Tax Base Effects and Fiscal Externalities of Local Capital Taxation: Evidence from a Panel of German Jurisdictions

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Abstract:

This paper provides empirical evidence on the tax base effects of local capital taxation. Using a large panel of German municipalities it tests whether both the local tax rate and the tax rate in adjacent jurisdictions affect the local tax base. The results obtained from a spatial GMM approach confirm a strong negative impact of the local tax rate, whereas the average tax rate of neighboring municipalities proves insignificant. Only if interacted with the relative population size of neighbors a significant positive impact is found, indicating that externalities from taxing decisions of adjacent jurisdictions are experienced only by relatively small municipalities.

Keywords: Local Capital Taxation, Tax Competition, Fiscal Externalities, Fiscal Equalization

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

1 Introduction

The literature on tax competition has emphasized that taxation of a mobile factor may, under certain circumstances, lead to a situation where taxing decisions have an impact not only on the own budget but on the budget of other jurisdictions as well (for an overview see Wilson, 1999). It is well established that these fiscal externalities give rise to inefficiencies since they increase the marginal cost of raising public funds at the local level (Wildasin, 1989). Whereas a rich body of theoretical literature has explored the conditions under which fiscal externalities arise from taxation, empirical evidence on their significance is still scarce. Several empirical studies have tested the implications for the tax setting of local jurisdictions. In particular, ample evidence exists for spatial interaction effects in tax setting between neighboring jurisdictions.[2] But, as noted by several authors (*e.g.*, Case *et al.*, 1993, Brueckner, 2001) the presence of spatial interaction as such may well be explained by other theories of local fiscal policy, in particular by theories of yardstick competition (Besley and Case, 1995, Bordignon *et al.*, 2002). Thus, it is not clear that the existence of spatial interaction in local taxation necessarily implies the presence of fiscal externalities.

This paper takes a different route and focuses directly on the tax base effects of local tax rates in a context of capital taxation. Similar to Brett and Pinske (2000) and in difference to many other studies of tax base effects of local taxes (*e.g.*, Ladd and Bradbury, 1988, Inman, 1995, Haughwout *et al.*, 2000) not just the local tax rate but also the tax rate of neighboring jurisdictions is taken into account. This approach directly delivers evidence on the existence of fiscal externalities.

The empirical analysis employs a panel of about 1,000 local jurisdictions over 21 years in a major German state where the jurisdictions set the local business tax rate. In difference to Brett and Pinske (2000) who study a business property tax in Canadian municipalities, the results point to significant

[2]Existing studies cover a wide range of different cases, *e.g.* Besley and Case (1995) consider US. states, Bordignon *et al.* (2001) investigate Italian cities, Brett and Pinske (1997,2000) investigate Canadian municipalities, Buettner (1999, 2001) studies German counties and municipalities, Brueckner and Saavedra (2001) analyze cities in the Boston area, Case (1993) is concerned with US. states, Hayashi and Boadway (2000) study the case of Canadian provinces, Heyndels and Vuchelen (1998) focus on Belgian municipalities, Ladd (1992) investigates US. counties, Revelli (2001) considers English districts, and, finally Seitz (1994) investigates German cities. For a survey see Brueckner (2001).

tax base effects of local tax rates. Whereas the results confirm a strong adverse impact of the own tax rate, the average tax rate of neighboring municipalities proves insignificant. Only if interacted with the relative population size of neighbors a significant positive impact is found, suggesting that in the current dataset fiscal externalities from adjacent jurisdictions are experienced only by relatively small municipalities. The rather large estimate for the effect of the own tax rate indicates that a reduction of the local tax rate would lead to an increase of local tax revenues, the reluctance of municipalities to lower tax rates is attributed to a redistributive system of intergovernmental transfers.

The next section discusses the basic theoretical framework underlying the empirical study. Section 3 presents the investigation approach taken to unravel the relationship between the local tax base and local tax rates. This is followed by a description of the data including the instrumental variables. After the results are presented in Section 5, the final section states the conclusions.

2 Theoretical Framework

The standard model of capital tax competition (*e.g.*, Wilson, 1999) at least distinguishes two factors of production, capital as a mobile and labor as an immobile factor.[3] From the mobility assumption the after tax rate of return on capital at jurisdiction i is equal to the common rate of interest, formally

$$\frac{\partial f\left(k_i, x_i\right)}{\partial k_i} - \tau_i = r, \tag{1}$$

where k_i is the capital-labor ratio, $f\left(k_i, x_i\right)$ is a neoclassical production function in intensive form, and x_i captures other determinants of productivity exogenous to the individual firm. τ_i is the per-unit tax on capital, and r is the common rate of interest, both are treated parametrically by the individual firm. Given the labor input and with $\partial^2 f / \partial k_i^2 < 0$ this equation gives rise to an inverse relationship between the amount of capital employed at i and the local tax rate at the given interest rate. If the world consists of two jurisdictions ($i = 1, 2$) with given labor endowments (l_1, l_2) and if the total supply of capital is fixed there is a linear relationship between the capital-labor ratios at

[3] Note that the assumption of immobile labor is not crucial. The following argument simply builds on the assumption that due to the presence of at least one immobile factor there are diminishing marginal returns to the mobile factor.

the two jurisdictions. Assuming, for simplicity, that both the total labor and the total capital supply equal unity

$$1 = k_1 l_1 + k_2 l_2. \tag{2}$$

With this condition, we can use the capital demand equation (1) for each of the two jurisdictions to endogenize the common rate of interest and formalize the tax base k_i by a function

$$k_i = k\left(\tau_i, \tau_j, x_i, x_j, l_i, l_j\right), \quad \text{where} \quad \frac{\partial k}{\partial \tau_i} < 0, \ \frac{\partial k}{\partial \tau_j} > 0, \quad i, j = 1, 2, \quad j \neq i, \tag{3}$$

and j is the index of the other jurisdiction, respectively.[4] The negative impact of the jurisdiction's own tax rate reflects the reduction of capital demand at i. The positive impact of the other jurisdiction's tax rate τ_j results from the reduction of capital demand at j. Obviously, taxing decisions affect not only the tax base of the own jurisdiction but give rise to fiscal externalities as the tax base of the competing jurisdiction is affected as well.

Although the current paper focuses on the question of whether the impact of taxing decisions on the tax base as specified by equation (3) is empirically relevant, it is important to note that the tax policy is determined simultaneously. To see this, assume that each local government maximizes a utility function defined over public spending e_i and consumption c_i per worker

$$\max_{\tau_i} \ U\left(e_i, c_i\right),$$

subject to the budget constraint

$$e_i = \tau_i k_i + g_i.$$

[4] Given the equilibrium condition for the capital allocation

$$\frac{\partial f\left(k_i, x_i\right)}{\partial k_i} - \tau_i = \frac{\partial f\left(k_j, x_j\right)}{\partial k_j} - \tau_j,$$

and given (2) the tax base effects of tax rates are

$$\frac{\partial k}{\partial \tau_i} = -\left[-\frac{\partial^2 f\left(x_i, k_i\right)}{\partial k_i^2} - \left(\frac{l_i}{l_j}\right)\frac{\partial^2 f\left(x_j, k_j\right)}{\partial k_j^2}\right]^{-1}, \quad \frac{\partial k}{\partial \tau_j} = -\frac{\partial k}{\partial \tau_i}.$$

g_i denotes an exogenous budget component, which may be positive or negative. Assuming, for simplicity, that the capital endowment is zero, consumption is equal to the income of the immobile factor $c_i = f(k_i, x_i) - k_i (\partial f(k_i, x_i) / \partial k_i)$. With these assumptions, the maximand is a function of τ_i, g_i, x_i, and k_i, where the latter is determined by equation (3). Provided the production and utility functions are sufficiently well behaved, the optimal choice of the tax rate conditional on the other jurisdiction's taxing decision is given by

$$\tau_i = \tau(g_i, \tau_j, x_i, x_j, l_i, l_j). \tag{4}$$

While its sign depends on the properties of utility and production functions (*e.g.*, Brueckner and Saavedra, 2001) the presence of the tax rate at j gives rise to strategic interaction in the taxing decisions of the two jurisdictions. In the current framework τ_j enters the tax-setting equation because of its impact on the local tax base ($\partial k / \partial \tau_j > 0$). But, strategic interaction may also be due to yardstick competition (Besley and Case, 1995, Bordignon *et al.*, 2001), which rests on informational spillovers. Hence, given ample empirical evidence on the existence of interaction effects the current analysis tests whether an impact of t_j on the local tax base is empirically relevant.

Since the equilibrium in tax competition is characterized by a simultaneous determination of tax rates and the tax bases, an estimation of the above tax base equation (3) should employ instrumental variables for the tax rates at i and j. In the framework presented, an appropriate identification strategy with regard to the tax rate could rely on the exogenous budget components g_i at the two jurisdictions, as g_i enters only the tax-setting equation (4).

The theory of tax competition provides many suggestions to extend this rudimentary framework in various ways. For instance, one could allow for differences in the demand for public services, include public inputs, or grants. Each of those extensions might deliver additional suggestions for possible identification strategies for the tax base effects of local tax rates. However, the analysis below rests on exogenous or predetermined budget components. Since the appropriate choice of instrumental variables is also determined by the approach of the empirical analysis, we will come back to the instrumental variable strategy after presenting the investigation approach in the next section.

3 Investigation Approach

Since the empirical analysis is concerned with a capital income tax, the empirical setting slightly differs from the theoretical discussion above, which followed standard practice and dealt with a per-unit tax on capital. However, noting that the income of capital before taxes in the above model is uniquely determined by k_i and x_i a corresponding tax base equation can be stated for the modified model[5]

$$b_i = b\left(\tau_i, \tau_j, x_i, x_j, l_i, l_j\right), \quad \text{where:} \quad \frac{\partial b}{\partial \tau_i} < 0, \ \frac{\partial b}{\partial \tau_j} > 0, \tag{5}$$

where b_i denotes local capital income.

Although the standard model of tax competition is atemporal, the empirical analysis below employs not just a single cross section but a panel dataset of jurisdictions. This reduces identification problems due to unobserved heterogeneity of jurisdictions, since the analysis can control for time-invariant characteristics of a jurisdiction and its neighbors by means of local effects. In addition, the time-series dimension allows to take account of a simple pattern of dynamic adjustment of the tax base to changing local conditions. For that purpose the analysis imposes a partial adjustment model

$$\Delta \log b_{i,t} = (1-\rho)\left(\log b^*_{i,t} - \log b_{i,t-1}\right) + \epsilon_{i,t}, \quad \text{with} \quad 0 < \rho < 1, \tag{6}$$

where $b_{i,t}$ denotes the tax base per capita as observed at location i in period t, Δ is the difference operator and $b^*_{i,t}$ is the equilibrium level as implied by the above tax base equation. The tax base is entered in per-capita values. This amounts to the assumption that the supply of the immobile factor is correlated with local population size. Because the tax base per capita in the sample shows a rather skewed distribution the analysis uses logs.

The key issue in implementing this model is to find a proper description of the determinants of the equilibrium level of the tax base ($\log b^*_{i,t}$) which can be seen as the target value of investors. The

[5] With a capital income tax the tax base is $k_i\left(\partial f\left(k_i, x_i\right)/\partial k_i\right)$ The corresponding equilibrium condition (1) is

$$(1-\tau_i)\frac{\partial f\left(k_i, x_i\right)}{k_i} = r.$$

Applying the same reasoning as above yields the modified tax base equation (5).

tax base equation (5) suggests to use the tax rate and other characteristics of the local jurisdiction and the same variables of the competing jurisdiction. To operationalize the concept of a competing jurisdiction in a multijurisdictional setting the analysis follows a heuristic approach. For each municipality a set of neighboring jurisdictions is defined, which might exert a particular strong impact on the local tax base. Although neighborhood could be seen as a rather general concept and need not necessarily be defined in a geographical sense (Case *et al.*, 1993, Seitz, 1994), the recent empirical literature on the local interaction in tax setting as cited in the introduction has relied much on the geographic proximity of jurisdictions as an indicator of their exposure to interjurisdictional competition. Moreover, previous research on the German business tax analyzed below has established significant correlation in the local taxing decisions among geographically neighboring municipalities (Seitz, 1994, 1995, and Buettner, 2001). Consequently, the empirical analysis uses spatial weights in order to calculate averages of the tax rates of neighboring jurisdictions, formally,

$$\overline{\tau}_{i,t} = \sum_j \mathsf{W}_t \left[i, j\right] \tau_{j,t},$$

where $\tau_{j,t}$ denotes the local tax rate at jurisdiction j in period t. In the spatial econometrics literature $\overline{\tau}_{i,t}$ is sometimes referred to as a spatial lag (*e.g.*, Anselin, 1988). The weights are defined such that $\mathsf{W}_t [i, j] > 0$ for neighboring municipalities and $\mathsf{W}_t [i, j] = 0$ for more distant locations as well as for $j = i$.

To apply the concept of spatial lags requires, first, a definition of neighbors, and, second, a specification of spatial weights. In accordance with previous work on tax competition based on the same sample of municipalities (Buettner, 2001), in the current analysis neighbors are defined as municipalities with a distance up to 30 kilometers (18.65 miles). Sensitivity checks using smaller or wider ranges did not yield a higher significance of the spatial variables. With regard to the weighting scheme the analysis employs population as well as distance based weights with and without row standardization.[6] As we will see below, the choice of the weighting scheme is important for the significance, in particular, of the tax rate variable.

[6]If the weights are row standardized $\sum_j \mathsf{W}_t [i, j] = 1$. This might be helpful for the interpretation of the results, however, it is not always appropriate, as for instance in the case of asymmetric tax competition, see below.

The basic estimation equation is

$$\log b_{i,t} = \rho \log b_{i,t-1} \ + \alpha_1 \tau_{i,t} + \alpha_2 \overline{\tau}_{i,t} \ + \alpha_3 x_{i,t} + \alpha_4 \overline{x}_{i,t} \ + \psi_i + \phi_t + \epsilon_{i,t}, \tag{7}$$

where ψ_i is an individual effect capturing all time-invariant locational characteristics of relevance for investment decisions, ϕ_t is a time-specific effect controlling for common shocks to the tax base across jurisdictions due to the business cycle or to changes in the tax code, and $\epsilon_{i,t}$ is an error term.[7] For simplicity, the tax rate is entered in levels. Alternative estimation use $\log \tau_{i,t}$ or $\log(1-\tau_{i,t})$.[8] Aside of individual effects the estimation employs time-varying locational characteristics ($x_{i,t}$) such as population and employment, which are entered in logs, if appropriate. Note that the equation also takes account of spatial lags of those characteristics ($\overline{x}_{i,t}$). However, as noted above, the tax rates as well as some of the characteristics may be correlated with shocks in the tax base. Hence, the analysis makes use of instrumental variables.

As equation (7) employs spatial lags it is important to control for spatial autocorrelation. Since the estimation allows for fixed effects, the basic cross-sectional correlation between the jurisdictions is removed (Case, 1991). Additional spatial dependence in the error terms is taken into account using a General Method of Moments (GMM) approach which rests on a heteroskedasticity and spatial-dependence consistent covariance matrix following Conley (1999).[9]

[7]The available dataset provides 21 consecutive years of observation. Hence, the Nickell (1981) bias will be rather small. Estimations in a previous version (available upon request) using a dynamic panel data estimator along the lines of Arellano and Bond (1991) did not indicate a significant bias in the lagged dependent variable.

[8]Note that the capital demand equation for a capital income tax contains $1-\tau_{i,t}$ (cf. footnote 5).

[9]Conley (1999) suggests to compute a consistent estimate of the covariance matrix of the orthogonality conditions ($\mathbf{S}$) using a weighted average of estimated autocovariances

$$\mathbf{S} = (1/N) \sum_i \sum_j 0.5 K(i,j) \left[\mathbf{z}_i \hat{\epsilon}_i \hat{\epsilon}_j \mathbf{z}_j' + \mathbf{z}_j \hat{\epsilon}_j \hat{\epsilon}_i \mathbf{z}_i' \right], \qquad K(i,i) = 0,$$

where N is the number of jurisdictions, $\hat{\epsilon}_i$ is the first-step estimate of the residual, and $\mathbf{z}_i$ is the vector of instruments. $K(i,j)$ is a two dimensional kernel defined over a regular lattice field with a distinct address for each of the N jurisdictions. In the current panel data context the procedure is extended by pooling the cross sections. The computation was programmed in TSP and cross-checked with the STATA routine provided by Tim Conley. The cut-off point up to which a neighboring jurisdiction obtains a positive weight in the kernel is set corresponding to the definition of neighbors used in the spatial weighting matrix, *i.e.* up to a distance of about 30km (18.65 miles).

4 Data

To study the tax base effects of local taxation the analysis employs a panel of local municipalities (Gemeinden) in a major German state. Whereas the German system of fiscal federalism mainly relies on grants and tax revenue sharing and limits taxing autonomy at the local level, the local business tax (Gewerbesteuer) is the important exception.[10] While the tax code is uniformly defined, the local tax rate of the business tax is set by the municipalities, and each individual location is characterized by a specific tax rate. With the tax administration supervised at state level, the business tax has the appealing feature that the differences in the local tax burden are fully reflected in a single parameter. In addition, data are centrally collected and available for a large number of jurisdictions over time. The dataset reports tax revenues and tax rates from the business tax as well as other local variables on an annual basis from 1980 until 2000 for exactly 1111 jurisdictions which cover without overlap the complete area of the state of Baden-Württemberg. This section gives a short description of the main characteristics of the business tax and the dataset and discusses the instrumental variables chosen to tackle the above mentioned problems of simultaneity.

Although the business tax has some peculiarities it is essentially a tax on business earnings (see Appendix A). As the definition of taxable business earnings not only includes profits but also a major part of interest payments, the business tax can be regarded as a capital income tax. However, because of tax allowances, in particular for unincorporated enterprises (Personengesellschaften) the tax base does not include total business earnings. As discussed below, these allowances have some implications for the interpretation of the empirical results.

The tax base is not actually observed but derived from revenues and tax rates. Some small jurisdictions report negative revenues in one or two years. These are cases where tax rebates exceed current revenues, and the tax base in the preceding periods has obviously been mismeasured. Jurisdictions which report any non-positive figures during the 21 years of analysis are, therefore, removed entirely

[10] For a description of the finances of Germany's municipalities interested readers might refer to Norton (1994, 237pp). A standard reference in German is Zimmermann (1999). A short english description of the business tax and the German tax system is provided in International Bureau of Fiscal Documentation (1994: 145p).

from the dataset (see appendix). This still leaves 996 jurisdictions for the analysis.

[Table 1 about here.]

Table 1 reports descriptive statistics for this sample. The tax base shows marked variation. The implied tax rate on capital income is substantial, yielding a figure of 15.2% at the mean. Although the standard deviation is only somewhat higher than half a percentage point there are significant differences at the tails of the distribution as tax rates vary between 12.7% to 21.1%.[11] While the table lists only statistics for pooled observations, it should be noted that there is also variation in time: over the period of 21 years the average change in the tax rate is a small decline of about −0.7 percentage points, but the range of tax rate changes is between −2.5 and +5.6 percentage points.

Besides of tax rates the analysis employs variables capturing time-varying locational characteristics $(x_{i,t}, \overline{x}_{i,t})$, which possibly determine the spatial distribution of the tax base. First of all, to take account of the size of municipalities the total number of residents (population) is used. However, even municipalities of the same size differ substantially in the extent to which they host business activities. Therefore, total employment is added, and, in order to capture at least a part of the differences in the industry composition the list of explanatory variables also includes employment in manufacturing. The employment figures are expressed relative to population. As depicted in Table 1 the mean population of the municipalities in the dataset is at 9,880 residents. There is strong variation from below 1,000 residents up to a figure of half a million. Some of the considered municipalities report virtually no employment at all whereas others report even more employment than residents. Also the employment figure for manufacturing indicates strong disparities.

Aside of the business tax the municipalities under investigation receive a large amount of grants. Since grants constitute an income flow to the local jurisdiction, they likely affect local business earnings. However, in the German setting grants can contribute only to a limited extent to an

[11] Since the business tax is deductible in the federal personal and corporate income taxation, the effective tax rate is lower. However, location decisions within Germany depend on the additional reduction of the net rate of return caused by the local tax rate $1 - \tau_i$. Hence, the empirical analysis focuses on the local tax rate.

explanation of the spatial distribution of the tax base. This relates to fiscal-equalization grants, which aim to compensate for differences in taxing capacity and, hence, are directly dependent on the tax base. Similarly, to argue that matching grants explain the spatial distribution of the tax base is problematic, because they imply corresponding local spending decisions, which in turn depend on the tax base. However, some other grants can be regarded as predetermined if not exogenous. This applies in particular to the distribution of the state wide income tax revenues, where the allocation rule depends on personal income taxes paid by residents five to eight years ago.[12]

Finally, to capture temporal shocks to the local economy, the local unemployment rate is added to the list of explanatory variables following Inman (1995) and Haughwout *et al.* (2000).[13]

As was noted in the previous section the empirical identification of the effects of local tax rates requires instrumental variables. Since the theoretical discussion above suggests to rely on given components of the budget, the empirical analysis relies on the debt burden of the municipalities. The basic justification for this is that the obligation to service the debt is not under the immediate discretion of the local policy maker. Thus, it constitutes a predetermined budget component. Furthermore, in the light of the intertemporal budget constraint the debt burden is a central determinant of tax rate expectations. This is important, since business location decisions involve substantial investment and, hence, it is the expected rather than the current tax burden which is decisive for location. To capture the indebtedness the analysis below rests on a debt-service variable. Actually, because the current interest rate might depend on current policies, and, thus, could be correlated with the current tax base, the lagged value of the debt service is used. Since the impact of debt service on tax policy will also depend on revenue capacities the lagged deficit, the lagged tax rate, the lagged level of predetermined grants, and the lagged tax base are added to the list of instruments.[14]

Of course, also population and employment are possibly correlated with shocks to the tax base. As

[12]This reflects the considerable time lag in providing the underlying official income tax statistic for all municipalities.

[13]The unemployment rate employed is reported not at the level of the municipality but at the level of the employment service districts. Whereas small municipalities share the district with their neighbors large municipalities form their own employment service district.

[14]Note that the lagged tax base is already employed as an explanatory variable.

these variables are intended to capture differences in endowment and productivity across jurisdictions, which may be subject to location-specific trends in the medium- or long-run, it seems reasonable to use lagged values as instruments. Also, unemployment might well be correlated with shocks in the tax base. Since the purpose of the unemployment variable is to capture short-run fluctuations, the lag of the unemployment rate is possibly only a weak instrument. Therefore, the lagged composition of unemployment with regard to its duration (three month, six month, nine month, a year, two years, more than two years) and with regard to skills (skilled, unskilled, handicapped) is added to the set of instruments.

5 Results

Table 2 displays the results from several specifications. Column (1) displays results from a regression of the tax base on own characteristics taking account of two lags of the dependent variable. The inclusion of a second lag should not be regarded as a contradiction to the partial adjustment model. Due to tax rebates and payments in advance more complex dynamics in the tax base could simply reflect the derivation of the tax base from revenue data. However, qualitatively, none of the other results hinges on the inclusion of a second lag in the dependent variable. The estimated effect of the local tax rate confirms the theoretical prediction as the tax rate shows a significant negative impact. With regard to the other covariates, we see strong significance for unemployment and employment, indicating that a high tax base is associated with a low unemployment rate and high employment relative to population.

[Table 2 about here.]

To take account of possible simultaneity biases with regard to the tax rate but also to population, employment, and unemployment the same specification was estimated relying on the instrumental variables as discussed above.[15] The results from the GMM estimation are presented in column (2).

[15] The list of instruments includes all regressors, excluding the tax rate, population, total and manufacturing employment, and unemployment. In addition it includes lagged values of debt service, deficit, and unconditional grants

As the J-statistic for overidentifying restrictions is clearly insignificant, there is no indication that the exclusion restriction with regard to the instrumental variables is invalid. The results are qualitatively similar to those of the basic estimation. The impact of the tax rate is reduced and the coefficients of employment and unemployment are increased in absolute terms.

In columns (1) and (2) the tax policy and time-varying characteristics in the neighborhood are neglected. Column (3) reports results obtained from an estimation where the set of variables and instruments alike is augmented by spatially transformed variables.[16] The employed weighting scheme simply reflects the population share of each neighbor in the neighborhood (Brueckner and Saavedra, 2001), formally

$$\mathsf{W}_{\mathsf{t}}^{\mathsf{1}}\left[i,j\right] = I\left[i,j\right]\ \frac{P_{j,t}}{\sum_j I\left[i,j\right] P_{j,t}},$$

where $P_{j,t}$ is the current population at j and $I\left[i,j\right]$ is a binary variable which is unity if municipality j is a neighbor of i.[17] As above, the J-statistic does not reject the specification. The local characteristics show basically similar results, except that the grants variable now has a significant positive effect and unemployment is insignificant. With regard to the neighbor characteristics the lower part of the table in column (3) shows significant effects for employment, unemployment, grants, and population, while the average tax rate in the neighborhood is insignificant. Of course, the results are obtained conditional on the choice of the weighting scheme. However, alternative estimations using weighted averages based on distance or even unweighted averages (both not shown) did not detect any significance of the tax rate in the neighborhood either.

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per capita, the lagged tax rate, lagged shares of unemployed with three, six, nine, twelve, and twenty four month of duration, lagged shares of skilled and handicapped unemployed, as well as lagged population, lagged total and manufacturing employment per capita, and the lagged unemployment rate.

[16]The list of instruments is augmented by spatial lags of the following variables: lagged values of debt service, deficit, unconditional grants, and the lagged tax base per capita, the lagged tax rate, lagged shares of unemployed with three, six, nine, twelve, and twenty four month of duration, lagged shares of skilled and handicapped unemployed, as well as lagged population, lagged total and manufacturing employment per capita, and the lagged unemployment rate.

[17]Note that the spatial transformation is based on the full dataset of 1111 municipalities. Hence, in order to avoid problems with zero observations the logarithmic transformation is carried out after variables have been spatially transformed.

Column (4) presents results from a slightly different weighting concept, which reflects the relative population size of the municipalities, formally

$$\mathsf{W}_{\mathsf{t}}^{2}\left[i,j\right]=I\left[i,j\right]\;\left(\frac{1}{\sum_{j}I\left[i,j\right]}\right)\;\frac{P_{j,t}}{P_{i,t}},$$

where $P_{i,t}$ is the current population at municipality i. This weighting scheme yields a simple arithmetic average if all municipalities are of the same size. But, if a neighbor is large (small) relative to the considered municipality it gets a larger (smaller) weight. This specification reflects the prediction of the literature on asymmetric tax competition (*e.g.*, Bucovetsky, 1991, and Wilson, 1991) that the response of the tax base to the tax rate of competing jurisdictions differs between small and large municipalities. The results presented in column (4) show that the change in the weighting scheme matters. In particular, the spatial neighborhood effect is now significant for the tax rate. Accordingly, a higher tax rate of neighbors tends to raise the tax base, whereas higher unemployment in the neighborhood again is found to exert a negative impact.

Given the difference in the results of columns (3) and (4) it is interesting to note that the weighting scheme used in column (4) is equivalent to an interaction between the relative population size of neighbors and the population-weighted average used in column (3). Formally, there is the following relationship between the two weighting schemes

$$\mathsf{W}_{\mathsf{t}}^{2}\left[i,j\right]\;=\left(\frac{\sum_{j}I\left[i,j\right]P_{j,t}}{\sum_{j}I\left[i,j\right]}\;/\;P_{i,t}\right)\;\mathsf{W}_{\mathsf{t}}^{1}\left[i,j\right],$$

where the term in brackets is the average size of neighbors relative to the size of the considered jurisdiction, which is in the following referred to as the relative population size of neighbors.

However, in column (4), due to the logarithmic transformation of some of the variables, the nature of the interaction differs between the tax and unemployment rates of neighbors on the one hand and the other characteristics of neighbors, which are expressed in logs, on the other hand. To avoid this asymmetry, column (5) presents results from a slightly different specification. In this specification all neighbor characteristics, transformed using population-weighted averages as in column (3) and expressed in logs, where appropriate, are interacted with the relative population size of neighbors. The coefficients of the neighbor characteristics now indicate the impact of the average neighbor characteristic on a municipality's tax base if its size were equal to the average size of its neighbors. Larger (smaller) municipalities will experience weaker (stronger) effects. As compared to columns (3) and (4) this specification yields more convincing results. First of all, the J-statistic points to a much better fit. Moreover, own and neighbor variables capturing locational differences in endowment or productivity now tend to show opposite signs. Furthermore, all neighbor variables show smaller coefficients in absolute value as compared to the own variables. More specifically, the results indicate a positive impact of own population and employment as well as a negative impact of these characteristics in the neighborhood. Both, the own rate of unemployment and the neighbors' rate of unemployment show negative effects, pointing to the significance of economic fluctuations and their spillovers across jurisdictions. Own grants show a significant positive effect, grants received by the neighbors show a negative but insignificant effect. Manufacturing employment is insignificant. Finally, the own tax rate has a significant negative, and the neighbors' tax rate has a significant positive effect.

In order to substantiate the findings presented in column (5) it is important to check that the interaction term is not significant just because of a correlation between the tax base and the interacting variable. Therefore, several additional estimations have been carried out. The results presented in column (6) refer to a regression where weighting scheme and relative population size of neighbors are based on the population figures at the first year of the sample. Here, the interacting variable is time invariant and thus its level is controlled by the fixed effects. Moreover, a potential simultaneity problem of the population figures is avoided. Again, according to the J-statistic no significant misspecification is present. Although the neighbor characteristics tend to show somewhat weaker effects, the tax rate of the neighbors as well as the neighbors' population size and unemployment rate still proves significant.

It may be possible, however, that also the impact of the own characteristics varies in the regression with the relative population size. Therefore, in a further regression, interaction terms with the relative population size have been included also for all own characteristics. In addition, the set of instruments has been augmented by corresponding interaction terms. Remarkably, the results (not shown) do not reveal any significance for the additional variables. Formal testing based on the difference between the J-statistic for the extended model and the restricted specification (5) does not reject the restriction.[18]

To test, whether the significance of the tax rate of neighbors as documented in column (5) results from observations where the relative population size of neighbors is extremely high or low, further regression results shown in column (7) are obtained using only observations where the relative population size is between the 10 % and 90 % quantile in all years. Consequently, the sample size is reduced. However, the results do not show much difference as compared to column (5).

To finally test, whether the results are sensitive with regard to changes in the specification of the tax rate, column (8) and column (9) use alternative specifications for the tax rate. Specification (8) replaces the tax rate by its log. Specification (9) uses $\log(1-\tau_{i,t})$. Both specifications confirm the significance of the own tax rate as well as of the tax rate of neighboring jurisdictions. Aside of the coefficients on the tax variables, specification (9) shows almost identical results to (5).

The various specifications tested suggest that if neighbor variables are interacted with the relative population size of neighbors we find a robust positive impact of neighbors' taxing decisions on the local tax base. This indicates that fiscal externalities from neighboring jurisdictions are experienced only by relatively small municipalities. In fact, estimations following specification (5) based on a decomposition of the sample into one with average population below the median and another with average population above the median (available upon request) indicate that the tax rate of neighbors is only significant in the sample of small jurisdictions. Of course, whereas the impact of geographically neighboring jurisdictions is weaker or even absent for large cities it seems quite likely that the relevant concept of competing jurisdictions for large cities includes other, more distant, locations as well. However, the tax rates of cities outside of the state did not show any significance, regardless of any interactions with population size. This is probably due to the inclusion of period-specific effects, which take account of all common shocks to the jurisdictions, and thereby limit the

[18] The χ^2 statistic shows a figure of 6.22 at 7 degrees of freedom.

possibilities to identify fiscal externalities to the immediate neighborhood.

In order to get an impression about the magnitude of the estimates it is instructive to approximate the implied long-run elasticity of the tax base with respect to the own tax rate. For the results presented in column (5) we obtain:[19]

$$\frac{\mathrm{d}\log b_i}{\mathrm{d}\log \tau_i} \quad \approx \quad -1.40\ (.303).$$

Note that a policy of revenue maximization would imply an elasticity of (minus) unity, but the estimated figure is larger by more than the standard error. This indicates that tax revenues would rise if the tax rate is reduced, i.e. the average jurisdiction is at the downward sloping part of its "revenue hill" (Inman, 1995).[20]

Due to the smallness of the units of observation a high elasticity of the tax base can be expected because spatial transaction cost will depend on the size of the units. Nevertheless, it is surprising that the largest part of the response takes place within two periods. This raises the issue as to what extent the response in the tax base is due to relocation of capital or whether it reflects profit-shifting activities of individual firms. In fact, as the individual municipalities are small, many firms have branches in different jurisdictions, and profit shifting is very likely important. Unfortunately, no evidence is available about the significance of profit shifting in the context of the German business tax. However, there is an additional explanation for the strong response of the tax base to the tax rate related to tax allowances. In fact, due to allowances the business tax is progressive and therefore changes in the tax base are overestimated if the tax base is derived from the revenues. As suggested by a rough calculation using available data the true tax base elasticity could be about 26.3 % smaller than the estimate.[21]

[19] Implied long-run elasticity based on the coefficient of the tax rate divided with 1 minus the coefficients of the lagged tax base. Evaluated using the mean tax rate in the sample period. The standard error (in parentheses) treats the mean as a nonstochastic scalar.

[20] The implied elasticity for specifications (8) and (9) has almost the same size (-1.39 and -1.40, respectively).

[21] To get a rough estimate of the size of this effect assume that the business tax revenues y_i are determined by a linear tax on capital income minus tax allowances of a, formally

$$y_i = \tau_i \left(b\left(\tau_i, ...\right) - a\right), \quad \text{if} \quad b\left(\tau_i, ...\right) > a, \quad \text{and} \quad 0 \quad \text{otherwise.}$$

Even if the empirical response of the tax base overestimates the impact on local business earnings, it remains to explain what prevents municipalities from lowering their tax rate, if a reduction of the tax rate would raise tax revenues as the high elasticity suggests. An explanation is offered by a closer look at the state's fiscal institutions, in particular, at the system of intergovernmental transfers, sometimes referred to as the fiscal-equalization system. As this system has a strong redistributive character, it is important to note that the tax base effects as estimated above only capture the impact of the tax rate on the primary distribution of revenues. But, the final distribution is quite different. As in the case of the Canadian representative tax system, fiscal transfers are determined by the taxing capacity of jurisdictions defined by a measure of the tax base (Smart, 1998). Because transfer obligations decline and equalization grants rise if the tax base shrinks, the adverse impact of a tax increase on the tax base is accommodated by an increase in net transfers received. In a sense, a part of the adverse tax base effect is shifted to other jurisdictions. Consequently, the redistributive system of intergovernmental transfers provides incentives to set taxes rates higher than in the case of independent jurisdictions.

6 Summary and Conclusions

This paper has presented an empirical investigation of tax base effects of local taxation using a large panel of local jurisdictions. A central tenet in the literature on tax competition has been tested, namely, that local jurisdictions taxing a mobile factor cause significant externalities on other jurisdictions. Since existing empirical studies point to a significant interdependence of tax rates

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Note that the tax base in the empirical section is obtained from the revenues

$$\tilde{b}_i \equiv \frac{y_i}{\tau_i} = b(\tau_i, ...) - a.$$

The corresponding elasticity is

$$\frac{d \log \tilde{b}_i}{d \log \tau_i} = \frac{\partial \log b}{\partial \log \tau_i} \left(\frac{b_i(\tau_i, ...)}{b_i(\tau_i, ...) - a} \right).$$

Available statistical sources suggest that the ratio of the total tax base and the tax base corrected for allowances is about 1.263 (own computation based on the detailed statistics of the business tax available for 1995 from the Federal Statistical Office. This figure includes the implied tax exemption due to lower tax rates for earnings below the threshold of 144,000 DM for unincorporated enterprises.

among geographic neighbors the analysis has focused on externalities from adjacent jurisdictions.

In difference to Brett and Pinske (2000) the results point to significant tax base effects of local tax rates. The results clearly confirm an adverse impact of the own tax rate on the local tax base. However, the average tax rate in the neighborhood exerts no significant effect on the local tax base. Only if interacted with the relative population size of neighbors a significant positive impact is found. This suggests that fiscal externalities are experienced only by relatively small municipalities. This is in accordance with the view of the asymmetric tax competition literature that smaller jurisdictions are more responsive to competing jurisdictions' taxing decisions. However, this does not imply that larger jurisdictions are not affected by any fiscal externalities from taxing decisions. Instead, it seems plausible to argue that the appropriate neighborhood of larger jurisdictions extends to a wider range and includes, in particular, locations outside of the state. But, since the empirical analysis has employed period-specific effects, the possibilities of the estimation approach to identify fiscal externalities are limited to the immediate neighborhood.

The estimated tax base effects of the local tax rate are quite strong, indicating a situation where a reduction of the local tax rate would lead to an increase of tax revenues. However, this apparent violation of the rationality of tax policy can be attributed to the fiscal-equalization system, since even if a municipality would experience a much larger tax base if it lowers the tax rate, this would be accompanied by higher transfer obligations and a reduction in equalization grants received.

The strength of the tax base effects found as well as the rather short time period needed for substantial adjustments in the tax base raise doubts whether the tax base effects just reflect the relocation of the capital stock. A partial explanation of the strength of the tax base effects is related to indirect progression resulting from tax allowances. However, since allowances are mainly granted to unincorporated enterprises but not to corporations they can only to a limited extend explain the strength of the tax base effects found. Given the smallness of the individual municipalities, certainly many companies have establishments in different municipalities. Hence, very likely profit shifting is involved. However, the extent to which the existing formula allocation method permits profit-shifting activities is not known. To further explore the significance of profit shifting in this case is an interesting issue for future research.

Appendix A: The German Business Tax

The German business tax precisely consists of a combination of a tax on earnings and a tax on capital. The local municipalities determine the actual tax rates by choosing a multiple or collection rate (Hebesatz) which is applied to basic tax rates of 5% on earnings and 0.2% on capital (International Bureau of Fiscal Documentation, 1994: 146). Accordingly, the revenues are described by a function

$$R_i = c_i \left[0.05 \left(E_i - R_i\right) + 0.002 K_i\right], \tag{8}$$

where the tax base is determined by the taxable business earnings $E_i - R_i$ – after deduction of the tax payments –, the amount of business capital K_i, and the collection rate c_i. Note that business capital excludes land, which is taxed under a separate land tax (Grundsteuer). The basic tax rates and the definition of taxable earnings and taxable capital in the tax code determine the weights of business earnings in the combined tax base. In 1995 the weight of earnings was much higher than that of capital as 89.8% of tax payments belong to the tax on business earnings (German Statistical Yearbook, 1999: 529). As business earnings in 1995 where particular low because of the weak performance of the German economy and because of special depreciation allowances related to German unification, the weight of business earnings might even be higher in other periods. Unfortunately, the local revenues determined from the two sources of the tax are not reported separately. We, therefore, simplify the analysis and treat the whole business tax as a tax on earnings. Correspondingly, the local tax rate is approximated by

$$\tau_i = \frac{c_i 0.056}{1 + c_i 0.05}, \qquad \text{with} \quad R_i \approx \tau_i E_i. \tag{9}$$

The approximation uses the fact that the average ratio of the taxable base of the capital and the earnings components before deduction of taxes ($\frac{K_i}{E_i}$) is 2.976 (based on Statistical Yearbook, ibid.). Replacing business capital in equation (8) and isolating earnings gives expression (9). Effective in 1998 the tax on business capital was abolished. Thus, for the period from 1998 to 2000 the local tax rate is computed as

$$\tau_i = \frac{c_i 0.05}{1 + c_i 0.05}, \qquad \text{with} \quad R_i \approx \tau_i E_i. \tag{10}$$

However, note that the above results are robust against a reduction of the sample to the period before the tax reform (1980-1997).

Appendix B: Sources and Definitions of Data

The dataset consists of all 1111 municipalities (Gemeinden) of the state of Baden-Württemberg. The municipalities build the lowest of the fiscal tiers, forming 44 districts, i.e. 35 counties (Kreise) and 9 independent cities (Kreisfreie Städte). All municipalities which report non-positive figures for the tax base in at least one year are removed from the sample, yielding a sample of 996 municipalities. The municipalities show marked differences in size with average population ranging from 100 to more than 500,000 residents (see Table 3). The table also shows that only small municipalities are removed because of non-positive tax base figures.

[Table 3 about here.]

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

Tax base is calculated from the total revenues of the business tax (Gewerbesteueraufkommen, brutto) as reported in the annual budgetary statistics (Jahresrechnungsstatistik). It is obtained via dividing tax revenues by the tax rate as defined in equation (9). The obtained measure of the tax base is employed in terms of 1,000 DM per capita in constant prices of 2000.

Price index used is the producers price index (Erzeugerpreisindex) for West Germany (source: Council of Economic Experts, "Sachverständigenrat").

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

Local tax rates of the business tax (Gewerbesteuer) are calculated using the transformations (9) and (10) from the collection rates (Hebesätze) for the years (Rechnungsjahre) 1980-2000.

Unemployment rate is the annual average of official quarterly figures reported at the level of employment service districts in the state. Figures on total unemployment as well as on unemployment with regard to duration (up to three month, six month, nine month, a year, two years, more than two years) and with regard to skills (skilled, unskilled, handicapped) are reported at the end of September for each year at the level of employment service districts.

Total employment refers to the number of employed at the end of June at each year at local establishments as reported in the employment statistics based on the complete set of social security accounts.

Manufacturing employment is the corresponding number for manufacturing establishments (Produzierendes Gewerbe).

Grants include revenue sharing grants related to the distribution of state-wide income tax revenues (Gemeindeanteil an der Einkommensteuer) as well as specific non-matching grants independent of the tax base (Zuschüsse für laufende Zwecke) as reported in the annual budgetary statistics (Jahresrechnungsstatistik). Fiscal-equalization grants and matching grants are excluded.

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

Deficit is the annual primary deficit, own calculations based on annual budgetary statistics.

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). For the weights, see text.

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Table 1: Descriptive Statistics

		mean	std.dev.	min	max
tax base per capita	in 1,000 DM	2.761	2.920	0.003	85.231
tax rate		0.152	0.007	0.127	0.204
population	in 1,000	9.880	26.408	0.350	599.415
total employment per capita		0.246	0.140	0.013	1.159
manufacturing employment per capita		0.157	0.110	0.005	0.974
grants per capita	in 1,000 DM	0.610	0.150	0.153	2.001
unemployment rate		0.056	0.019	0.008	0.133

Sample consists of 966 municipalities over the period 1980-2000. DM figures in prices of 2000.

Table 2: Estimation Results (dependent variable: log tax base$_t$)

Variable \ Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
log tax base$_{t-1}$	.347 $\star$	.351 $\star$	.346 $\star$	.348 $\star$	.345 $\star$	.347 $\star$	.346 $\star$	.345 $\star$	.345 $\star$
	(.015)	(.015)	(.015)	(.015)	(.015)	(.015)	(.016)	(.015)	(.015)
log tax base$_{t-2}$	.067 $\star$	.069 $\star$	.069 $\star$	.067 $\star$	.069 $\star$	.069 $\star$	.065 $\star$	.070 $\star$	.069 $\star$
	(.013)	(.012)	(.012)	(.012)	(.012)	(.012)	(.013)	(.012)	(.012)
Own characteristics									
log grants$_t$	.085	.090	.130 $\star$	.097 $\star$	.099 $\star$	.117 $\star$	.100	.108 $\star$	.099 $\star$
	(.048)	(.046)	(.048)	(.048)	(.048)	(.047)	(.052)	(.047)	(.048)
tax rate$_t$	-5.97 $\star$	-5.08 $\star$	-4.27 $\star$	-5.35 $\star$	-5.38 $\star$	-5.45 $\star$	-4.42 $\star$		
	(.958)	(1.19)	(1.22)	(1.18)	(1.18)	(1.18)	(1.38)		
log tax rate$_t$								-.816 $\star$	
								(.183)	
log (1-tax rate$_t$)									4.56 $\star$
									(.995)
unemployment rate$_t$	-2.33 $\star$	-2.82 $\star$	-1.40	-4.48 $\star$	-2.53 $\star$	-2.43 $\star$	-2.80 $\star$	-2.52 $\star$	-2.53 $\star$
	(.426)	(.473)	(.710)	(.701)	(.481)	(.483)	(.572)	(.480)	(.481)
log population$_t$	-.025	-.020	-.029	-.009	.296 $\star$	.233	.321	.219	.295 $\star$
	(.071)	(.075)	(.085)	(.235)	(.113)	(.121)	(.162)	(.109)	(.113)
log total empl.$_t$	.367 $\star$	.397 $\star$	.402 $\star$	.387 $\star$	.409 $\star$	.410 $\star$	.455 $\star$	.403 $\star$	.409 $\star$
	(.045)	(.053)	(.054)	(.055)	(.052)	(.052)	(.054)	(.052)	(.052)
log manuf. empl.$_t$	.001	-.062	-.063	-.025	-.048	-.053	-.049	-.046	-.047
	(.032)	(.037)	(.038)	(.039)	(.037)	(.037)	(.039)	(.037)	(.037)
Neighbor characteristics									
log grants$_t$			-.422 $\star$	.167	-.011	-.013	.003	-.022	-.011
			(.130)	(.376)	(.022)	(.028)	(.029)	(.023)	(.022)
tax rate$_t$			-1.33	.766 $\star$	1.29 $\star$	1.11 $\star$	1.35 $\star$		
			(2.70)	(.258)	(.350)	(.367)	(.540)		
log tax rate$_t$								.188 $\star$	
								(.059)	
log (1-tax rate$_t$)									-1.09 $\star$
									(.293)
unemployment rate$_t$			-4.95 $\star$	-.516 $\star$	-1.26 $\star$	-1.23 $\star$	-1.36 $\star$	-1.24 $\star$	-1.26 $\star$
			(1.01)	(.143)	(.237)	(.222)	(.294)	(.234)	(.237)
log population$_t$			.496 $\star$	.508	-.039 $\star$	-.034 $\star$	-.044 $\star$	.019	-.037 $\star$
			(.253)	(.565)	(.010)	(.008)	(.013)	(.013)	(.009)
log total empl.$_t$			-.648 $\star$	.178	-.249 $\star$	-.170	-.227 $\star$	-.273 $\star$	-.250 $\star$
			(.254)	(.472)	(.088)	(.095)	(.106)	(.088)	(.088)
log manuf. empl.$_t$			-.055	-1.11 $\star$	-.034	-.061	-.061	-.018	-.033
			(.179)	(.373)	(.044)	(.053)	(.056)	(.044)	(.044)
Weighting scheme			W_t^1	W_t^2	W_t^1	W_0^1	W_t^1	W_t^1	W_t^1
Interaction w. pop. size			no	no	yes	yes	yes	yes	yes
J-statistic		10.4(10)	23.6(21)	24.4(21)	19.0(21)	20.2(21)	26.6(21)	20.6(21)	19.0(21)
Sample size	18354	18354	18354	18354	18354	18354	15029	18354	18354

All specifications include time- and region-specific fixed effects. Standard errors in parentheses. (1) displays least squares estimates and heteroscedasticity and spatial dependence consistent standard errors, (2)-(9) report GMM estimates. If significant at the 5 % level coefficients are marked with a star.

Table 3: Size Distribution of Municipalities

pop. size in 1,000		<1	1-2	2-5	5-10	10-20	20-50	50-100	>100
jurisdictions	N=1111	94	136	416	245	135	63	13	9
	N=996	23	114	374	238	132	63	13	9

Number of municipalities in population size class based on average population 1980-2000.