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## Administrative Structure and Inner-Metropolitan Tax Competition

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# Administrative Structure and Inner-Metropolitan Tax Competition

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## Abstract:

This paper considers the impacts of differently formed borders of municipalities on local business tax policy. First a model is presented that shows the dependence of the level of taxation on the administrative structure. Afterwards, data from Germany are employed to discover the effects of the number and size of municipalities within agglomerations. The results show that the administrative structure matters for the level of local business taxation. On the one hand, the core cities tax rate in a monocentric region is the lower, the more municipalities are situated within a certain distance from the city. This effect is the more important, the smaller the region that is considered. On the other hand, the tax of the core city is the higher, the larger its share in the agglomeration. Thereby, the result has more power for larger regions. The empirical results coincide with the results from standard tax competition theory.

**Keywords:** Local Business Taxation, Tax Competition, Administrative Structure, Municipal Borders

**JEL Classification:** H25, H71, H73

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# 1 Introduction

Analyzing the role of borders has ever been a main research topic in economics, not just since the significant increase in global trade in recent years and decades. Typically, the questions being discussed deal with trade of goods and services between countries. Thereby, the literature has found a notable impact of borders on the intensity of trade between regions. Helliwell (1997) for instance has shown, that trade between provinces of Canada is much more intensive than trade between these provinces and states of the U.S. But borders do not just impose a restriction on the intensity of trade; they also define the number of players in the competition of institutions. This paper aims at looking at a smaller administrative level, namely metropolitan areas. Also in this context borders have widely been subject to empirical analyses. Hoxby (2000) has studied the impact of the concentration of public school districts in metropolitan areas on school outcomes, whereby rivers as natural borders serve as an instrument for concentration. She has found a positive effect of the number of school districts on the quality of schooling. Even closer to the issue of this paper is the study of Hatfield/Kosec (2009). They examine the administrative structure of metropolitan statistical areas in the U.S. and their impacts on income growth. They find the latter to be higher in areas that host many county governments.

In this regional consideration borders are the crucial determinant of the scope of local governments actions. They define which firms are subject to taxation, to fees for public services, but also the area of authority of public administration in general. However, one can not assume that borders have been designed according to economic considerations. While in rare cases borders follow natural conditions, like in the case of islands, in most cases their design is accompanied by a certain degree

of arbitrariness. This is in particular the case with agglomerations. While the arbitrariness in cases of clear-cut villages is not of major importance, as long as all inhabitants of the settlement are covered by the village area and a local exit option does not exist, the situation proves different when borders cut populations. When this is the case, the location of business can be strongly driven by borders. Firms that decided not to locate their business in the core of the city, but rather at the urban fringe, can choose between two or more municipalities which makes them subject to different administrative bodies. Given that the proximity to customers or relevant public infrastructure is the same at both sides of the border, the firm will choose the municipality that provides a more appealing bundle of taxes and administrative services. When one assumes the core of a city to be naturally more attractive to firms, as long as we keep public policy issues aside, this aspect should be the more relevant the closer the border of a city is drawn around its core.

To analyze the extent to which municipal borders exert effects on local business taxation we rely on German data. Since the population density of Germany is rather high, there is a notable number of agglomerations that are characterized by a fluent passage of population across borders. The arbitrariness of municipal borders mentioned above motivates the question of having a closer look at the influences of borders on local policy. Since the local business tax is one of the most powerful tools of local politicians it is the impact of the borders' design on this instrument that seems to be a particularly relevant one. Due to the fact that German municipalities have a high degree of freedom with respect to choosing their local rate of business taxation, it is of interest, in which way the policy of highly segmented monocentric regions differs from that of those regions, that consist just of a few municipalities. Apart from the sheer number of municipalities the share of the city in its agglomeration is another indicator of potential importance in this context. The analysis could

eventually allow to infer changes in tax policy that could follow after reforms of the borderlines. Thereby, however, the impacts on the city and those on the region would have to be distinguished.

The paper is organized as follows: Section 2 presents results from a theoretical model, Section 3 provides some background information on the relevant German institutions in place and the central concept of competitive regions. In chapter 4 the empirical analysis is performed. Chapter 5 concludes.

## 2 Theoretical Model

To analyze the impacts of different administrative structures we start by considering a theoretical model. Thereby, the analysis follows the framework of the tax-competition model by Zodrow/Mieszkowski (1986).

We consider a region that consists of  $i = 1, 2, \dots, m$  municipalities, where one municipality is the core city of the metropolitan region. In municipality  $i$  there are  $n^i$  households, each of whom providing one unit of labor. Firms produce a single good with a linear homogenous production function

$$F^i(n^i, K^i),$$

where  $K^i$  denotes capital.<sup>1</sup> We assume capital to be perfectly mobile, so that the marginal product of capital will equal the rate of return  $r$ . Since all municipalities face the same rate of return in

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<sup>1</sup>This implies:  $F(K, n) = F_K K + F_n n$ . Furthermore, we assume:  $\frac{\partial F}{\partial K} \equiv F_K > 0$ ,  $\frac{\partial F}{\partial n} \equiv F_n > 0$ ,  $\frac{\partial^2 F}{\partial K^2} \equiv F_{KK} < 0$ ,  $\frac{\partial^2 F}{\partial n^2} \equiv F_{nn} < 0$ ,  $\frac{\partial^2 F}{\partial K \partial n} \equiv F_{Kn} > 0$ , and  $\frac{\partial^3 F}{\partial K^3} \equiv F_{KKK} > 0$ .

equilibrium, we can write:

$$F_K^i(n^i, K^i) = r.$$

Households income is formed by both labor ( $wn$ , where  $w$  denotes the wage rate) and capital income ( $s^i r$ , with  $s^i$  denoting savings). Their utility depends on private consumption  $x^i$  and public consumption  $z^i$ .

To finance public goods, the government raises a distortive tax on capital,  $\tau_K^i$ . Hence, the government budget constraint reads

$$\tau_K^i K^i = C(n^i, z^i),$$

where the costs of providing public goods depend on the population  $n^i$  and the size of the public good,  $z^i$ , which allows for some degree of rivalry in consumption.

Each firm will maximize its profits  $\pi = F(K^i, L^i) - (r + \tau)K^i - wn$ . The resulting first-order conditions will be

$$F_K^i = r + \tau \tag{1}$$

and

$$F_n^i = w.$$

Differentiating (1) yields

$$F_{KK}^i \partial K^i = \frac{\partial r}{\partial \tau^i} \partial \tau^i + \partial \tau^i.$$

Arranging this equation yields the effect of a tax increase in  $i$  on the capital employed in  $i$ :

$$\frac{\partial K^i}{\partial \tau^i} = \frac{\frac{\partial r}{\partial \tau^i} + 1}{F_{KK}^i}. \quad (2)$$

The impact of a tax increase in  $i$  on the capital in municipality  $j$  reads

$$\frac{\partial K^j}{\partial \tau^i} = \frac{\frac{\partial r}{\partial \tau^i}}{F_{KK}^j}. \quad (3)$$

In equilibrium, the employed capital in all municipalities has to equal the total amount of capital in the region:

$$K = \sum_{j=1}^m K^j.$$

Deriving this with respect to  $\tau^i$  yields:

$$\frac{\partial K^i}{\partial \tau^i} + \sum_{j \neq i}^m \frac{\partial K^j}{\partial \tau^i} = 0.$$

Since all municipalities (apart from the core) are symmetric, this can be simplified to:

$$\frac{\partial K^i}{\partial \tau^i} + (m-1) \frac{\partial K^j}{\partial \tau^i} = 0.$$

Plugging in (2) and (3) we obtain:

$$\frac{\frac{\partial r}{\partial \tau^i} + 1}{F_{KK}^i} + (m-1) \frac{\frac{\partial r}{\partial \tau^i}}{F_{KK}^j} = 0. \quad (4)$$

In contrast to the original framework by Zodrow/Mieszkowski, here the second derivatives of the

production function with respect to capital do not cancel. Because the city can have a higher capital stock (and more labor) than the other municipalities, these derivatives can be different, even though the marginal products of capital have to be the same in equilibrium.

Before we can find out about the effects of different administrative structures, we still have to solve the government problem. The benevolent mayor will maximize the utility of the representative private household. Because private consumption can be written as  $c = F^i(K^i) - F_k^i K^i + r s^i n^i$  and the public good as  $z = \tau_K^i K^i$ , the maximization problem reads:

$$\max_{\tau} u(F^i(K^i) - F_k^i K^i + r s^i n^i, \tau_K^i K^i).$$

The FOC then reads:

$$u_c(-F_{KK}^i \frac{\partial K^i}{\partial \tau} K^i + \frac{\partial r}{\partial \tau} s^i n^i) + u_z(K^i + \tau \frac{\partial K^i}{\partial \tau}) = 0.$$

Given a balanced capital account ( $s^i n^i = K^i$ ) this can be rearranged to

$$\frac{u_z}{u_c} = \frac{K^i}{K^i + \tau_K^i \frac{dK^i}{d\tau_K^i}}, \quad (5)$$

which is the marginal cost of public funds (MCPF).

**Proposition 1.** When the core city faces  $(m-1)$  competitors, the chosen tax rate in the core will be declining in  $m$ . Hence, the level of underprovision of public goods is increasing in the number of municipalities.



*Proof:* Solving equation (4) for  $\frac{\partial r}{\partial \tau^i}$  yields:

$$\frac{\partial r}{\partial \tau^i} = - \frac{1}{1 + (m-1) \frac{F_{KK}^i}{F_{KK}^j}}. \quad (6)$$

Deriving this with respect to the number of competitors  $m$  yields:

$$\frac{\partial \frac{\partial r}{\partial \tau^i}}{\partial m} = \frac{\frac{F_{KK}^i}{F_{KK}^j}}{(1 + (m-1) \frac{F_{KK}^i}{F_{KK}^j})^2} > 0.$$

Hence, the effect of a tax increase on the return to capital  $r$  becomes less negative. Plugging this into (2), the RHS of this becomes more negative and the MCPF (5) increases. Hence, the underprovision of public goods becomes more severe and the tax rate is declining.

**Proposition 2.** The core city will set a tax rate that is the higher, the larger the share of the core within its region in terms of capital.

*Proof:* Starting from (6), the impact of an increase in the share of capital of the core city ( $\frac{K^i}{K}$ ) reads:

$$\frac{\partial \frac{\partial r}{\partial \tau^i}}{\partial \frac{K^i}{K}} = \frac{(m-1) \frac{\partial \frac{F_{KK}^i}{F_{KK}^j}}{\partial \frac{K^i}{K}}}{(1 + (m-1) \frac{F_{KK}^i}{F_{KK}^j})^2} < 0.$$

Since the derivative in the numerator is negative, the impact of a tax increase on the return to capital will be stronger (more negative) when the capital share of the city is higher. Plugging this into (2) yields a smaller impact of a tax increase on the stock of capital in the core. Accordingly, the MCPF (5) will approach one from above, when the capital share of the core increases. Hence, there will be less of an underprovision of public goods and therefore a higher tax rate in the core

when the share of the core is larger.

### 3 German Municipalities and Competitive Regions

After having shown the results that are predicted by theory, we will try to test whether they can be confirmed by an empirical analysis. Because we rely on German data, it is necessary to have a look at the German institutions since their design might influence the results.

The tax system in Germany designates both the central government and municipalities to tax business income. While the *corporate tax* rate has to be taken as granted by the municipalities, they are free to raise a *local business tax* with an open-end rate. The rate to be chosen is the "rate of assessment", that has a lower bound of 200 points. Since this is to multiply in the formula of calculation by currently 3.5 % to obtain the percentage being taxed away, it equals a burden of 7 %. This lower bound has been introduced in 2004 so as to avoid single municipalities to attract firms at no local business tax at all.<sup>2</sup> The local business tax is the most important revenue for municipalities that they can influence with their policy. In 2007 it generated XXX % of municipal revenues on average.

Altogether there were 12263 municipalities in Germany in 2007. The trend of recent years shows a notable decline in the number of municipalities, in particular in eastern Germany, but also in other parts of the country. Apart from that one can observe significant differences in the municipal structure among the german states ("Bundesländer"). The state of Rhineland Palatinate, for

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<sup>2</sup>The municipality of Norderfriedrichskoog (about 40 inhabitants) in northern Germany had attracted some hundred firms until 2004 with a zero tax rate. The lower bound aims at preventing the emergence of such tax havens with phantom companies.

Table 1: Descriptive Statistics (Regions of 15 km)

Variable	Observations	Mean	Standard Dev.	Min	Max
Area Core City	119	170.3103	121.6815	4.2	891.02
Pop. Core City	119	181283.8	388881.6	1299	3416255
Number of other munic.	119	17.03361	13.91617	1	67
Share of Core (Pop.)	119	61.32559	13.19311	45.04064	100
Avg. tax rate Core	110	393.3636	45.6994	300	490

Table 2: Descriptive Statistics (Regions of 25 km)

Variable	Observations	Mean	Standard Dev.	Min	Max
Area Core City	108	158.3391	125.1925	4.2	891.02
Pop. Core City	108	197946.8	402457.4	1299	3416255
Number of other munic.	108	53.24074	36.51907	1	175
Share of Core (Pop.)	108	35.65327	14.73855	20.10426	100
Avg. tax rate Core	102	396.8137	42.62146	300	490

instance, has 2306 municipalities but the state of North Rhine-Westphalia just 396, though being characterized by almost equal areas.

A data set of all 12263 German municipalities in 2007 is employed, where information on the population, the area, the local business tax rate and some further derived measures is exploited. To measure the distance between municipalities, we rely on the geographical coordinates of the official central points of cities. The latter are well-defined in Germany and are typically some very central place in the centre of the municipality.

The strategy employed in this paper to identify differences in tax policies among regions dependent on the administrative structure is straightforward. Regions are defined – in the remainder of the text called "Competitive Regions" – around some more than 100 cities. Thereby a competitive

Table 3: Descriptive Statistics (Regions of 50 km)

Variable	Observations	Mean	Standard Dev.	Min	Max
Area Core City	111	157.4668	122.2477	4.2	891.02
Pop. Core City	111	211614.8	400225.3	1299	3416255
Number of other munic.	111	218.964	150.5956	3	912
Share of Core (Pop.)	111	12.29633	10.58789	5.023048	74.66116
Avg. tax rate Core	107	400.486	41.39965	300	490

region consists of all municipalities that have their central point within a certain distance (15, 25, or 50 km) to the core municipality. The criterion to identify the monocentric regions are population shares of the core of 45, 20, and 5 % of the total population, respectively. Hence, it can happen in some cases that these competitive regions overlap. For each of these competitive regions the average population of the municipalities (apart from the core) or the number of municipalities within it is counted, which serves as a measure for the degree of separation in the design of municipal borders. Also the share of population of the core city relative to the remaining municipalities in the region is calculated. Tables 1 through 3 provide descriptive statistics on the most relevant figures.

## 4 Empirical Results

We try to explain the local business tax rate of the core city. In order to identify the extent to which the borders of municipalities are of importance for the level of local business taxation we focus on two indicators. On the one hand it is the number or size (population) of municipalities around the core and on the other hand the share of the core. Because data on the share of capital is not available we use population shares instead.

Since local business taxation might be driven by other points than administrative aspects, a set of control variables has to be added. These concern basically population figures. It can be considered rather likely to observe higher levels of taxation in more populated regions than in sparsely populated ones. Therefore population or population density figures are included to isolate the administrative effects.

A further important factor is the affiliation of a municipality to a state. A brief look on Figure 1 shows that the level of local business taxation depends crucially on the state the municipality belongs to. The likely reason for this to be the case may be the different designs of fiscal equalization schemes in the states, that are associated with different degrees of redistribution of fiscal resources between the municipalities and hence different incentives in setting tax rates.<sup>3</sup> Thus, state fixed effects are included to control for this aspect.

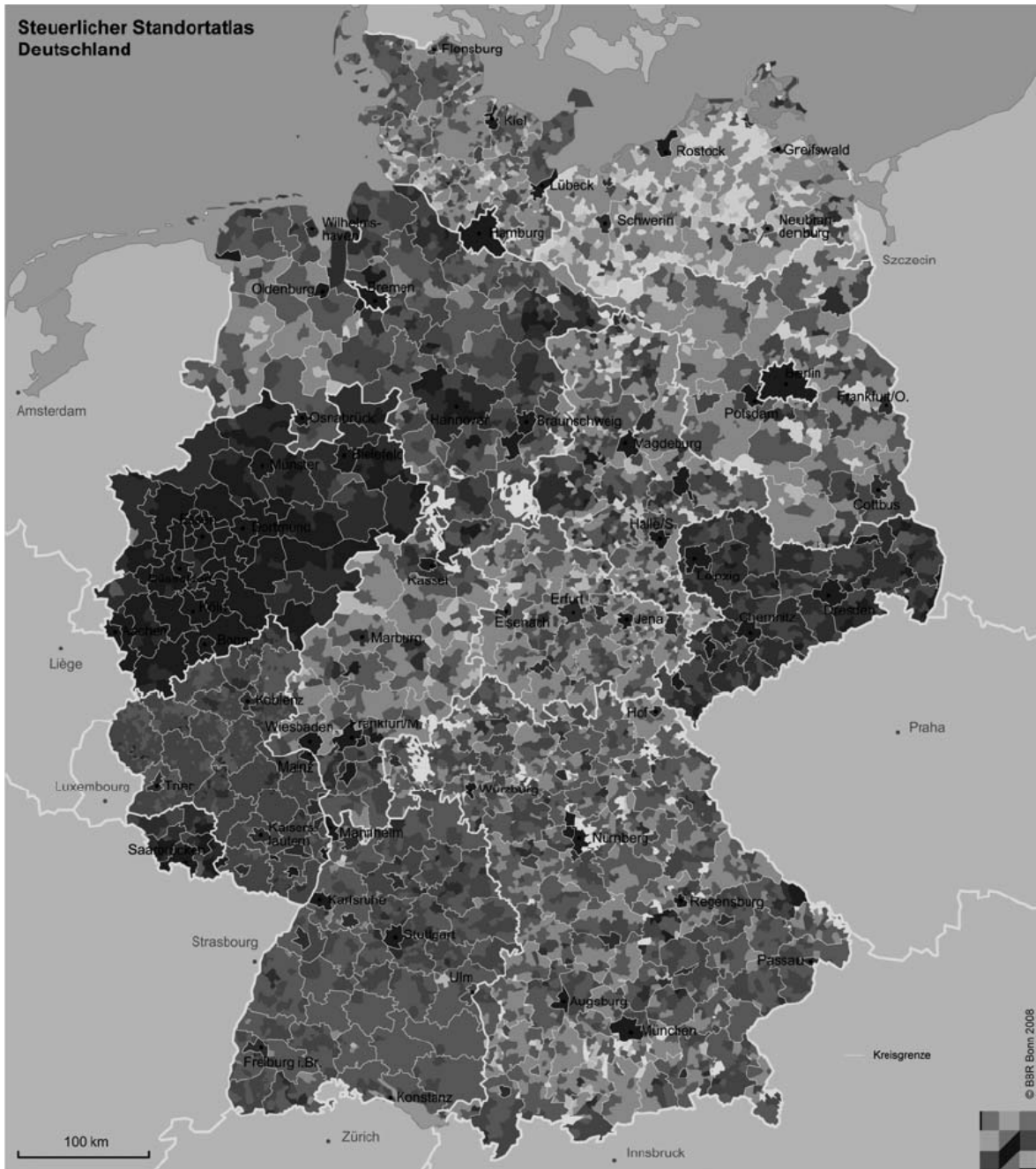
The following tables show the empirical results of different specifications, each of whom have been performed for competitive regions of a radius of 15, 25, and 50 km around the center of the core municipality, respectively. In Table 4 regions of 15 km are considered. As the first column shows, there is a highly significant impact of the size and hence the number of municipalities that are situated around the core. The share the city has in this region, however, does not prove significant. Since the regions here are defined in a narrow fashion, they do not consist of that much more than the core city itself. These results remain almost the same, when we control for the population density in the region, that does not prove significant (column 2).

The third column shows a negative effect of the number of municipalities on the tax in the core.

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<sup>3</sup>See Buettner (2006) for a theoretical and empirical analysis of this aspect. See Bucovetsky/Smart (2006) and Koethenbueger (2002) for further discussions.

Figure 1: Business Taxation in Germany (Source: German Ministry of Finance)



Dark areas indicate a high tax burden, light areas a low tax burden.

Table 4: Local Business Taxation in Monocentric Regions of 15 km

	(1)	(2)	(3)	(4)
Constant	117 *** (34.8)	159 *** (50.8)	294 *** (14.5)	115 *** (28.9)
log Pop. per municipality	31.3 *** (4.19)	25.9 *** (6.44)		
log number munic. region			-12.6 ** (5.68)	
Share of core city	-.017 (.261)	-.008 (.261)		.285 (.223)
Pop. density region		.013 (.012)		
log Pop. core and region				23.5 *** (2.47)
log Pop. region			29.7 *** (3.59)	
R <sup>2</sup>	0.673	0.678	0.726	0.735
adj. R <sup>2</sup>	0.617	0.618	0.679	0.689
Observations	110	110	110	110

Dependent variable: Rate of assessment of the central municipality in the competitive region. Fixed-Effects estimation with state fixed effects. Standard errors in parentheses. A single star denotes significance at the 10% level, two stars at the 5% level, and three stars at the 1% level.

Furthermore, the population of the region has a positive effect on the level of taxation. As the last column shows, also the population of the core *and* the region implies a higher tax rate in the core city.

When we turn to regions of 25 km in Table 5, the effect of the size of the other municipalities matters still to about the same extent as it does in the case of 15 km regions. But now also the share of the city in this region proves important to explain the level of taxation in this city. The higher the share of the core city, the higher its taxes. Hence, the power a city has in its region is an important factor to explain the tax burden the firms have to bear. This holds also true when the population density of the region is added as a control variable – that has a positive impact on

Table 5: Local Business Taxation in Monocentric Regions of 25 km

	(1)	(2)	(3)	(4)
Constant	111 *** (38.7)	168 *** (50.1)	296 *** (16.6)	103 *** (26.2)
log Pop. per municipality	31.0 *** (5.05)	23.3 *** (6.61)		
log number munic. region			-17.1 *** (6.13)	
Share of core city	.539 ** (.246)	.461 * (.247)		.576 *** (.196)
Pop. density region		.035 * (.020)		
log Pop. core and region				23.7 *** (2.39)
log Pop. region			33.3 *** (4.50)	
R <sup>2</sup>	0.654	0.667	0.697	0.768
adj. R <sup>2</sup>	0.584	0.595	0.636	0.722
Observations	102	102	102	102

Dependent variable: Rate of assessment of the central municipality in the competitive region. Fixed-Effects estimation with state fixed effects. Standard errors in parentheses. A single star denotes significance at the 10% level, two stars at the 5% level, and three stars at the 1% level.

the tax either, as column (2) shows.

As the third column shows, the number of municipalities and hence competitors lower the tax rate in the core. This effect is now notably stronger than in the case of regions of 15 km. The population in the region is still a significant control variable, that is associated with higher taxation. In the last column the share of the core city is again a significant factor in explaining the tax rate of the core: The larger the share of the core, the higher its tax rate. The control variable population in core and region is still significant.

Table 6 shows the results for competitive regions that are defined as the municipalities within a



radius of 50 km around the city. Still both the size of the other municipalities and the share of the core prove important. Compared to the preceding definitions of regions the effect of the size of the competitors becomes less important though. This means that competitors that come from farther away are less important to explain the tax burden in the city than the municipalities that are close by. The effect of the core cities share in the region has become more important though. This means that a large share in a large region, and hence more power for the city, has a higher impact on the level of taxation than having a large share in a small region (and hence a weaker position).

Taking a look at the impact of the size or number of the municipalities around the core in columns (2) and (3) it shows that these are not important factors to explain the level of taxation as soon as we control for some population or population density variable (that prove significant). The last column confirms again the importance of the share of the core, also when the population in core and region is controlled for. As the coefficients of determination show, the specifications can explain about two thirds to three quarters of the variation, no matter what size the regions considered have.

## **5 Conclusion**

This paper considers the effects of the design of municipal borders on the level of local business taxation. A theoretical model of tax competition shows that the number of competitors lowers the level of taxation, while a larger share of the core city in the region increases its tax rate. German data confirm these results. In monocentric regions the size of municipalities around the core is

Table 6: Local Business Taxation in Monocentric Regions of 50 km

	(1)	(2)	(3)	(4)
Constant	197 *** (42.7)	300 *** (55.0)	261 *** (23.2)	137 *** (24.8)
log Pop. per municipality	17.9 *** (5.66)	3.10 (7.60)		
log number munic. region			-4.79 (7.15)	
Share of core city	2.29 *** (.367)	2.30 *** (.354)		.930 *** (.343)
Pop. density region		.071 *** (.025)		
log Pop. core and region				21.8 *** (2.63)
log Pop. region			27.18 *** (5.93)	
R <sup>2</sup>	0.661	0.689	0.617	0.788
adj. R <sup>2</sup>	0.596	0.625	0.544	0.747
Observations	107	107	107	107

Dependent variable: Rate of assessment of the central municipality in the competitive region. Fixed-Effects estimation with state fixed effects. Standard errors in parentheses. A single star denotes significance at the 10% level, two stars at the 5% level, and three stars at the 1% level.

accompanied by an increase in the level of taxation in the core, since tax competition becomes less fierce. This is because larger municipalities imply fewer competitors. The larger the competitive region that we consider, the less important this effect becomes. Furthermore, the higher the share of the core in its agglomeration the higher its tax rate. Hence, not just the competitors prove important, but also the position of the core city itself. The effect of the size of the core city becomes more important when the region that is considered becomes larger, since a certain share in a large region is associated with a more powerful position of this city than in a small region.

It remains left for future research to analyze whether reverse impacts exist. One could raise the question whether the level of business taxation exert effects on the administrative structure. Furthermore, the reaction of firms to the administrative structure could be considered. On the one hand it is of interest where firms locate *within* the agglomeration as a reaction to different designs of borders. On the other hand the question of beneficial aspects for the region from redesigning their borders, hence interregional aspects can be analyzed.

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