# Is Your Neighbor's Policy Affecting Your Tax Base? A Quantification of Local Fiscal Externalities

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**Abstract:**

The paper explores the significance and magnitude of horizontal fiscal externalities in presence of capital mobility. Using a panel of more than thousand jurisdictions the impact of the own and the neighbors' tax rates and expenditures on the local tax base is estimated by means of instrumental variable techniques. The results confirm the theoretical predictions, as an increase of the tax rate in the neighborhood is found to have a large and significant positive effect on the local tax base, if the local policies are unchanged. However, if the own tax rate is increased jointly with the neighborhood no significant impact on the tax base is found.

**Keywords**: Business Tax (Gewerbesteuer), Empirical Study, Generalized Method of Moments, Fiscal Externalities, Local Public Finance, Panel Data

**JEL-Codes**: H71,H72,H73,C23,D62

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# 1 Introduction

It is well known from the literature on interregional tax competition that decentralized taxation may cause distortions if mobile factors respond to tax rate differentials by interregional movements. Whereas the theoretical literature has already explored the conditions under which inefficiencies arise, normative judgements and policy recommendations are still difficult to derive. One obstacle is the lack of empirical results on the magnitude of the distortions (e.g., Oates, 1999). Based on the notion that fiscally induced factor movements constitute fiscal externalities Wildasin (1989) has provided a framework which allows to assess the welfare effects if the quantitative response of the mobile factor to tax rate differences is known.

Yet, the empirical research faces large difficulties when establishing and quantifying the effects of the corresponding tax incentives. On the international level there are substantial difficulties of measuring factor movements and of comparing the fiscal incentives provided by the highly complex national tax systems. Given the difficulties of cross-country investigations it is helpful to study effects of local tax differentials in federal countries. This combines a rich experience with tax policy of highly open jurisdictions with comparable institutions, tax codes, and data.

Several studies have already established some kind of local tax competition by observing significant comovements of tax burdens or tax rates (e.g., Ladd, 1992, Brett / Pinske, 1995, Büttner, 2000a). However, as long as fiscal externalities are not quantified directly it is not always clear whether comovements in taxing decisions are an implication of the externalities or of some kind of mimicking neighbors's policies in what has been denoted as *yardstick competition* (Besley / Case, 1995).

The present study provides an empirical test of fiscal neighborhood externalities of local policies in a context of local capital income taxation. It employs a panel of local jurisdictions in Germany reporting local tax rates and the tax base, which allows to directly estimate the horizontal fiscal externalities. In order to allow for various types of non-stationarity the empirical approach employs a quasi-differencing procedure as suggested by Holtz-Eakin et al. (1988). The results indicate large and significant positive externalities of taxing decisions of local neighbors.

The following section discusses the impact of the local tax rate on the tax base in a theoretical model with interregional factor mobility, factor taxation, exogenous revenues, and productive public expenditures (cf. Haughwout et al., 1999). It derives a testable relationship between the tax base and the tax rates in the considered jurisdiction as well as in the local neighborhood. After a brief description of some relevant institutional characteristics of the tax under investigation, the empirical section develops a reasonable specification of this relationship along the lines of dynamic panel data modelling techniques and applies this to the data. After having presented the results, the paper ends with a short summary pointing out open questions for future research.

## 2 Theoretical view: fiscal impacts on the tax base

Consider a standard local economy with two factors. One is assumed mobile, say capital, the other, labor, is immobile. The local economy produces a single good according to the production function,

$$y = g(e) f(k), \tag{1}$$

where $y$ denotes output per worker and $k$ denotes the capital intensity. $f$ is a standard homogeneous production function and $g$ is a neutral productivity shift term capturing the impact of public expenditures $e$, also expressed in units per worker.

On the revenue side of the local governments' budget constraint we distinguish tax revenues and exogenous revenues, say grants, formally

$$e = tb + z, \tag{2}$$

where $z$ denotes grants per worker, $b$ denotes the tax base per capita, and $t$ is the tax rate. As the considered tax is a source based tax on capital income, the base is defined by

$$b = g(e) f'(k) k. \tag{3}$$

Assuming a static setting the budget is always balanced and no deficit and surplus can be run by the local government.

The mobility of capital introduces an additional constraint to the local economy as it requires that the after tax rate of return is not different from any opportunity location. If region $j$ belongs to the set of opportunity locations of region $i$ this can be stated by the condition

$$(1 - t_i) g(e_i) f'(k_i) \stackrel{!}{=} (1 - t_j) g(e_j) f'(k_j), \tag{4}$$

requiring that the net marginal revenue of capital is equalized across locations. This condition plays a central role in the discussions about tax competition, as it links the allocation of capital captured by $k_i, k_j$ with the local fiscal policies described by the tax rates $t_i, t_j$ and the supply of public goods $e_i, e_j$.

The standard mechanism works as follows. Consider the special case where public goods have no impact on productivity, i.e. $g(e) = 1$. Then the increase of the tax rate at location $i$ will reduce the after tax rate of return at $i$, ceteris paribus. In order to reinstall interregional equilibrium, equation (4) suggests that capital moves out of location $i$ until the marginal productivity of capital is high enough to compensate the higher taxation. The partial impact of public goods can be illustrated best in the opposite case, where public expenditures are productive and are totally financed out of grants so that the tax rate is zero. Then an increase in the grants received will cause an increase in the public good supply, and thereby increase the marginal revenue, ceteris paribus. Condition (4) then requires an inflow of capital in region $i$ until the marginal productivity is reduced sufficiently in order to compensate higher productivity.

This simple mechanism will, however, generate fiscal externalities, if the movements of capital out of and into location $i$ affect the capital supply at location $j$. This becomes most obvious, if we consider a case of only two locations, where the total supply of capital is fixed. Because then, $k_j$ is fully determined by $k_i$ according to the full employment condition

$$k_i l_i + k_j l_j = k, \qquad l_i + l_j = 1 \tag{5}$$

where $k$ is the given overall capital supply per worker and $l_i$ is the number of workers located at $i$. In this setting an increase of the tax rate at location $i$ will cause an outflow of capital at location $i$ and, simultaneously, an inflow of capital at location $j$. Similarly, an increase in grants to location $i$ will induce capital movements from $j$ to $i$. In case of the local capital taxation, the movement of capital in response to the fiscal location conditions implies changes in the local tax base and thereby causes fiscal externalities.

In order to derive a formal expression for the impact of the fiscal parameters on the local tax base of a location we differentiate the equation for the tax base (3) taking account of the budget constraint (2), yielding

$$\hat{b}_i = \left(\frac{1-\varphi_i}{1-\gamma_i}\right)\hat{k}_i + \left(\frac{\gamma_i}{1-\gamma_i}\right)\hat{t}_i + \left(\frac{\gamma_i}{1-\gamma_i}\frac{z_i}{e_i}\right)\hat{z}_i. \tag{6}$$

$$\varphi_i \equiv -\frac{f''(k_i)\,k_i}{f'(k_i)} > 0,$$

$$\gamma_i \equiv -\frac{g'(e_i)\,e_i}{g(e_i)} > 0,$$

which makes use of the "hat" notation for relative changes. $\varphi_i$ represents the elasticity of the marginal productivity of capital, and $\gamma_i$ represents the elasticity of productivity with respect to public spending, which are both required to be greater than zero and less than unity. The expression indicates that the tax base is increasing with the stock of capital installed locally. If public expenditures exert an impact on productivity there are also direct positive effects of the tax rate and of the level of grants received.

The impact of the fiscal parameters on the local stock of capital is formally obtained by total differentiation of equation (4), taking into account that the local economy at both locations is described by the system (2), (3), and (5). After some reformulations we obtain

$$\begin{aligned}\left[\frac{\varphi_i-\gamma_i}{1-\gamma_i} + \frac{\varphi_j-\gamma_j}{1-\gamma_j}\frac{k_i l_i}{k_j l_j}\right]\hat{k}_i &= -\left[\left(\frac{t_i}{1-t_i}\right) - \left(\frac{\gamma_i}{1-\gamma_i}\right)\right]\hat{t}_i \\ &+ \left[\left(\frac{t_j}{1-t_j}\right) - \left(\frac{\gamma_j}{1-\gamma_j}\right)\right]\hat{t}_j \\ &+ \left(\frac{\gamma_i}{1-\gamma_i}\frac{z_i}{e_i}\right)\hat{z}_i - \left(\frac{\gamma_j}{1-\gamma_j}\frac{z_j}{e_j}\right)\hat{z}_j.\end{aligned} \tag{7}$$

The bracket on the left hand side is positive if the elasticity of the total factor productivity with respect to public expenditures is smaller than the elasticity of the marginal productivity of capital:

$$\varphi_i > \gamma_i, \varphi_j > \gamma_j.$$

This requirement ensures that the increasing returns introduced by the productivity impact of public expenditures is dominated by the decreasing returns from holding constant the immobile factor. This is a standard assumption in models with increasing returns in order to ensure the determinateness of the locational equilibrium (e.g., Henderson, 1985). The impact of an increase in the local tax rate on the local stock of capital is negative, if the local tax rate is set higher than the elasticity of the total factor productivity with respect to public expenditures, $t_i > \gamma_i$. Obviously a tax rate $t_i$ equal to $\gamma_i$ would maximize the local supply of capital. Yet, in the presence of productive effects of public expenditures it is not rational for a government to maximize the local supply of capital. Even, if it aims at maximizing the value of local production it would set a tax rate higher than $\gamma_i$, because of the direct beneficial effect of additional public expenditures on total factor productivity. Thus, expression (7) together with the equation for the change in the tax base (6) indicates that we should expect a negative impact of the own tax rate.

Irrespective of the existence of productivity effects we should observe a positive impact of the other location's tax rate on the tax base via an increase in the local capital supply $k_i$, i.e. a positive fiscal neighborhood externality. In addition, we expect grants to the own location to be positively related to the tax base, but grants to the other location to reduce it. The influence of grants to the other location is, however, not a standard fiscal externality, as it is not the consequence of a decision of the other locations' governments.

## 3 Empirical study of fiscal externalities

The empirical investigation provides an estimate of the relationship between the tax base, the tax rates, and the exogenous revenues as derived above. It employs a large panel of local communities in a major German state. Whereas the German system of fiscal federalism mainly relies on a system of grants and tax sharing and because it limits taxing discretion at the local level, the current study focuses on the business tax which is the important exception. The following subsection starts with a short description of the relevant characteristics of this tax, before the discussion turns to issues of specification and results.

### 3.1 The German business tax

In the period of our investigation German business taxation consisted of two taxes, one levied on business earnings the other levied on business property. The local communities determine the actual tax rates by choosing a *collection* *rate* which is a factor applied to basic tax rates of 5 % on earnings and 0.2 % on property. Accordingly the revenues are determined by a function

$$c_i B_i = c_i \left(0.05 E_i + 0.002 P_i\right), \tag{8}$$

where $B_i$ denotes the tax base determined by the business earnings $E_i$ and property $P_i$, and the collection rate $c_i$. Since the tax rates are fixed up to a common factor, the relative weight of earnings and property in the tax base is constant. Conditional on the definition of taxable earnings and taxable property in the tax code we can say that the tax on earnings constitutes the main part of the business tax, the tax on property is much less important.[2]

With a median collection rate of $c_i = 3.3$ in 1996 the tax rate on business earnings determined by the local collection rate seems to be quite substantial yielding a nominal figure of 16.5 %. But, because the payments of the business tax rate are deductible with respect to business taxation itself as well as to personal and corporate income taxation, however, the effective tax rate is lower. With $t$ denoting the rate of income taxation, the overall effective tax rate on business earnings can be computed as

$$t_i^e = t_i^l \left(1 - t\right) + t, \qquad \text{where:} \quad t_i^l = \frac{c_i 0.05}{1 + c_i 0.05},$$

where $t_i^l$ denotes the local tax rate on business earnings and $t_i^e$ denotes the overall effective tax rate. The latter varies with the income tax rate $t$ depending on the characteristics of the tax payer.[3]

The current investigation, however, does not deal with the impact of the overall effective tax rate as such but focuses on the role of interjurisdictional differences. In order to measure tax induced horizontal differences we evaluate the arbitrage condition (4) at different locations and focus on the ratio of net and gross returns determined by:

$$1 - t_i^e \quad = \quad \left(1 - t\right)\left(1 - t_i^l\right).$$

As the income tax rate $t$ is independent of the location of investment it shows the same effect on the after tax rate of return across locations and the first

[2] In 1995 about 12.6 % of total revenues from the business tax were attributed to the tax on business property (Statistisches Jahrbuch, 1999: 529).

[3] If the tax payer is a corporation the resulting median effective tax rate in 1996 on retained earnings, is 7.3 %, calculated using the corporation tax rate of 48.4 % (including the unification levy ( "Solidaritätszuschlag"). The 1996 figure for the private German tax payer with the top rate is quite similar.

term at the right-hand side drops out of the arbitrage condition. Thus, what matters for location decisions is the wedge driven by the local tax rate $t_i^l$ between pre-tax and after-tax return. In other words, it is the additional reduction of the net rate of return relative to the reduction caused by the income tax, which determines the location decisions.[4]

## 3.2 Dataset

The dataset consists of 1110 communities in the state of Baden-Württemberg.[5] Table 1 presents descriptive statistics. The per capita tax base is computed from the reported revenues (see appendix). It displays market variation, ranging from more than 30,000 DM per capita to figures below zero. The negative figures related to the minimum result from the fact that current tax payments are payments in advance based on the previous year's tax declarations and payments resulting from revisions of previous tax payments. As repayments are often substantial, the revenue series displays strong fluctuations.[6] The variation of local tax rates is quite large. For instance, in 1996 tax rates from 12.7 % to 18.2 % are reported. Note that this local tax rate is applied to the earnings after the income tax, and, thus the effective tax rate is roughly half of the figures listed in the table (see above).

## 3.3 Estimation approach and specification issues

A basic difficulty to identify and estimate the influence of determinants of the business tax is the slow response of the tax base to changes in the fiscal parameters combined with a high volatility of the tax base. In addition, the reported tax payments which are used to calculate the tax base are not strictly related to a certain period as they consist of payments in advance and revisions. Ex-post revision of tax obligations often lead to substantial repayments. A full representation of this complicated dynamic process seems difficult given a dataset with observations for only 17 years.

[4] If cost of mobility were taken into account the income tax rate would not drop out of the arbitrage condition. In this case, the income tax rate constitutes a barrier to mobility as it is after tax earnings which have to exceed mobility costs in order to trigger relocation.

[5] From the full set of communities the community of Blaubeuren was removed, see appendix.

[6] The magnitude of fluctuations is seen as a major shortcoming of the business tax in the German discussion.

Table 1: Descriptive Statistics

| | Tax Base per Capita | | | Exog. Rev. per Capita | | | Tax Rate | | |
|---|---|---|---|---|---|---|---|---|---|
| year | mean | min | max | mean | min | max | mean | min | max |
| 1980 | 3,151 | -0,161 | 33,035 | 0,740 | 0,191 | 1,917 | 13.5 | 12.3 | 16.5 |
| 1981 | 2,859 | -0,395 | 29,739 | 0,691 | 0,176 | 1,612 | 13.5 | 12.3 | 16.5 |
| 1982 | 2,576 | -0,459 | 29,657 | 0,678 | 0,193 | 1,658 | 13.5 | 12.3 | 16.5 |
| 1983 | 2,440 | -0,162 | 30,699 | 0,684 | 0,206 | 1,639 | 13.6 | 12.3 | 16.5 |
| 1984 | 2,503 | -0,548 | 34,538 | 0,702 | 0,271 | 1,475 | 13.6 | 12.3 | 16.5 |
| 1985 | 2,545 | -0,180 | 37,764 | 0,765 | 0,253 | 1,768 | 13.6 | 12.5 | 16.5 |
| 1986 | 2,876 | -0,267 | 49,253 | 0,839 | 0,351 | 1,888 | 13.6 | 12.5 | 16.7 |
| 1987 | 3,068 | -1,880 | 51,823 | 0,905 | 0,376 | 2,216 | 13.6 | 12.5 | 16.7 |
| 1988 | 3,140 | -0,289 | 41,165 | 0,924 | 0,114 | 2,361 | 13.6 | 12.5 | 16.7 |
| 1989 | 3,344 | -0,488 | 49,333 | 0,977 | 0,296 | 2,627 | 13.7 | 12.7 | 17.1 |
| 1990 | 3,438 | -0,378 | 45,118 | 0,907 | 0,353 | 2,534 | 13.7 | 12.7 | 17.1 |
| 1991 | 3,393 | -0,262 | 46,495 | 1,005 | 0,356 | 2,655 | 13.7 | 12.7 | 17.7 |
| 1992 | 3,441 | -3,866 | 31,699 | 1,020 | 0,445 | 2,487 | 13.8 | 12.7 | 17.7 |
| 1993 | 3,220 | -0,417 | 55,218 | 0,999 | 0,416 | 2,082 | 13.9 | 12.7 | 17.7 |
| 1994 | 3,123 | -4,017 | 39,455 | 0,945 | 0,284 | 2,024 | 14.0 | 12.7 | 17.7 |
| 1995 | 2,821 | -2,552 | 29,648 | 0,927 | 0,257 | 1,581 | 14.2 | 12.7 | 18.2 |
| 1996 | 3,003 | -1,433 | 42,050 | 0,927 | 0,273 | 1,527 | 14.2 | 12.7 | 18.2 |
| av. | 2.996 | | | | | | 13.7 | | |

Tax base and exogeneous revenues in DM per capita in prices of 1996. Own computations for 1110 communities in the state of Baden–Württemberg.

However, the recent literature on panel data estimation has developed procedures aimed at improving the quality of the empirical representation of dynamic processes by exploiting the cross-sectional dimension of the data. But, with panel data we have to face an additional difficulty arising from unobserved heterogeneity, and it may be wrong to simply pool the observations. As is standard in panel data analysis we take account of regional effects which – in the current context – pick up the given locational characteristics determining the attractiveness as a business location. Yet, it is not obvious that the regional pattern of attractiveness is constant. For instance, the ongoing process of European Integration may constantly work in favor of border regions. And, since suburbanization is also observed in Germany (cf. Seitz, 1996), the locational attractiveness of cities is possibly reducing during the period under investigation. Besides difficulties to impose constant regional effects a-priori it seems difficult to assume constant parameters anyway, since the tax base of the business tax fluctuates strongly. As the tax rates display a rather gradual trend this suggests to allow the effect of the tax rate to vary across periods.

Given these challenges to specification, it seems appropriate to follow the suggestions by Holtz-Eakin, Newey, and Rosen (1988) which build up a general framework relying on a quasi-differencing procedure of Chamberlain (1983). Accordingly it is assumed that the true representation of the tax base is

$$\begin{aligned} b_{i,t} = \alpha_{0,t} \; &+ \; \sum_{l=1}^{m} \alpha_{l,t} b_{i,t-l} + \sum_{l=1}^{m} \delta_{1,l,t} \overline{t}_{i,t-l} + \sum_{l=1}^{m} \delta_{2,l,t} t_{i,t-l} \\ &+ \; \sum_{l=1}^{m} \delta_{3,l,t} \overline{z}_{i,t-l} + \sum_{l=1}^{m} \delta_{4,l,t} z_{i,t-l} + \Psi_t f_i + \epsilon_{i,t}, \quad m \geq 1, \end{aligned} \tag{9}$$

where $b_{i,t}$ denotes the tax base as observed at location $i$ in period $t$. $t_{i,t}$ and $z_{i,t}$ are the corresponding tax rate and exogenous revenues, respectively. The bar on tax rates and revenues $(\overline{t}_{i,t}, \overline{z}_{i,t})$ represents averages across the local neighborhood. $f_i$ is the unobserved individual effect. Since current tax revenues depend on earnings in the previous year we lag all explanatory variables on the right hand side. Note that all coefficients (greek letters) are indexed with the time period. Even the impact of the regional effect is allowed to vary across time.

In order to remove the individual effects equation (9) is transformed into quasi-differences, adjusted for the change in the impact of the regional effect

$\Psi_t$, yielding the estimation equation

$$\begin{aligned} b_{i,t} = a_{0,t} &+ \sum_{l=1}^{m+1} a_{l,t} b_{i,t-l} + \sum_{l=1}^{m+1} d_{1,l,t} \bar{t}_{i,t-l} + \sum_{l=1}^{m+1} d_{2,l,t} t_{i,t-l} \\ &+ \sum_{l=1}^{m+1} d_{3,l,t} \bar{z}_{i,t-l} + \sum_{l=1}^{m+1} d_{4,l,t} z_{i,t-l} + u_{i,t}. \end{aligned} \tag{10}$$

The available dataset provides us with 17 consecutive years of observation. We start estimation with a model of three lags (m=3) which requires to use four lags in the differenced estimation procedure. As the first lags of the five variables are not valid instruments in the quasi-differencing procedure, the identification of each year's equation is only secured for 12 time periods. In specifying the number of instruments employed not all theoretically available instruments were employed in order to avoid overfitting. If available, each equation employs one year of observations more in its specific set of instruments, as is required for identification. That is, we used observations of the periods t-2,...t-m,t-(m+3) as instruments. The basic estimation thus consists of estimating the 12 period specific equations with 55 overidentifying restrictions.

As depicted in Table 2 the Sargan statistic (denoted with Q) does not allow to reject the orthogonality of instruments (cf., column (3)).[7] Conditional on this basic specification the appropriateness of parameter restrictions is tested. Following the suggestions of Holtz-Eakin et al. (1989) the first restriction imposed is that the impact of the fixed effects is constant across periods ($\Psi_t = 1, t = 1, ..., 12$). This restriction improves the possibilities of identifying the underlying model parameters. As is displayed by the L-Statistics in column (6) of Table 2 this restriction cannot be rejected.[8] However, the restriction of the lag length to three periods (m=2) is rejected. The reduction of the lag length was rejected also when testing conditional on the stationarity of the regional fixed effects. Two further statistics in Table 2 indicate that tax effects and expenditure effects are significant, separately.

[7] In difference to the standard procedure by Holtz–Eakin, et al. (1988) in the estimation of the covariance matrix we took account of the correlation between the period specific equations as in standard SUR estimation. This seems necessary since we found medium-run correlation between the error terms because of marked differences in the cyclical sensitivity of regions. However, this procedure does not alter the results concerning the specification search, qualitatively.

[8] This chi-squared statistic tests for the difference between the restricted and unrestricted sum of squared residuals, cf. Holtz-Eakin et al. (1988), 1380f.

Table 2: Model selection

| condition | dof | Q [P-val.] | | parameter restriction | dof | L [P-val.] |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | | (4) | (5) | (6) |
| 4 lags ($m = 3$) | 55 | 53.4 [.537] | (i) | stationary fixed effects | 45 | 54.0 [.167] |
| | | | (ii) | 3 lags ($m = 2$) | 60 | 102.8 [.000] |
| 4 lags ($m = 3$) + stationary fixed effects | 100 | 103.1 [.396] | (i) | 3 lags ($m = 2$) | 45 | 257.5 [.000] |
| | | | (ii) | no tax effects | 78 | 123.0 [.000] |
| | | | (iii) | no exp. effects | 78 | 214.4 [.000] |
| | | | (iv) | all parameters stationary, (except $a_{0,t}$) | 175 | 2663 [.000] |

The usual parameter restriction of equal slopes across equations is also rejected. Therefore, the subsequent analysis employs a model with four lags (m=3) and stationary fixed effects.

## 3.4 Results

In order to obtain results on the overall significance and direction of each variable the results can possibly be best summarized by listing the sum of the coefficients for each variable. For, instance accounting for the time required for adjustment the neighbors' tax rate will have a positive impact on the tax base in the long-run, if

$$\sum_{l=1}^{3} \delta_{1,l,t} > 0.$$

Given that the impact of the regional fixed effect is stationary this will be the case if the estimated parameters obey

$$\sum_{l=1}^{3} d_{1,l,t} + \sum_{l=1}^{2} d_{1,l,t-1} + d_{1,l,t-2} > 0,$$

since

$$\sum_{l=1}^{3} \delta_{1,l,t} = \sum_{l=1}^{3} d_{1,l,t} + \sum_{l=1}^{2} d_{1,l,t-1} + d_{1,l,t-2}.$$

This can be checked for 10 of the 12 estimation periods. Similar expressions can be obtained for the other parameters.[9] Table 3 displays the results. It shows that the sum of the coefficients always has the expected sign. The neighbors' tax rates have a positive impact, which is significant in all years, indicating the presence of strong fiscal externalities. As the data are not logarithmically transformed the coefficients cannot be interpreted as elasticities. The average long-run effect of an increase in the neighbors' tax rates by one percentage point on the local tax base is estimated by

$$\frac{\partial b_i}{\partial \bar{t}_i} = \frac{-3.03}{1 + 0.587} = 1.911. \qquad (11)$$

[9] In the case of the coefficients of the lagged tax base the relationship is

$$\sum_{l=1}^{3} \alpha_{l,t} = \sum_{l=1}^{3} a_{l,t} + \sum_{l=1}^{2} a_{l,t-1} + a_{l,t-2} - 3.$$

Table 3: Estimation results

| | dependent variable: tax base | | | | |
|---|---|---|---|---|---|
| | tax rate | | exog. revenues | | tax base |
| | neighb. | own | neighb. | own | |
| | $(\overline{t})$ | $(t)$ | $(\overline{z})$ | $(z)$ | $(b)$ |
| 1987 | 2.99 ** | -2.19 ** | -6.69 | 4.52 ** | -.295 ** |
| | (1.32) | (.822) | (4.72 ) | (1.43) | (.099) |
| 1988 | 2.96 ** | -2.17 ** | -5.72 | 2.83 ** | -.368 ** |
| | (1.29) | (.835) | (4.37 ) | (1.16) | (.078) |
| 1989 | 3.02 ** | - 2.09 ** | -4.57 | 1.55 | -.410 ** |
| | (1.31) | (.853) | (4.31 ) | (1.11) | (.076) |
| 1990 | 2.94 ** | -2.17 ** | -5.44 | 1.84 * | -.408 ** |
| | (1.31) | (.852) | (3.97 ) | (1.10) | (.068) |
| 1991 | 3.10 ** | -2.23 ** | -6.60 * | 2.27 * | -.361 ** |
| | (1.32) | (.858) | (3.83 ) | (1.26) | (.071) |
| 1992 | 3.13 ** | -2.14 ** | -6.11 | 1.18 | -.567 ** |
| | (1.33) | (.893) | (3.87 ) | (1.25) | (.068) |
| 1993 | 2.77 ** | -2.17 ** | -7.55 ** | .885 | -.730 ** |
| | (1.32) | (.922) | (3.86 ) | (1.33) | (.087) |
| 1994 | 2.61 ** | -2.20 ** | -7.41 ** | 1.04 | -.908 ** |
| | (1.33) | (.986) | (3.77 ) | (1.68) | (.093) |
| 1995 | 2.44 * | -2.02 ** | -6.77 | 2.14 | - .994 ** |
| | (1.38) | (1.03) | (4.23 ) | (2.37) | (.107) |
| 1996 | 4.37 ** | -2.24 * | -8.21 * | 5.06 * | -.830 ** |
| | (1.77) | (1.24) | (4.80 ) | (3.03) | (.127) |

Sum of coefficients from GMM estimation of the VAR system (10) subject to the restriction of four lags (m=3) and stationary fixed effects. Standard errors in parentheses. The coefficients are marked with one or two stars, depending on whether the significance level is 0.1 or 0.05 respectively.

Thus, the estimated effect suggests that an increase in the tax rate of the local neighbors increases the local tax base by as much as DM 1,911 per capita. Using the mean tax rate in 1996 and taking into account the presence of revenue sharing with the federal and the state level the average revenue effect is about DM 191 per capita.[10]

Yet, the large revenue gains result under the assumption that the local jurisdiction leaves its tax rate unchanged, since the own tax rate has a negative impact, which is significant in all years. This indicates that the average community is not able to increase its revenues proportionally with the tax rate and thus has a "revenue hill" (cf. Inman, 1992) with a slope of less than unity. The average long-run effect of an increase in the tax rate by one percentage point is

$$\frac{\partial b_i}{\partial t_i} = \frac{-2.16}{1+0.587} = -1.362 \qquad (12)$$

indicating that the tax base is reduced by DM 1,362 per capita if the tax rate is increased by one percentage point, ceteris paribus.[11] Despite the fact that due to vertical revenue sharing the impact on the budget is only about 10 %, this is a very large effect as compared with an average tax base of DM 2,996 per capita. Yet, compared with evidence from US. business taxation the magnitude is not extreme. Inman (1992 and 1995) estimates that an increase of Philadelphia's business tax rate by one percentage point reduces the tax base by US-$ 3,471 per resident.[12]

Actually, the coefficient of the local tax rate is somewhat smaller in absolute terms than that of the coefficient of the neighbors' tax rates. But, formal testing showed that one can only reject the equality in absolute terms for the period 1996. Since the coefficient of the neighbors' tax rates is quite similar to the coefficient of the own tax rate in absolut terms we can say that a joint increase of the tax rate at the local jurisdiction and in the neighborhood has no effect on the tax base.

For the exogenous revenues received by the jurisdictions the results give a similar picture: An increase in the own revenues tends to have a positive effect, whereas the increase in the neighbors' revenues tends to have a negative

[10] Part of the revenues is transferred to the state and the federal level. The transfer obligation is independent of the local tax rate and in 1996 amounts to revenues from a fictive tax rate of 4.1 %.

[11] In terms of the underlying collection rate this experiment would imply that a jurisdiction at the mean would increase its collection rate by approximately 30 percentage points.

[12] The tax base in Inman's study is, however, much larger with a value of 12,625 US-$.

influence. This supports the hypothesis that exogenous revenues are used to finance expenditures which improve the locational attractiveness.

## 4 Summary and conclusions

The paper has presented a test of a central tenet in the recent literature on tax competition, namely, that the taxation of a mobile factor exerts a positive fiscal externality on other jurisdictions. Since recent empirical findings point to a significant interdependence of tax rates among geographic neighbors', however, the analyses has focused on neighborhood externalities. Using a large panel of local jurisdictions the results confirm the theoretically maintained hypothesis that an increase of neighbors' tax rates significantly increases the local tax base if the local tax rate is held constant. If the local tax is increased as well, no effect on the tax base is found. The estimated effect is quite strong indicating that a tax increase in the neighborhood by one percentage point brings about an average increase in the revenues by approximately DM 191 per capita in the long-run.

Holding constant the tax base the gain of an increase of the own tax rate by an additional percentage point in 1996 is around DM 30 per capita on average. However, the average revenue loss from a reduction of the local tax base in response to such a tax increase is about DM 136. This indicates that the average jurisdiction would actually gain from a reduction of its tax rate - if the other jurisdictions don't follow this move.

So we are left with the question of why jurisdictions do not reduce their tax rate. One possible answer is that the effect actually is smaller than indicated due to the existence of common shocks to both tax basis and tax rate. If there is some further determinant of the local tax base which is also correlated with the tax rate the true tax effect could be smaller. Therefore, future research could explicitly take account of the implicit tax setting equation and estimate the response of the tax base in a simultaneous setting.

If the estimated relationship is not driven by common shocks we have to search for explanations of why tax policy is not adequately described by myopically efficient behaviour. An explanation may rest on the role of the state authorities in controlling local jurisdictions. Since, there are cases where local jurisdictions are forced by the state's fiscal authorities to raise their tax rate before they are allowed to incur further debts.

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# 5 Sources and definitions of data

**Communities:** The dataset consists of the 1111 communities of the state of Baden–Württemberg. In the German system of fiscal federalism the communities build the lowest of the fiscal tiers. The 1111 communities form 44 districts, i.e 35 counties and 9 independent cities. The community of Blaubeuren (id: 425020) was removed from the dataset as it reports a very high negative tax revenue in 1996 (-25.6 Million DM). This results from repayments to a large local employer indicating that previous tax payments would strongly overestimate the tax base. Whereas repayments are often observed the size of this case is exceptional.

**Spatial weighting matrix:** Euclidian distances are computed from a digital map of the geographical position of the administrative center of each community. The employed matrix defines local neighbors as communities located within a distance of 30 kilometers (km). This results from using commuting of the working population as an indicator of the geographic proximity, as 90 % of the male commuters – as a proxy for full–time employed commuters – have a commuting distance up to 30 km. This figure was obtained by means of linear interpolation based on relative frequencies of commuting distances published by Heidenreich (1988). Each neighboring community is weighted according to the inverse of its relative distance, since previous studies applying spatial techniques to German regional data have shown that weights according to the inverse distance give the best fit among various weighting concepts (cf. Buettner, 2000b). The matrix has a dimension of 1111, shows an average weight of .0236, contains 47028 nonzero links and an average of 42.3 links. The two most connected communities show 83 links, the least connected community display 5 links. From the complete matrix the column referring to the community of Blaubeuren is removed (see above).

**Local collection rates** of the local business tax (Gewerbesteuer) for the years (Rechnungsjahre) 1980–1996 are obtained from the state's statistical office

(Statistisches Landesamt Baden–Württemberg), where it is contained in the database "Struktur- und Regionaldatenbank" (SRDB).

**Annual population** refers to the first of January, census data, official projections using resident registration information, source: SDRB.

**Tax base** calculated using the revenues of the Business Tax (Gewerbesteueraufkommen, brutto) as reported in the annual budgetary statistics (Jahresrechnungsstatistik) in the SDRB. Since the tax payments are deductible from the tax base it was calculated by multiplication of the revenues with the factor $\frac{1}{c_i 0.05}[1 + c_i 0.05]$. The obtained tax base figure is employed in terms of 1,000 DM per capita in constant prices of 1996. The price index used is the national producers price index (Erzeugerpreisindex) for West Germany, source: council of economic experts (Sachverständigenrat).

**Exogeneous revenues** refers to the sum of **unconditional grants** (Schlüsselzuweisungen) and the community's share of **income tax revenues** (Gemeindeanteil an der Einkommensteuer) reported in the annual budgetary statistics. Employed in terms of 1,000 DM per capita in constant prices of 1996, source: SDRB. Note that income tax revenues are shared with the federal and the state level, and are an instrument of redistribution among communities.