delta\tau_{i,t} \;&=\; \beta_1\Delta y_{i,t} \;+\; \beta_2\Delta\vartheta_{i,t} \;+\; \beta_3 S\left(\Delta\gamma_{i,t}\right) \;+\; \beta_4\Delta x_{i,t} \;+\; \phi_t \;+\; \epsilon_{i,t}, \qquad (11) \\ &\quad \text{if } R\left(\gamma_{i,t}\right) \;=\; R\left(\gamma_{i,t-1}\right), \end{aligned}$$

[8] This problem has been encountered in the empirical analysis of incentive effects of taxation on labor supply. For recent surveys see Blundell and MaCurdy (1999), Slemrod (1999), and Triest (1999).

[9] In presence of lagged dependent variables Heckman and Robb (1986: 163) suggest to specify the estimation equation as a reduced form expression of exogenous variables.

where $R(\gamma_{i,t})$ is an index reflecting the classification of the fiscal capacity $\gamma_{i,t}$ as being "low", "medium", or "high". While *per se* being just another transformation, first differencing allows us to focus attention on those observations where there is no regime switch with regard to the previous period. With the condition $R(\gamma_{i,t}) = R(\gamma_{i,t-1})$ we dismiss all observations where a regime switch occurs with regard to the previous period. With this condition most of the remaining variation in incentives arises from policy changes.

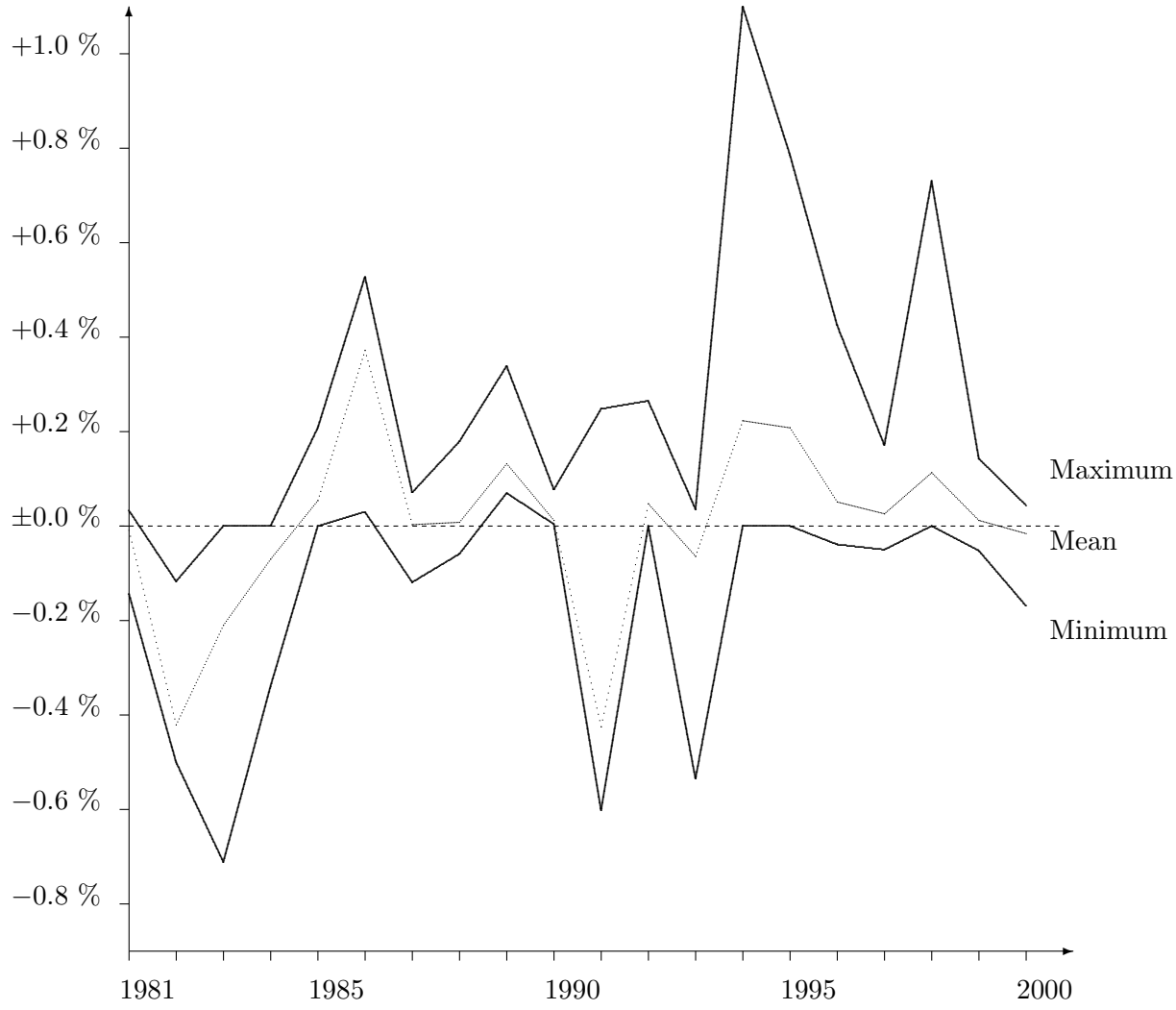
For the sample used below Figure 2 depicts the remaining variation in the marginal contribution rate over time. Evidently, in most periods some municipalities are not at all affected by policy changes, while others experience increases or reductions. But there are also periods where no municipality experiences a reduction or, alternatively, an increase.

4 Data and Specification

The basic dataset consist of the complete set of municipalities in a major German state (Baden-Wuerttemberg). However, many of these municipalities are rather small showing population sizes below 10000 inhabitants (see Appendix). Due to their smallness these jurisdictions are subject to substantial fluctuations in taxing capacity. For several small municipalities even negative tax revenues are reported for individual years reflecting periods where rebates exceed payments. Furthermore, in terms of tax incentives there is a clear distinction between the majority of municipalities which belong to a county on the one hand and independent cities on the other. As there are only few independent cities in the state, it seems reasonable to restrict attention to the sub-sample of 185 municipalities with at least 10000 residents which are associated to a county. Table 2 provides some descriptive statistics.

The basic estimation follows equation (10) and controls for regional and time effects by means of a fixed effects approach which simply conditions on the average distribution. This approach emphasizes the variation of incentives within groups of observations, *i.e.* within observations for a specific jurisdiction. The basic specification includes, first of all, the marginal contribution rate and an indicator of virtual equalization grants. Following the regression discontinuity approach, as the marginal contribution rate and virtual equalization grants are itself depen-

Figure 2: Changes in the Marginal Contribution Rate excl. Regime Changes



Statistics for the subsample of municipalities associated with a county with average population above 10000 and without regime switches w.r. to the previous period, see text.

Table 2: Descriptive Statistics

		Mean	Std Dev	Min	Max
Statutory tax rate	in %	16.29	0.922	14.00	19.75
Statutory tax rate, spatial lag	in %	16.05	0.493	15.00	17.47
Virtual equalization grants	1000 € per cap.	0.587	0.164	0.000	1.031
Marginal contribution rate	in %	12.78	1.325	6.646	15.10
Relative fiscal capacity	in %	0.691	0.144	0.346	1.394
Low relative fiscal capacity	binary	0.172	0.378	0	1
Medium relative fiscal capacity	binary	0.783	0.412	0	1
Grants excl. equalization grants	1000 € per cap.	0.782	0.121	0.386	1.257
Debt service	1000 € per cap.	0.065	0.076	-0.296	0.529
Population	in 1000	21.98	16.04	10.01	102.9
Average population	in 1000	21.98	16.11	8.119	110.5

3885 Observations: 185 cities over 21 years (1980-2000).

dent on relative fiscal capacity we include the latter among the conditioning variables. As it is important to control for possible nonlinearities in the effect of the smooth triggering variable (*e.g.*, Heckman, Lalonde, and Smith, 1999), several alternative specifications are used, including linear, quadratic, and cubic specifications in $\gamma_{i,t}$ as well as linear and quadratic specifications with spline.

Even though the basic estimation equation already takes account of regional and time effects, it seems possible that further differences between jurisdictions obscure the empirical relationship between tax policy and incentives. This refers, first of all, to other unconditional grants which extend the amount of fiscal resources available, irrespective of fiscal equalization grants. We might, therefore, include other unconditional grants explicitly as a conditioning variable. Whereas the theoretical discussion has neglected any intertemporal relations in fiscal policy, the empirical analysis might also take into account that part of revenue is needed to service the current level of debt, which reduces the amount of fiscal resources available for the supply of public services. Thus, further specifications also include the net debt service

as a control variable. Another potentially important intertemporal aspect is the possible dependency on taxing decisions in previous periods. More specifically, one might argue that current tax policy considerations are affected by the level of taxation already enacted, and ask for a partial-adjustment model which includes the lag of the tax rate as a conditioning variable. However, following Heckman and Robb (1986) an alternative to the explicit inclusion of the lagged dependent variables is to specify a reduced form equation employing lags of conditioning variables on the right hand side.

However, we might also want to take account of the fact that tax policy could just differ because of differences in the tax policy of competing jurisdictions. Following standard practice this would suggest to include the tax rates of neighboring jurisdictions. While, certainly, competition is not solely determined by geographic proximity the empirical literature has shown that the latter is an empirically significant dimension of tax competition (see Brueckner, 2003, for an overview). However, simply conditioning on neighbors' tax policy is no viable solution due to the spatial simultaneity bias (Anselin, 1988). In order to avoid the complexities of fitting the resulting highly non-linear model, a simple solution is to condition on spatial lags of other explanatory variables similar as in the case of lags in time, of course, taking account of municipalities which are not included in the current subsample.

Whether or not we use fixed effects or first differences, for purposes of inference it seems important to control for autocorrelation. Since the estimation allows for fixed time and regional effects, some basic cross-sectional and time-series dependence is removed. To take account for additional spatial dependence a heteroskedasticity and spatial-dependence consistent covariance matrix is used following Conley (1999). Additional dependence of residuals across time is taken into account by combining the spatial dependence consistent estimate of the covariance matrix with the autocorrelation consistent estimate suggested by Newey and West (1987).[10]

[10]The estimate of the covariance matrix is given by

$$\mathbf{S} = \sum_{m=0}^{p} \left(1 - \frac{m}{p+1}\right) \mathbf{S}_m,$$

5 Results

Table 3 reports results for specifications using only the three basic variables: virtual equalization grants, marginal contribution rate, and the relative fiscal capacity. Without conditioning on relative fiscal capacity specification (1) shows a significant effect only for the marginal contribution rate. Including relative fiscal capacity also the level of virtual equalization grants shows a significant effect in specification (2). The sign of the effects is in accordance with the theoretical expectations as the marginal contribution rate is associated with a higher tax rate whereas the level of virtual equalization grants is associated with a lower tax rate. Relative fiscal capacity shows a negative effect, suggesting that a relatively large endowment with fiscal resources is associated with lower taxes. Columns (3) to (6) add various nonlinear terms in relative fiscal capacity. According to the adjusted R-squared the nonlinear specifications show a slightly better fit, although the coefficients on the non-linear terms are less precisely estimated. Note that the table reports standard errors which are robust against heteroskedasticity and autocorrelation across time and space. The best fit is found for the quadratic spline specification (6). With non-linear terms of relative fiscal capacity included the absolute size of the effect of both the marginal contribution rate as well as the level of virtual equalization grants is higher than in the linear specification. The results point to a substantial incentive effect of fiscal equalization: specification (6) suggests that an increase in the marginal contribution rate by 1 % point is associated with an increase in the tax rate by about 0.20 % points.

Table 4 provides results where not only the basic variables but also two further conditioning variables are employed: the level of other grants received, as well as the level of (net) debt

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where p is the maximum lag length and

$$\mathbf{S}_m = (1/NT) \sum_t \sum_i \sum_j 0.5K(i,j) \left[\mathbf{z}_{i,t} \hat{u}_{i,t} \hat{u}_{j,t-m} \mathbf{z}'_{j,t-m} + \mathbf{z}_{j,t-m} \hat{u}_{j,t-m} \hat{u}_{i,t} \mathbf{z}'_{i,t} \right],$$

where N is the number of observations, T is the number of periods, $\hat{u}_{i,t}$ is the first-step estimate of the residual, and $\mathbf{z}_{i,t}$ is the vector of instruments. Following Conley (1999) $K(i,j)$ is a two-dimensional Bartlett kernel defined over a regular lattice field with a distinct address for each of the N jurisdictions. For $K(i,j) = 0$ if $j \neq i$ the covariance matrix follows Newey and West (1987). Conversely, for $p = 0$ the covariance matrix follows Conley (1999). The analysis set the spatial kernel such that the extension in each direction is about 30km (18.65 miles), p is set to 3.

Table 3: Basic Regression Results (Dep. Variable: Tax Rate)

Variable \ Specification	(1)	(2)	(3)	(4)	(5)	(6)
Virtual equal. grants	-.228	-.463 ⋆	-.698 ⋆	-.676 ⋆	-1.09 ⋆	-.939 ⋆
	(.202)	(.214)	(.235)	(.235)	(.289)	(.292)
Marginal contribution rate	.056 ⋆	.056 ⋆	.067 ⋆	.064 ⋆	.164 ⋆	.204 ⋆
	(.022)	(.022)	(.023)	(.023)	(.057)	(.070)
Rel. fiscal capacity		-.545 ⋆	1.82	-.944	-.670 ⋆	1.46
		(.190)	(.747)	(3.04)	(.270)	(1.23)
Rel. fiscal capacity, squared			-1.59 ⋆	1.87		-1.37 ⋆
			(.490)	(3.76)		(.694)
Rel. fiscal capacity, cubed				-1.38		
				(1.50)		
Rel. fiscal capacity × low capacity					-.573	-2.08
					(.447)	(1.77)
Rel. fiscal capacity × med. capacity					-.033	-1.07
					(.251)	(.963)
Rel. fiscal capacity, sq. × low capacity						1.28
						(1.95)
Rel. fiscal capacity, sq. × med. capacity						.681
						(.793)
Sample size				3885		
Mean of dep. var.				16.3		
R^2 (adjusted)	.8057	.8067	.8078	.8078	.8100	.8103

All specifications include time- and region-specific fixed effects. Heteroskedasticity, time as well as spatial dependence robust standard errors in parentheses. If significant at the 10 % level coefficients are marked with a star.

Table 4: Regression Results with Conditioning Variables (Dep. Variable: Tax Rate)

Variable \ Specification	(1)	(2)	(3)	(4)	(5)	(6)
Virtual equal. grants	-.142	-.347 ⋆	-.580 ⋆	-.547 ⋆	-.953 ⋆	-.823 ⋆
	(.195)	(.204)	(.231)	(.234)	(.293)	(.297)
Marginal contribution rate	.046 ⋆	.042 ⋆	.055 ⋆	.051 ⋆	.166 ⋆	.207 ⋆
	(.021)	(.021)	(.022)	(.023)	(.055)	(.068)
Rel. fiscal capacity		-.635 ⋆	1.25	-1.58	-.594 ⋆	1.18
		(.194)	(.774)	(3.12)	(.267)	(1.23)
Rel. fiscal capacity, squared			-1.25 ⋆	2.28		-1.17 ⋆
			(.504)	(3.83)		(.700)
Rel. fiscal capacity, cubed				-1.40		
				(1.52)		
Rel. fiscal capacity × low capacity					-.717	-2.50
					(.450)	(1.75)
Rel. fiscal capacity × med. capacity					-.136	-1.21
					(.256)	(.962)
Rel. fiscal capacity, sq. × low capacity						1.76
						(1.92)
Rel. fiscal capacity, sq. × med. capacity						.747
						(.780)
Other grants	.133	.367	.155	.188	.030	.023
	(.267)	(.285)	(.291)	(.269)	(.300)	(.299)
Debt service	1.68 ⋆	1.68 ⋆	1.65 ⋆	1.64 ⋆	1.68 ⋆	1.67 ⋆
	(.270)	(.270)	(.269)	(.269)	(.264)	(.263)
Sample size			3885			
Mean of dep. var.			16.3			
R^2 (adjusted)	.8110	.8122	.8128	.8129	.8152	.8154

All specifications include time- and region-specific fixed effects. Heteroskedasticity, time as well as spatial dependence robust standard errors in parentheses. If significant at the 10 % level coefficients are marked with a star.

Table 5: Regression Results with Lags in Time (Dep. Variable: Tax Rate)

Variable \ Specification	(1)	(2)	(3)	(4)	(5)	(6)
Virtual equal. grants	-.076	-.244	-.526 ⋆	-.558 ⋆	-.832 ⋆	-.701 ⋆
	(.191)	(.198)	(.234)	(.228)	(.304)	(.310)
Marginal contribution rate	.040 ⋆	.036 ⋆	.052 ⋆	.053 ⋆	.151 ⋆	.206 ⋆
	(.021)	(.021)	(.023)	(.023)	(.052)	(.065)
Rel. fiscal capacity	no	linear	squared	cubed	linear spline	cubed spline
Sample size	3700					
Mean of dep. var.	16.3					
R^2 (adjusted)	.8164	.8172	.8178	.8180	.8193	.8198

All specifications include time- and region-specific fixed effects as well as current and lagged values of relative fiscal capacity, debt service, and other grants. Relative fiscal capacity entered as indicated. Heteroskedasticity, time as well as spatial dependence robust standard errors in parentheses. If significant at the 10 % level coefficients are marked with a star.

service. Whereas the debt service proves significant throughout all specifications, indicating that tax rates tend to be higher if the debt burden is higher, all the other results show only small changes as compared to Table 3.

Table 5 provide results of specifications which additionally condition on lagged control variables. Table 6 additionally includes spatial averages of conditioning variables. As in the basic estimations, the effects of the marginal contribution rate and the level of virtual equalization grants increase in absolute value if nonlinear terms of the relative fiscal capacity are employed. In case of Table 6 it seems that the coefficients for the incentives are somewhat smaller in absolut terms, however, the difference to previous results is below the standard error. Thus, the results conditioning on lags and spatial averages support rather than question the previous estimates both in qualitative and quantitative respects.

While the results clearly support the theoretical predictions, qualitatively, with regard to the actual size of coefficients there is some uncertainty, since the inclusion of non-linear terms in the relative fiscal capacity has been found to exert a strong effect on the size of coefficients. This may reflect the difficulty to distinguish between temporary fluctuations and permanent changes in fiscal capacity. As we have discussed above, the alternative approach focusing

Table 6: Regression Results with Lags in Time and Lags in Space (Dep. Variable: Tax Rate)

Variable \ Specification	(1)	(2)	(3)	(4)	(5)	(6)
Virtual equal. grants	-.087	-.258	-.537 ⋆	-.527 ⋆	-.827 ⋆	-.669 ⋆
	(.190)	(.196)	(.225)	(.226)	(.292)	(.063)
Marginal contribution rate	.039 ⋆	.036 ⋆	.053 ⋆	.050 ⋆	.130 ⋆	.175 ⋆
	(.020)	(.020)	(.022)	(.022)	(.051)	(.063)
Rel. fiscal capacity	no	linear	squared	cubed	linear spline	cubed spline
Sample size			3700			
Mean of dep. var.			16.3			
R^2 (adjusted)	.8179	.8189	.8200	.8210	.8234	.8243

All specifications include time- and region-specific fixed effects as well as current and lagged values and spatial averages of relative fiscal capacity, debt service, and other grants. Relative fiscal capacity entered as indicated. Heteroskedasticity, time as well as spatial dependence robust standard errors in parentheses. If significant at the 10 % level coefficients are marked with a star.

on changes in the rules of the system should be less affected by temporary switches. Table 7 reports the results. To facilitate comparisons, the set of control variables used in the estimations is the same as in Table 3. In difference to the results obtained from the fixed effects approach, both the marginal contribution rate as well as the level of virtual grants show rather stable results across specifications. The coefficient for the marginal contribution rate is remarkably close to the above figure of 0.20. As above, virtual equalization grants have a significant negative impact, but the absolute size of the coefficient is much lower than above. As depicted in Table 8, the inclusion of further control variables does not affect the results.

6 Summary and Conclusion

Extending the standard model of tax competition we have seen that fiscal equalization transfers exert an incentive effect on the taxing effort of local jurisdictions. With some restrictive assumptions, in particular with regard to the government's objective function, a higher marginal contribution rate, *i.e.* the rate at which an increase in the tax base is reducing those transfers, is associated with a higher tax rate. The amount of virtual grants, *i.e.* equal-

Table 7: Results for First Differences (Dep. Variable: Tax Rate)

Variable \ Specification	(1)	(2)	(3)	(4)	(5)	(6)
Virtual equal. grants	-.273 ⋆	-.281 ⋆	-.272 ⋆	-.270 ⋆	-.280 ⋆	-.274 ⋆
	(.123)	(.123)	(.123)	(.123)	(.120)	(.123)
Marginal contribution rate	.202 ⋆	.203 ⋆	.208 ⋆	.206 ⋆	.207 ⋆	.210 ⋆
	(.093)	(.093)	(.092)	(.092)	(.058)	(.094)
Rel. fiscal capacity		-.023	.236	1.71	.050	3.46
		(.081)	(.348)	(1.57)	(.210)	(4.23)
Rel. fiscal capacity, squared			.161 ⋆	-1.91		-1.47 ⋆
			(.217)	(1.81)		(1.81)
Rel. fiscal capacity, cubed				.657		
				(.661)		
Rel. fiscal capacity × low capacity					.554	-5.28
					(.445)	(5.90)
Rel. fiscal capacity × med. capacity					-.111	-2.73
					(.226)	(4.25)
Rel. fiscal capacity, sq. × low capacity						3.79
						(4.49)
Rel. fiscal capacity, sq. × med. capacity						.941
						(1.86)
Sample size				3228		
Mean of dep. var.				.070		
R^2 (adjusted)	.0330	.0327	.0326	.0325	.0330	.0327

All specifications include time-specific fixed effects. Heteroskedasticity, time as well as spatial dependence robust standard errors in parentheses. If significant at the 10 % level coefficients are marked with a star. Observations where the status as having "low", "medium", or "high" fiscal capacity has changed relative to the previous period are dismissed.

Table 8: Results for First Differences with Conditioning Variables (Dep. Variable: Tax Rate)

Variable \ Specification	(1)	(2)	(3)	(4)	(5)	(6)
Virtual equal. grants	-.283 ⋆	-.291 ⋆	-.281 ⋆	-.280 ⋆	-.288 ⋆	-.282 ⋆
	(.130)	(.127)	(.127)	(.127)	(.127)	(.126)
Marginal contribution rate	.204 ⋆	.205 ⋆	.210 ⋆	.209 ⋆	.209 ⋆	.212 ⋆
	(.092)	(.093)	(.092)	(.092)	(.092)	(.093)
Rel. fiscal capacity		-.022	.270	1.79	.040	3.55
		(.081)	(.345)	(1.58)	(.199)	(4.19)
Rel. fiscal capacity, squared			-.182 ⋆	-1.99		-1.51
			(.216)	(1.82)		(1.80)
Rel. fiscal capacity, cubed				.678		
				(.667)		
Rel. fiscal capacity × low capacity					.574	-5.24
					(.438)	(5.83)
Rel. fiscal capacity × med. capacity					-.099	-2.75
					(.206)	(4.21)
Rel. fiscal capacity, sq. × low capacity						3.72
						(4.43)
Rel. fiscal capacity, sq. × med. capacity						.946
						(1.85)
Other grants	-.041	-.039	-.042	-.047	-.031	-.037
	(.156)	(.156)	(.156)	(.156)	(.151)	(.151)
Debt service	.408 ⋆	.408 ⋆	.413 ⋆	.414 ⋆	.410 ⋆	.417 ⋆
	(.180)	(.180)	(.180)	(.179)	(.179)	(.179)
Sample size			3228			
Mean of dep. var.			.070			
R^2 (adjusted)	.0341	.0338	.0337	.0337	.0341	.0339

All specifications include time-specific fixed effects. Heteroskedasticity, time as well as spatial dependence robust standard errors in parentheses. If significant at the 10 % level coefficients are marked with a star. Observations where the status as having "low", "medium", or "high" fiscal capacity has changed relative to the previous period are dismissed.

ization grants received if the tax base were zero, exerts an inverse impact on taxing effort. Furthermore, the analysis points to an impact of other determinants, such as the tax policy of competing jurisdictions or the preferences for public services.

The theoretical results about the incentive effect of fiscal equalization have been tested in an empirical investigation based on a large panel of German municipalities. The data allow us to analyze directly the impact on the tax rate. A special advantage of the dataset is that the incentives vary across subregions (counties) as well as across the time period covered by the data allowing to pursue different identification strategies and to compare their results. The first approach taken in the paper exploits the fact that incentives are discontinuous functions of relative fiscal capacity by means of regression discontinuity estimation techniques. More specifically, we can distinguish three regimes of fiscal equalization, which introduce discontinuous changes in the marginal contribution rate and virtual equalization grants as relative taxing capacity is gradually increasing. Thus, at the threshold levels of taxing capacity even a tiny change in relative fiscal capacity results in strongly different incentives. The second approach exploits the variation of incentives due to changes in the system over time.

Regardless of the identification approach taken, the empirical results support the predictions of the theoretical analysis, qualitatively. In particular, the marginal contribution rate is found to exert a significant positive impact on the local tax rate whereas the volume of grants received is inversely associated with taxing effort. With regard to the quantitative impact the coefficients in the basic fixed effects regression are sensitive to the inclusion of nonlinear terms in fiscal capacity. Considering the specifications with the best fit the estimated impact of incentives suggests that an increase in the marginal contribution rate by one percentage point induces municipalities to raise their tax rate by up to 0.2 percentage points. The impact of virtual grants is much weaker, indicating that an increase in the amount of virtual grants by as much as 1000 € per capita tends to reduce the tax rate by 0.9 to 1 percentage points. Despite of the sensitivity with regard to the inclusion of nonlinear terms, these results are robust against the inclusion of further conditioning variables such as other grants and debt service, and also show up in specifications employing lags in time as well as in space.

While the results from the first approach are sensitive with regard to the inclusion of nonlinear

terms in fiscal capacity, the alternative approach which neglects regime shifts and focuses on the impact of a variation in the incentives due to changes in the rules over time, again yields a coefficient around 0.2 for the marginal contribution rate. However, for the level of virtual grants much smaller effects are found, suggesting that an increase of virtual grants by 1000 € causes a reduction in tax rates by about 0.3 percentage points. An impression of the magnitude of the effects is obtained when considering that the implied tax rate increase at the sample average of contribution rate (12.8 %) is about 2.6 %. The net effect calculated at the sample average of virtual grants (587 €) is around 2.4 %.

While the results point to a significant incentive effect of fiscal equalization transfers, the implications for welfare are not obvious. It could possibly be that the incentives created by the system of fiscal equalization are actually restoring a first-best optimum. But if externalities from tax competition are weak, and if there are important inefficiencies within the public sector, the fiscal equalization system is likely to induce jurisdictions to set tax rates too high. One possible route to tackle this difficult question in future research is to ask whether state level policies have the right incentives to internally optimize their system of fiscal equalization or whether they pursue alternative objectives.

Data Sources and Definitions

The basic dataset consists of all 1111 municipalities (*Gemeinden*) of the state of Baden-Wuerttemberg. The municipalities build the lowest of the fiscal tiers, forming 44 districts, i.e. 35 counties (*Kreise*) and 9 independent cities (*Kreisfreie Städte*). The municipalities show marked differences in size with average population ranging from 100 to more than 500,000 residents.

With the exception of the price index all data are obtained from the state's statistical office (*Statistisches Landesamt*).

The **statutory tax rate** of the business tax (*Gewerbesteuer*) is calculated applying the base

Table 9: Size Distribution of Municipalities

Population size in 1.000		<1	1-2	2-5	5-10	10-20	20-50	50-100	>100
No. of munic.	N=1111	94	136	416	245	135	63	13	9

Based on average population figures 1980-2000.

tax of 0.05 to the collection rates (*Hebesätze*) for the years (*Rechnungsjahre*) 1980-2000.

Marginal contribution rates are obtained from a full implementation of the fiscal equalization law and further relevant statutory definitions for each year in the period 1980-2000. State specific rules are obtained from the "Gesetzblatt fuer Baden-Wuerttemberg" issued by the Ministry of State (*Staatsministerium fuer Baden-Wuerttemberg*). Data for taxing capacity (*Steuerkraft*) and fiscal capacity (*Steuerkraftsumme*) are obtained from the state's statistical office. Fiscal need is explicitly calculated from the official population figures according to the equalization law. Further specific additions with regard to the number of students and military personnel etc. are neglected. The base amount of fiscal need per (modified) resident (*Grundkopfbetrag*) is obtained from the state's ministry of finance. A comparison with available figures for fiscal need in 2000 shows an accordance of 99 %.

Virtual equalization grants give the amount of equalization grants the considered municipality would receive if it would have a zero tax base under its current equalization regime.

Other grants excluding fiscal equalization grants include revenue sharing grants related to the distribution of statewide income tax revenues (*Gemeindeanteil an der Einkommensteuer*) as well as specific non-matching grants independent of the tax base (*Zuschuesse fuer laufende Zwecke*) as reported in the annual budgetary statistics (*Jahresrechnungsstatistik*).

The **tax base** is calculated from the total revenues of the business tax (*Gewerbesteueraufkommen, brutto*) as reported in the annual budgetary statistics. It is obtained via dividing tax revenues by the statutory tax rate.

Debt service is defined as annual interest expenses net of interest income according to the annual budgetary statistic.

The **price index** used is the price index for public consumption for West Germany (source: Council of Economic Experts).

Annual population is the average of quarterly figures based on census data and official projections using resident registration information.

Spatial weighting matrix: Euclidian distances are computed from a digital map of the geographical position of the administrative center of each municipality. The matrix employed in the estimations presented defines neighbors as municipalities located within a distance of 30 kilometers (18.65 miles). A simple binary weighting scheme is used. The matrix is row standardized.

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