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IDENTIFYING LOCAL TAX MIMICKING: ADMINISTRATIVE BORDERS AND A POLICY REFORM

Thushyanthan Baskaran

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

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Identifying local tax mimicking: administrative borders and a policy reform

Thushyanthan Baskaran*

thushyanthan.baskaran@uni-goettingen.de

Abstract

This paper exploits an exogenous reform of the local fiscal equalization scheme in the German State of North Rhine-Westphalia to identify tax mimicking by municipalities in the neighboring state of Lower Saxony. The spatial lag regressions provide no evidence for the existence of strategic interactions in municipal business and property taxes. In contrast, traditional spatial lag regressions that rely on variation in neighbors' demographic, political, or economic characteristics for identification provide strong evidence for strategic interactions. This pattern of results indicates that most of the extant literature overestimates the importance of local tax mimicking.

Keywords: Tax mimicking, business tax, property tax, intergovernmental equalization

JEL codes: H20, H71, H77

*Corresponding author: Thushyanthan Baskaran, Department of Economics, University of Goettingen, Platz der Goettinger Sieben 3, 37073 Goettingen, Germany, Tel: +49(0)-551-395-156, Fax: +49(0)-551-397-417.

1 Introduction

Tax policies of local governments can be interdependent for several reasons. First, the tax competition literature argues that municipalities set tax rates to attract mobile tax bases. In this framework, a cut in tax rates by other jurisdictions provides incentives for a given jurisdiction to cut its tax rates as well (Wilson, 1986; Zodrow and Mieszkowski, 1986).[1] The second reason for local tax mimicking is yardstick competition: voters observe taxes and expenditures in other jurisdictions and evaluate the performance of their officials accordingly (Besley and Case, 1995). Officials, therefore, have an incentive to adjust their tax policies according to those in other jurisdictions. Yet another reason for interdependencies are benefit spillovers. If public goods provided by a given jurisdiction have benefits in other jurisdictions, these jurisdictions have to provide fewer public goods themselves. Such spillovers can lead to negative interactions in tax rates (Case et al., 1993).[2]

Following these theoretical arguments, several empirical papers have attempted to identify interactions in local tax rates. The common methodology is to estimate reaction functions using a spatial lag (SL) framework (Anselin, 1988).[3] The idea is that if there are tax policy interactions, tax rates in "other" municipalities should have a causal effect on the tax rate chosen by a given municipality (Brueckner, 2003).

Evidence for strategic interactions in the SL framework has been found in many different settings: the metropolitan areas surrounding Boston (Brueckner and Saavedra, 2001) and Barcelona (Sollé Ollé, 2003); Swiss cantons (Feld and Reulier, 2009; Schaltegger and Küttel, 2002); and Dutch (Allers and Elhorst, 2005), French (Leprince et al., 2007), Italian (Bor-

[1]However, the literature following the seminal contributions of Wilson (1986) and Zodrow and Mieszkowski (1986) has established various exceptions and qualifications to this basic result; see e. g. Wilson (1991),Wildasin (1998), Keen and Kotsogiannis (2002), Wilson and Wildasin (2004), and Wilson and Janeba (2005). See also Wilson (1999) for a survey.

[2]There are several preceding albeit informal treatments of local fiscal interactions, notably Tiebout (1956), Bradford and Oates (1971), Oates (1972), Brennan and Buchanan (1980) and Salmon (1987).

[3]Different terminologies are used to refer to spatial models of reaction functions. Following Allers and Elhorst (2005), I refer to the generic model that relates neighbors tax rates to the tax rate of a given municipality as a spatial lag model.

dignon et al., 2003), Belgian (Heyndels and Vuchelen, 1998), and German municipalities (Büttner, 2001).[4]

The main methodological difficulty in estimating strategic interactions in local tax policy is that the tax rates in other jurisdictions are by construction an endogenous variable in the SL framework. To address this endogeneity problem, many authors rely on instrumental variable (IV) regressions, e. g. Büttner (2001), Feld and Reulier (2009), and Sollé Ollé (2003).[5] Gibbons and Overman (2012), however, argue that most of the extant empirical evidence on local fiscal interactions using the IV methodology is unreliable. The crucial assumption in the typical IV model estimated in the literature is that the characteristics of other municipalities – e. g. local demographics, politics, or incomes – can be excluded from the second stage in which the tax rate of a given municipality is explained, and therefore used as an instrument for other municipalities' tax rates.

However, this assumption does most likely not hold in reality. To credibly identify strategic interactions in a spatial lag framework, it is necessary to induce exogenous variation in the tax rates of other jurisdictions. One source of exogenous variation that is increasingly used in the public finance literature are natural experiments. Yet only two studies have hitherto exploited natural experiments to study interactions in local fiscal policy within a spatial lag framework. Lyytikäinen (2012) relies on a policy-induced change in minimum tax rates set by the Finish central government on municipal property taxes. His results indicate that Finish municipalities do not interact in their tax policies. Parchet (2012)

[4]See Brueckner (2003) and Revelli (2005) for a survey of the literature.

[5]The second popular methodology is Maximum Likelihood (ML). This methodology, too, relies on exogeneity assumptions but additionally requires functional form and distributional assumptions. Studies on fiscal interactions that use the ML methodology are, for example, Case et al. (1993), Brueckner and Saavedra (2001), and Bordignon et al. (2003). Allers and Elhorst (2005) provide a breakdown of the number of studies using either the IV or ML methodology. Of the 19 studies in their list, 3 use ML, 14 use IV, and 2 use both.

relies on Swiss cantonal borders and interactions between cantonal and municipal income tax rates for identification. His results suggest that tax interactions exist.[6]

In this paper, I add to this small literature by employing an identification strategy that relies both on policy induced exogenous variation in tax rates and administrative borders to study interactions in local taxation of German municipalities. The policy reform in question are changes to the local fiscal equalization scheme in the state of North Rhine-Westphalia (*Nordrhein-Westfalen*, NRW) imposed by the state government in 2003. I demonstrate that these changes caused NRW municipalities to significantly increase their local business and property tax rates. I then exploit this significant increase in the tax rates of NRW municipalities to study tax competition in a sample consisting of municipalities located in the neighboring state of Lower Saxony (*Niedersachsen*, NDS).

The results show that local governments in NDS neither interact in business nor in property tax rates. To compare these results with those obtained by previous studies, I also estimate SL models using other municipalities' demographic and political characteristics as instruments for their tax rates. Consistent with the findings in most of the previous literature, I find in these regressions strong evidence for strategic interactions in tax rates. This pattern of results indicate that the evidence for local tax competition in the previous literature is due to invalid instruments. These findings hence confirm those of Lyytikäinen (2012) even though they are obtained with a different natural experiment and in a different institutional framework.

The remainder of this paper is structured as follows. I describe in the next section the SL framework for the estimation of fiscal interactions. Section 3 discusses municipal finance

[6]Two studies provide quasi-experimental evidence on tax policy interactions in frameworks different than the traditional spatial lag one. Eugester and Parchet (2011) use language borders between French-speaking and German-speaking Swiss regions to compare discontinuities between fiscal preferences and local income tax rates. Agrawal (2013) uses US state borders to study competition in local sales taxes. These authors find strong evidence for tax mimicking, and in particular for tax competition.

in Germany and details the 2003 policy reform in NRW. Section 4 introduces the empirical framework. Section 5 collects the estimation results. Section 6 concludes.

2 Fiscal interactions and the spatial lag model

Spatial interactions in tax policies are studied by linking tax rates in "other" jurisdictions to the tax rate in a given municipality. A corresponding empirical model can be specified in general terms as follows:

$$\tau_{i,t} = \sum_{j \neq i} \delta_{j,t} \tau_{j,t} + \mathbf{x}_{i,t} \boldsymbol{\beta} + \epsilon_{i,t}, \tag{1}$$

where $\tau_{i,t}$ is the rate of a municipality i in year t for some municipal tax, $\tau_{j,t}$ is the tax rate of another municipality $j \neq i$, $\mathbf{x_{i,t}}$ is a vector of control variables , and $\epsilon_{i,t}$ the error term.

Most authors estimate a simplified version of Equation (1). They assume, first, that the nature of the strategic interactions between two municipalities is constant over time. Second, they impose some structure on the spatial pattern of the interactions. Rather than estimating interactions between municipality i and all other municipalities included in the sample, most empirical models estimated in the literature incorporate the assumption that a municipality i reacts only to the tax policy in a few selected other municipalities. Moreover, to facilitate interpretation, the tax rates in these selected municipalities are also not related individually to the tax rate of municipality i but jointly in the form of a weighted average.

The standard model estimated in the literature is therefore as follows:

$$\tau_{i,t} = \delta \sum_{j \neq} w_{i,j} \tau_{j,t} + \mathbf{x}_{i,t} \boldsymbol{\beta} + \epsilon_{i,t}, \tag{2}$$

where $\sum_{j\neq} w_{i,j}\tau_{j,t}$ is the weighted average of the neighbors' tax rates and $w_{i,j}$ is the weight of municipality j's tax rate in the weighted average. A significant coefficient estimate for δ is interpreted as evidence for strategic interactions.

The correct weights are unknown. Therefore, authors experiment with different weighting schemes. Most authors base the weights on geographical proximity. More specifically, a common weighting schemes gives all neighboring municipalities (i. e. municipalities that share a border with municipality i) the same weight. Other popular weighting schemes weigh neighboring municipalities according to their population size or their geographical distance from municipality i.

While Model (2) has a simple linear structure, it cannot be consistently estimated with OLS. If municipalities interact strategically in their tax policies, then the tax rate of a municipality i and those of its neighboring municipalities are by construction simultaneously determined (Brueckner, 2003). One solution to this endogeneity problem is to instrument the weighted average tax rate $\sum_{j\neq i} w_{i,j}\tau_{j,t}$. As instruments, authors typically use weighted averages of the neighbors' characteristics. That is, $\sum_{j\neq} w_{i,j}\tau_{j,t}$ is instrumented with $\sum_{j\neq} w_{i,j}x_{j,t,k}$ with k indicating a particular control variable. Popular instruments are, for example, variables related to the neighbors' population structure or income levels.

While neighbors' characteristics are common instruments for their tax rates, such instruments are not truly exogenous. First, it is plausible that the neighbors' tax policies have a direct effect on their own demographic structure, income levels, and other characteristics. Second, spatially correlated omitted variables might influence both neighbors' characteristics and the tax rate in municipality i. Third, the characteristics of neighboring municipalities might have a direct effect on municipality i's tax policy. In summary, the exclusion restriction is most likely not fulfilled when municipal characteristics are used as instruments (Gibbons and Overman, 2012).

To credibly identify fiscal interactions, it is necessary to rely on truly exogenous variation in the tax rate of neighboring municipalities. A reform of the local fiscal equalization scheme implemented by the state government of North Rhine-Westphalia in 2003 results in such exogenous variation for NDS municipalities located at the border to NRW. I describe this reform and provide some institutional details in the next section.

3 Institutional details

3.1 Municipal finance in Germany

The federal constitution of Germany guarantees all municipalities a degree of fiscal autonomy. In particular, municipalities can autonomously determine the rates for the business (*Gewerbesteuer*) and property taxes (*Grundsteuer*). Technically, municipalities do not choose a tax rate but a tax multiplier (*Hebesatz*) for these taxes. The multiplier is multiplied with a tax base that is calculated according to stipulations that are identical throughout the federation. Since the definition of the base is fixed for an individual municipality, the multiplier determines the effective tax rate. Therefore, I use in the following tax multiplier and tax rate interchangeably.

The business tax is levied by each municipality on all firms located within its boundaries. The tax base are net firm profits, even though some adjustments are made, for example regarding interest payments. It is an important tax for municipalities: total revenues in the federation from the business tax in 2010 were 32.42 Billion Euro[7].

Two property taxes exist in Germany. First, a tax on agricultural properties (*Grundsteuer A*). Second, a tax on developed properties (*Grundsteuer B*). In terms of revenue, the *Grundsteuer B* is much more important than the *Grundsteuer A*. Total revenues in

[7]Source: German Federal Statistical Office. Note that municipalities have to share business tax revenues with higher tiers of government (*Gewerbesteuerumlage*). Nevertheless, most of the revenues accrue to them.

the federation from the *Grundsteuer B* in 2010 were 9.62 Billion Euros[8], while total revenues from the *Grundsteuer A* were 0.36 Billion Euro[9]. Given that the *Grundsteuer A* is relatively unimportant, I focus in this paper only on the *Grundsteuer B* and refer to it as property tax.[10]

Municipalities receive revenues from several other sources. First, they are entitled to revenues from taxes that are shared with the federal and the state governments. Most notably, municipalities are currently entitled to 15% of the income tax revenues raised within their administrative boundaries and to 2.2% of the value added tax revenues.[11]

Apart from tax revenues, municipalities receive substantial transfers from local equalization schemes. The local equalization schemes in the German States consist of various rule-based and discretionary transfers. The majority of transfers are rule-based (*Schlüsselzuweisungen*). While the details vary both between states and over time (see below for a more thorough description of the equalization schemes in NRW and NDS), the rule-based transfers have a similar structure throughout the federation.

First, the state government allocates ex-ante some amount of resources to the various transfer programs.[12] Total municipal transfers cannot exceed this fixed amount. Then a measure for a municipality's fiscal need is calculated. While there are many details (see below) [13], the fiscal need measure is essentially designed to be the same for all municipalities. The idea is that in a given fiscal year, all municipalities have similar fiscal needs per

[8] Source: German Federal Statistical Office.

[9] Source: German Federal Statistical Office.

[10] In addition, I find (in unreported regressions) that municipalities in NRW responded only very weakly with their *Grundsteuer A* multipliers to the reform of the fiscal equalization scheme in 2003 – presumably because this tax is of little importance for municipal budgets. Since there is no meaningful variation in the *Grundsteuer A* after the reform, the first stage in IV regressions turns of to be very weak for this tax.

[11] As indicated above, the business tax is technically a shared tax as well.

[12] While the state constitutions forces state governments to provide sufficient revenues to their municipalities, state governments have leeway in determining how much to allocate to the local equalization scheme in a given year.

[13] See also e. g. Baskaran (2012) for a more thorough discussion of the details regarding the fiscal need measure.

capita. Additionally, the individual fiscal need measures take the total amount of available resources for the transfers into account.

Finally, fiscal need per capita is then compared to a municipality's fiscal capacity per capita. This measure is supposed to reflect the *ability* of a municipality to raise tax revenues. It takes into account revenues from both shared (income and value added tax) and municipal taxes (business and property taxes). Crucially, the fiscal capacity measure does not reflect actual revenues from municipal taxes but instead "normalized" revenues that a municipality could raise if it imposed "standardized" tax multipliers.[14]

Fiscal need per capita is compared with fiscal capacity per capita. Transfers are paid according to the difference between both measures. The difference between fiscal need and fiscal capacity per capita is compensated up to a certain fraction. Municipalities that have a higher fiscal capacity than fiscal need receive – depending on the state – either some minimum amount of transfers, no transfers, or even have to pay transfers themselves.

3.2 Consequences of the intergovernmental transfer schemes for local tax mimicking

The fiscal equalization schemes clearly reduce incentives to engage in tax competition as larger tax bases imply lower transfers (Kelders and Koethenbuerger, 2010). However, it is unclear to what extent such incentives are diminished. First, the equalization formulas in the German States only skim off a fraction of increases in the tax base. Most municipalities would still see an increase in tax revenues if their tax base increased. Second, attracting firms and high-income individuals through low business and property taxes entails benefits beyond higher revenues: for example lower municipal unemployment rates and positive peer effects.

[14] For the shared taxes, actual revenues are already equivalent to "normalized" revenues since municipalities have no autonomy over these taxes.

While the local equalization schemes reduce incentives to engage in tax competition, they might actually incentivize municipalities to engage in yardstick competition. The equalization schemes ensure that all municipalities have sufficient revenues to provide essential public goods and thereby raise all municipalities to a comparable footing. However, the elected municipal councils have the ability to raise further revenues through business and property taxes if they want to provide additional public goods. It is likely that voters take note of how any additional revenues are spent by comparing the tax-expenditure bundle in their municipality with those in neighboring ones. Such comparisons should be easily feasible at the level of the German States given that the local media serves multiple municipalities simultaneously.

Benefit spillovers are potentially important at the local level in Germany as well. While essential municipal services such as schools or care for the elderly are excludable, municipalities also provide on a voluntary basis many de facto non-excludable public goods such as hospitals, cultural venues (e. g. theaters), and recreational facilities. It is plausible that a municipality offers fewer voluntary public goods if such goods are already available in neighboring municipalities. The intergovernmental transfers scheme should not have a dampening effect on benefit spillovers as municipal expenditures do not affect transfers in any way.

The existing empirical evidence points toward the existence of local tax interactions in Germany. Büttner (2001) finds significant neighborhood effects in the business tax multiplier chosen by municipalities located in the state of Baden-Wuerttemberg.[15] Hauptmeier et al. (2012) also find evidence for tax policy interactions in the same state.

[15]However, Büttner (2003) finds in another study for Baden-Wuerttemberg that only small municipalities react to their neighbors' tax rates.

3.3 North Rhine-Westphalia and the reform of local fiscal equalization in 2003

The local fiscal equalization schemes are based on state laws. These laws change regularly, but changes typically only concern details. Major reforms only happen every few years. In this paper, I use a such a secular change to the regulations governing local equalization in NRW in 2003 as a source of exogenous variation to identify local tax mimicking in the neighboring state of NDS. NRW is the largest German State in terms of population size: in 2011, 17.8 Million inhabitants lived within 396 municipalities. NDS, which shares a long border with NRW (583 km), has 7.9 Million inhabitants. The number of municipalities has declined over time in NDS because of municipal amalgamations. In 2011, NDS had 1033 municipalities.[16] Figure 1 shows the location of both states within Germany together with municipal boundaries.

To understand why the reform in NRW should affect local tax rates, I first describe the equalization scheme in NRW in detail. As indicated in the previous section, in all German States the rule-based transfers are allocated to municipalities according to the difference between their fiscal need and their fiscal capacity. Denote fiscal need per capita of municipality i in year t with $n_{i,t}$ and fiscal capacity with $c_{i,t}$. The formula for rule-based transfers per capita $t_{i,t}$ employed in NRW both before and after 2003 can then be written as follows:

$$g_{i,t} = \begin{cases} 0.9(n_{i,t} - c_{i,t}) & \text{if } n_{i,t} > c_{i,t} \\ 0 & \text{else.} \end{cases} \quad (3)$$

Municipalities that have a smaller fiscal capacity than fiscal need receive 90 percent of the difference as rule-based transfers. Municipalities that are fiscally abundant (have a

[16] For administrative purposes, many municipalities in NDS are organized in "joint communities" (*Samtgemeinden*) to benefit from economies of scale. However, tax rates are independently chosen by the individual member municipalities.

higher fiscal capacity than need) receive no transfers, but do not have to pay any transfers either.

The crucial components of this formula are the measures for fiscal need per capita and fiscal capacity per capita. The fiscal need measure for a municipality i is essentially determined by dividing total resources allocated to the transfer scheme with an adjusted population size figure for municipality i. More specifically, it is assumed that more populous municipalities have a disproportionately larger fiscal need.[17] To account for this disproportionality, the number of inhabitants in each municipality is weighted with a factor that increases in population size.[18]

As indicated above, fiscal capacity is determined by the value of the tax base in a given municipality. For the municipal taxes, the value of the tax bases is established by dividing municipal revenues with the respective municipal tax multipliers since municipalities have the ability to choose different tax multipliers (in contrast to the shared taxes for which rates are set by the federal government) and then multiplying with a standardized "hypothetical" tax multiplier set by the state government (*fiktiver Hebesatz*). The state-wide multiplier is the same for all municipalities. More formally, fiscal capacity $c_{i,t}$ can be written as follows:

$$c_{i,t} = \sum_{m} r_{i,t,m} \frac{\overline{d}_{t,m}}{d_{i,t,m}} + r_{\text{shared}}, \qquad (4)$$

where $r_{i,t,m}$ indicates revenues per capita from municipal tax m (i. e. property and business taxes) of municipality i in year t, $d_{i,t,m}$ refers to the multiplier for the tax m, and $\overline{m}_{t,m}$ refers to the state-wide tax multiplier fixed by the state government. Revenues per capita from the shared taxes are denoted by r_{shared}

[17]This assumption underlies the fiscal equalization formulas of most German states. The theoretical rationale is Brecht's Law (Brecht, 1932), which enjoys widespread popularity in Germany.

[18]Further albeit minor adjustments are made. For example, the fiscal need measure also takes the number of school children and unemployed into account.

The state multipliers are supposed to be based upon the weighted average multipliers in the state (Innenministerium Nordrhein-Westfalen, 2010). However, they usually do not change from year to year. But in 2003, the state government decided to raise the state multipliers for the business tax and the two property taxes substantially because the actual average tax multipliers had increased after the last adjustment of the state-multiplier in 1996.

The reason for the increase in the state multipliers was therefore an attempt to align them with the weighted average of the actual municipal multipliers. Since the municipal tax multipliers are weighted, developments in the large cities in NRW have a disproportionate influence on the values for the state multiplier. It is consequently likely that the adjustments were not specifically driven by developments in municipalities located close to the border to NDS, and it is even more plausible that the adjustments were not driven by NDS municipalities located at the border to NRW.

In 2002, the NRW state multiplier for the business tax was 380 and for the property tax B 330.[19] With the equalization law of 2003, the state multiplier for the business tax was raised to 403 and for the property tax B to 381.[20]

Given that the total amount of resources allocated to the local equalization scheme did not change significantly from 2002 to 2003[21], the adjustments of the state multipliers should only have minor effects on the final allocation of transfers.[22] Consequently, municipalities' tax multiplier responses should be negligible as well. In practice, however, it turns out that the adjustments have considerable effects on municipal multipliers.

[19] Source: NRW GFG 2002. The state multiplier for the property tax A was 175 in 2002.

[20] Source: NRW GFG 2003. The state multiplier for the property tax A was raised to 192.

[21] According to the equalization laws of 2002 (NRW GFG 2002), 4.576 bn. Euros were allocated by the state government for rule-based transfers. In 2003, the state government allocated 4.581 bn.

[22] Equation (4), it shows that the state multiplier scales up fiscal capacity of each municipality by a constant factor. By differentiating Equation 4 with respect to $\bar{d}_{t,m}$, it can also be seen that municipalities with more valuable tax bases will be assessed with a disproportionately larger fiscal capacity if the state tax multipliers increase, and thus will receive relatively fewer transfers. However, these effects should be only of secondary importance.

First, the state multipliers send a strong signal to all municipalities about what multipliers the state government expects them to choose. The state multipliers thus set effectively a reference point. Second, the (wrong) belief that choosing multipliers smaller than the state multipliers will directly result in lower transfers is wide-spread (DIHK, 2009). This misconception provides an additional explanation for a positive effect of the state multiplier adjustment on actual municipal multipliers. Third, the increase in the state multipliers limited the negative tax base effects if a municipality increased its actual multiplier. Equations (3) and (4) show that any decreases in the tax base because of higher municipal tax multipliers would be almost fully compensated by higher transfers up until the new state multipliers (see Equation (3)).[23]

The 23 and 51 point (or 6 and 12 percent) increases in the state multipliers for the business and property tax, respectively, hence incentivized municipalities to raise their actual multipliers. Figures 2 and 3 show that the municipalities in NRW responded to these incentives. Subfigure (a) of Figure 2 plots the development of the (unweighted) average business tax multiplier in NRW and NDS from 2000 to 2010. Before 2003, there is a moderate upward trend in NRW. From 2002 to 2003, however, the series jumps noticeably by 13.6 points. From 2004 onward, the series picks up its moderate upward trend. No corresponding jump is observable in 2003 in municipalities located in NDS.

Subfigure (b) plots the average business tax multiplier in the 38 NRW and 50 NDS municipalities that are located at the each side of the border between NRW and NDS. The reason for plotting border municipalities is that I will be focusing on them for identifying interactions in tax multipliers. In this subfigure, the 2003 jump in the average of the multiplier in NRW border municipalities is even clearer than in the full sample: the series jumps by 20.7 points. No corresponding jump is observable in NDS border municipalities

[23] Various theoretical and empirical studies confirm that such fiscal equalization schemes lead to higher equilibrium tax rates, see e. g. Koethenbuerger (2002), Büttner (2006), Smart (2007), Kelders and Koethenbuerger (2010), and Egger et al. (2010).

in 2003. There is, however, a drop in the NDS series in 2006. I discuss this drop in more detail further below.

Subfigure (a) of Figure 3 presents the corresponding plots for the property tax. Both in the full sample and in the restricted sample with only border municipalities, a large increase in the average tax multiplier is observable in 2003 for NRW municipalities (36.5 and 49.4). While the average tax multiplier continuously increases in NDS, there is not a single year in which a comparable discontinuous rise is observable in this state.

Table 1 validates the graphical evidence with regression results. It collects results for difference in difference regressions with a sample consisting of almost[24] all municipalities in NDS and all municipalities in NRW. The model is:

$$d_{i,t,m} = \quad \mathit{GFG\ 2003}_{i,t,m} + \gamma_i + \delta_t + \epsilon_{i,t,m}, \tag{5}$$

were $d_{i,t,m}$ is the multiplier for either the business or property tax (m = business tax, property tax), *GFG 2003* is a dummy variable that is 1 for NRW municipalities in 2003 and 0 else, γ_i are cross-section fixed effects, δ_t are time fixed effects, and ϵ is the error term.

Consistent with the graphical evidence, I find that the dummy capturing the reform in NRW has a positive and significant effect on the business and property tax rates. When the sample consists of all municipalities, the reform causes an average increase of the business tax multiplier of 9.7 and of the property tax multiplier of 30.6 points. When the sample is restricted to border municipalities, the estimated effect is larger, just as in the graphs. According to these estimates, the reform leads to an increase of 17 points in the business tax and 42.4 points in the property tax multiplier.

There is hence a discontinuous increase in the tax multipliers of NRW municipalities in 2003 because of the reform. The idea for the remainder of this paper is to explore in a

[24] I drop those NDS municipalities that were amalgamated up until 2011. I use 2011 as cutoff because my GIS data, which I use to estimate the spatial lag models, is from this year.

spatial lag framework whether NDS municipalities located at the border to NRW react to the large and arguably exogenous increase in municipal tax rates in NRW.

3.4 Fiscal equalization in Lower Saxony

Lower Saxony's fiscal equalization scheme in 2002-2003 generally functioned in a similar fashion as the one in NRW. In particular, transfers were paid by comparing a measure for fiscal capacity with a measure for fiscal need. There were differences in some details, however. For example, the compensation rate with which the differences between fiscal capacity and fiscal need are equalized was non-linear (rather than being fixed at some constant factor as in NRW).[25]

As in NRW, hypothetical rather than the actual tax multipliers were used to calculate a municipality's fiscal capacity. In contrast to NRW, however, the hypothetical state multipliers varied between municipalities. Different (higher) state multipliers were used for the six municipalities over 100 000 inhabitants than for the remaining municipalities. But the state multipliers were constant for municipalities within the two groups. The state multipliers also varied from year to year for the two groups, but only marginally. In 2002, the state multiplier for municipalities with less than 100 000 inhabitants for the business tax was 307 and for the property tax B 293.[26] In 2003, the multipliers were 308 and 294, respectively.[27]

[25] Egger et al. (2010) provide a detailed description of the local equalization scheme that prevailed around 2003 in NDS.

[26] For the property tax A, the state multiplier for municipalities with less than 100 000 inhabitants in 2002 was 283. For the municipalities with more than 100 000 inhabitants, the multipliers in 2002 were: business tax: 383, property tax B: 419, property tax A: 313. See Niedersächsisches Landesamt für Statistik (2003a).

[27] For the property tax A, the state multiplier for municipalities with less than 100 000 inhabitants in 2003 was 284. For the municipalities with more than 100 000 inhabitants, the multipliers in 2003 were: business tax: 380, property tax B: 418, property tax A: 313. See Niedersächsisches Landesamt für Statistik (2003b).

Therefore, there was no change in the NDS state-wide multipliers from 2002 to 2003 that would be comparable to the one in NRW. Any potential responses in tax multipliers in NDS border municipalities in 2003 can therefore be attributed to the higher tax rates in NRW municipalities. Similarly, any absence of a reaction cannot be explained by adjustments of the state multipliers in NDS that were specifically designed to counteract the state multiplier increases in NRW.

4 Empirical framework

4.1 Model

To identify tax policy interactions with the reform, I use a standard SL framework as specified in Equation (2). As I rely on the reform on the NRW GFG in 2003 for identification and in order to account for fixed effects, I estimate the model in first-differences for the year 2003[28]:

$$\Delta\tau_{i,t=2003} = \delta\Delta\sum_{j\neq} w_{i,j}\tau_{j,t=2003} + \Delta\mathbf{x}_{i,t=2003}\boldsymbol{\beta} + \epsilon_{i,t=2003}. \tag{6}$$

That is, I explore whether the change in the weighted average business or property tax multiplier of neighboring municipalities from 2002 to 2003 affects the change in the business or property tax multiplier of municipality i.

I use three weighting schemes. First, simple contiguity weights. In this weighting scheme, all municipalities that share a border with municipality i receive the same weight. I refer to this weighting scheme as $\mathbf{W}^{cont}$. Second, I use distance based weights. All municipalities j receive weights according to the distance of their centroids to the centroid of municipality i. More specifically, if the centroid of a municipality j is within 10 km of the centroid

[28] Besley and Case (1995), Revelli (2001), and Lyytikäinen (2012) use a similar specification.

of municipality i, municipality j receives a weight based on its actual distance. If the centroid is beyond 10 km, municipality j receives a weight of 0 in the weighted average for municipality i.[29] The idea underlying this weighting scheme is that municipalities react more strongly to closer municipalities, but that municipalities beyond 10 km are so far away that they will be effectively ignored by municipality i. I refer to this weighting scheme as $\mathbf{W}^{dist}$. Third, I modify the contiguity weights to account for population size: contiguous municipalities receive larger weights if they have more inhabitants. The idea is that a municipality i reacts more strongly to the tax policy of a large municipality j. I refer to this weighting scheme as $\mathbf{W}^{pop}$.

As argued above, $\Delta \sum_{j \neq} w_{i,j} \tau_{j,t=2003}$ is endogenous irrespective of the weighting scheme used. I employ two strategies to address this endogeneity problem. First, I follow the traditional literature and instrument the weighted average of the neighbors' tax rate with municipal characteristics. The first stage in these regressions is hence

$$\Delta \sum_{j \neq i} w_{i,j} \tau_{j,t=2003} = \alpha \Delta \sum_{j \neq i} w_{i,j} x_{i,t=2003,k} + \nu_{i,t=2003}, \tag{7}$$

where x_k are either demographic or political variables.[30] While municipal characteristics are in all likelihood invalid instruments (Gibbons and Overman, 2012), the results in these models offer a useful baseline against which the results from the second strategy can be evaluated.

The second strategy for identification relies on the policy reform in NRW, which induced an exogenous increase in the neighbor's tax rates for NDS municipalities located at the border to NRW. More specifically, I instrument $\Delta \sum_{j \neq} w_{i,j} \tau_{j,t=2003}$ with a dummy variable that indicates whether a NDS municipalities i borders a NRW municipality:

[29] Note that with this neighborhood definition, even contiguous municipalities can receive a weight of 0 if their centroids are sufficiently far from the common border.

[30] I have also experimented with income per tax payer as an instrument. However, this instrument turned out to be very weak. Results are therefore not reported.

$$\Delta \sum_{j \neq i} w_{i,j} \tau_{j,t=2003} = \alpha \text{BM}_{i,t=2003} + \nu_{i,t=2003}, \tag{8}$$

with $\text{BM}_{i,t=2003} = 1$ if a NDS municipalities borders NRW and 0 else.

As documented above, NRW municipalities – including those located at the border to NDS – increased their business and property tax multipliers discontinuously in 2003. The rationale underlying Equation (7) is that the weighted average of the neighbors' tax rate of NDS municipalities located at the border to NRW should then increase discontinuously as well. As it is unlikely that the NRW state government implemented the change to the equalization scheme in view of tax rates in NDS border municipalities, the tax multiplier increases in NRW can be treated as exogenous from their perspective.

4.2 Discussion

While the policy change in NRW was exogenous to NDS municipalities, relying on this change to identify local tax competition in NDS has some limitations. The model specified by Equations (6) and (8) essentially studies whether Lower Saxonian municipalities located at the border to North Rhine-Westphalia react to tax increases in NRW municipalities. The corresponding estimate is a local average treatment effect (LATE) that is obtained for a limited number of treated units (Angrist and Pischke, 2009). The external validity of the findings depends on whether the border municipalities are comparable to the remaining municipalities in NDS. One way to appraise whether both sets of municipalities are similar is to compare their observable characteristics. Table 2 reports descriptive statistics for the 50 border and the remaining 972 interior[31] municipalities. It compares for the closest available pre-treatment year (2001 or 2002) the average tax rates and the averages of demographic, political, and income variables in border and interior municipalities. The

[31] I call for simplicity the NDS municipalities that border other states than NRW interior municipalities, too.

demographic variables are the share of inhabitants below 15 and over 65 years old. The political variables are the vote shares of the main political parties in Germany: the conservative CDU, the left-wing SPD, the pro-market FDP, and the environmentalist Green Party. The income variable is gross income in a municipality divided by the number of tax payers.

In general, border and interior municipalities are not significantly different. I find a statistically significant difference only for the property tax rate and the vote share of the FDP. However, these differences are not very big. The property tax multiplier in interior municipalities is about 20 points higher and the vote share of the FDP 1.3 points lower than in border municipalities.

Second, it is problematic that the causal effect of the neighbors' tax policy is identified by the reaction of only 50 municipalities in NDS that are located along the border to NRW. The size of treatment group relative to that of control group is thus relatively small. However, there is no reason why 50 municipalities should not be sufficient to identify tax policy responses. A more serious problem related to the small number of treated municipalities is that the treatment group is geographically concentrated. As all treatment municipalities are located to the border to NRW, confounding spatial shocks might bias the result. However, such shocks must follow the border between NRW and NDS closely, which seems unlikely given that the border is very long and highly non-linear.

A third concern about the identification strategy is that variation in tax rate of municipalities located outside of NDS is used to identify tax mimicking by NDS municipalities. It is possible that the state border constitutes such a strong barrier that neither tax nor yardstick competition nor budget spillovers result in meaningful tax policy interactions. That is, if NDS municipalities did not react to exogenous increases in NRW tax rates, this must not necessarily imply that they would not react to tax rate changes in NDS municipalities.

However, it is unlikely a NDS municipality will respond differently to the tax rates of NRW municipalities than to those of other NDS municipalities. First, the border represents neither for citizens nor for firms a meaningful restriction as both people and goods can cross freely. Given the availability of (toll-free) federal highways and a well-developed interstate railway network, travel times between and within states are very similar. Second, differences in laws and other institutional features between NRW and NDS, while present, are relatively small given the cooperative nature of Germany's federalism. With respect to taxation, in particular, the institutional environment in both states is practically identical. Most notably, the tax bases for the business and property property taxes are the same.

5 Results

5.1 Traditional instruments

In this section, I report estimation results for Equation (6) obtained with the type of instruments used in the previous literature, i. e. using a first stage as specified in Equation 7. More specifically, I instrument $\Delta \sum_{j\neq} w_{i,j}\tau_{j,t=2003}$ with (i) the first difference of the demographic structure – share of under 15 and over 65 year olds – and (ii) the vote share of the four national parties – CDU, SPD, FDP, and Green Party – in the neighboring municipalities. For the demographic variables, I use a sample that only covers 2003. The results with these instruments hence closely mirror those with the border municipality instrument below, which are also obtained for a sample that covers 2003. However, since the political variables only change in election years, I average the data over the legislative periods 2001-2005 and 2006-2010 and then take the first-difference.

The results with the traditional instruments for the business tax multiplier are reported in Table 3. The strength of the instruments varies somewhat. The Cragg-Donald and Kleibergen-Paap F statistics are large for the demographic variables for every weighting scheme, indicating that these instruments are strong. For the political variables, the weak identification statistics vary. The political variables have low weak identification statistics for the contiguity weights, mediocre ones for the distance weights, and large statistics for the population weights.[32] The Hansen-J overidentification tests display large p-values, thereby supposedly indicating that the instruments are valid (the test statistic is only significant in Model V).

The estimates for the weighted average of the neighbor's tax rate display in general a positive and significant coefficient, thereby suggesting the existence of strong positive interactions in tax policies. However, some of the coefficient are implausibly large. For the contiguity and distance weighting schemes, the estimated coefficients are larger than 1, which would imply explosive behavior. For the population weighting scheme, the estimates are more plausible. While they continue to suggest positive interactions, the coefficients are between 0.45 and 0.79.

The corresponding results for the property tax are collected in Table 4. These results mirror those for the business tax. The diagnostic statistics perform well. The coefficient estimates, while again implausibly large for some weighting schemes, suggest the existence of positive strategic interactions.

This pattern of results – well-performing diagnostic tests and significantly positive coefficient estimates – seemingly provides strong evidence for positive tax policy interactions. However, even though the Hansen-J tests is typically not rejected, it is problematic that the instruments are not truly exogenous. In particular, overidentification tests are only valid if at least one of the instruments is truly exogenous. Moreover, the exceptionally large coefficient estimates suggest that the results are in reality driven by unobserved spatially

[32] Weak instruments are not uncommon in applications that use traditional instruments. Lyytikäinen (2012) notes that weak identification is the reason why the extant literature relies primarily on cross-sectional estimators.

correlated variables. In the next section, therefore, I report results obtained with a more credible instrument and compare these results with those reported in this section.

5.2 Border municipalities instrument

In this section, I reestimate Equation (6) while using Equation (8) as first stage model. The first and second stage results for the business tax multiplier are reported in Table 5. The first stage results indicate that the instrument has, as expected, a positive and highly significant effect on the weighted average of the neighbors' tax rates: irrespective of the weighting scheme, the weighted average of the neighbors' tax multiplier increases more for border municipalities than non-border municipalities in 2003. The effect is statistically significant in all models. Depending on the weighting scheme, the coefficient is between 2.5 and 9.4 points. Consistent with the statistical significance of the instruments in the first stage, the Cragg-Donald and Kleibergen-Paap weak identification F statistics reported at the bottom of the table indicate that the instrument is strong.

The second stage results, however, provide no evidence for interactions in tax policy. The estimated coefficient for the weighted average of the neighbors' tax rate is insignificant, irrespective of the weighting scheme used. The size of the coefficient is between -0.09 and -0.29. The estimated coefficients are hence not only substantially smaller in absolute terms than those reported in Table 3, but even negative. The width of the 95% confidence intervals varies between the weighting schemes. The confidence interval for W^{cont} (-0.67,0.31) and W^{dist} (-1.26,0.67) are fairly large, while the interval for W^{pop} (-0.32,0.14) is smaller. Irrespective of the width of the confidence intervals, however, the results in Table 5 indicate that traditional instruments result in estimates that are upwardly biased.

Table 5 presents the first and second stage results for the property tax. The results mirror those for the business tax. The instrument has a statistically significant positive effect on the weighted average of the neighbors tax rate. Depending on the weighting scheme used, the weighted average increases by 9.39 to 23.98 points. The weak identification tests statistics are sufficiently large to rule out weak instruments. Nevertheless, the second stage results provide no evidence for strategic interactions. The estimated coefficient is insignificant and between 0.05 and 0.13. The 95% confidence intervals in these regressions are smaller than for the business tax regressions: (-0.15,0.30) for W^{cont}, (-0.21,0.48) for W^{dist}, and (-0.09,0.18) and W^{pop}. Overall, the coefficients are much closer to zero than those obtained with traditional instruments as reported in Table 4, again suggesting that the latter result in upward biases.

5.3 Extensions

5.3.1 Delayed responses

In theoretical models of horizontal tax competition, political jurisdictions react simultaneously and instantaneously. In reality, however, it is possible that municipalities can only react with some lag to their neighbors' tax policies. To account for the possibility of delayed responses, I re-estimate Equation 6 with the lagged values of neighbors' weighted average tax multipliers. More specifically, I study whether the change in the weighted average of neighbors' tax multipliers in 2003 affects the tax multiplier of municipality i in $t = 2004, 2005, 2006, 2007,$ and 2008.

The results are collected in Table 7. As in the previous regressions, I report results obtained with the three weighting schemes. The upper panel of the table collects the results for the business tax multiplier. I find that even after two years, there is no response by municipality i to an increase in the average business tax multiplier of its neighbors. However, in 2006 – three years after the policy reform in NRW – the coefficient turns significantly negative. The size of the coefficient is very large – it oscillates between -0.8 and -1.7. From a reduced form perspective, this result implies that NDS border municipalities decrease their business tax multiplier three years after NRW multipliers increase theirs. However, 2006 was also an election year in Lower Saxony. It is likely that the strong reduction in multipliers by border municipalities in 2006 is in realty due to idiosyncratic reactions of NDS border municipalities to the election rather than due to the tax increases in NRW three years previously.

More specifically, altogether only six adjustments of the business tax multipliers were made in border municipalities in 2006. Five of these are significant reductions of 50 or more points. The negative coefficient estimates found for 2006 is thus due to large reductions in only a few municipalities, which indicates that specific electoral developments in these few municipalities are responsible. Consistent with these observations, in 2007 – four year after the tax increases in NRW – the weighted average of neighbors' tax multipliers is again insignificant.

The lower panel of Table 7 collects the corresponding results for the property tax. As for the business tax, municipalities are found to ignore the weighted average of their neighbors' tax multiplier for two year after 2003. Only in 2006, the election year, municipal tax multipliers react. The estimated coefficient for the property tax is between -0.06 and -0.10. While numerically smaller than for the business tax, the estimated coefficient is still significant. But as for the business tax, the coefficient becomes insignificant again form 2007 onward.

5.3.2 Subsamples

A further concern is whether tax policy developments in NDS municipalities that are far away from the border to NRW offer a good counter-factual to developments in the border municipalities had they not received the treatment. While the treatment was exogenous and the border and interior municipalities are similar with respect to observable covariates (see Table 2), it would be reassuring if the baseline results in Section 5.2 are confirmed in a restricted sample that only includes municipalities close to the border: municipalities close but not adjacent to the border should provide an particularly valid counterfactual for the border municipalities.

Table 8 reports regression results with three distinct subsamples. I restrict the sample to NDS municipalities whose centroid is within (i) 10 km, (ii) 30 km, and (iii) 50 km of the border to NRW. The results confirm the baseline estimates. In fact, the coefficient estimates are smaller than in the baseline regressions in all subsamples and virtually indistinguishable from 0. Even though the standard errors are larger given the smaller sample sizes, the corresponding 95% confidence intervals are typically narrower than in the baseline estimates.

6 Conclusion

This paper studies whether the tax policies of local governments are interdependent. It relies on an exogenous policy intervention in the German State of North Rhine-Westphalia to identify strategic interactions in municipal tax multipliers of municipalities located in the neighboring state of Lower Saxony. The results provide no evidence for the existence of strategic interactions. This finding contrasts results from estimations with instruments that are traditionally used in the tax mimicking literature, which strongly point to the existence of strategic interactions in local tax rates.

This pattern of findings implies that the evidence for tax mimicking found in much of the previous literature is questionable. In particular, existing evidence suggesting tax mimicking by German municipalities, for example Büttner (2001) and Hauptmeier et al. (2012), appears to be spurious. In line with the results obtained by Lyytikäinen (2012) in a different setting, using a credible identification strategy results in the evaporation of the evidence for tax mimicking.

This result can be explained in two ways. The first explanation is that the intergovernmental transfer scheme in NDS diminishes incentives to engage in tax competition to such an extent that no meaningful tax policy interactions emerge. However, while it is certainly possible that the intergovernmental transfer scheme contains tax competition, it is not clear why it should prevent yardstick competition or limit budget spillovers. The absence of fiscal interactions cannot therefore be solely explained by the existence of the transfer scheme.

The second explanation is that despite the theoretical emphasis on tax and yardstick competition or budget spillovers, local governments might in reality not be too concerned with the tax policies of their neighbors. They might set their tax rates primarily according to the preferences of their citizens and consider the tax policies of their neighbors as negligible. Such an explanation is consistent with the Tiebout model of efficient tax competition (Tiebout, 1956). If citizens and firms self-select into different municipalities according to their preferences for taxes and public goods, policies pursed in other municipalities should be of limited interest for any given municipal government. Nevertheless, future work should attempt to explicitly discriminate between different explanations for the absence of tax policy interactions.

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Table 1: Reform of NRW GFG 2003 and municipal tax rates in North Rhine-Westphalia and Lower Saxony

	Business tax		Property tax	
	(I)	(II)	(III)	(IV)
GFG 2003	9.678***	17.537***	30.567***	42.395***
	(0.710)	(1.992)	(1.280)	(3.452)
Sample period	2002-2003	2002-2003	2002-2003	2002-2003
Municipalities NDS	1022	50	1022	50
Municipalities NRW	396	38	396	38
N	1418	88	1418	88

[a] This table presents difference in difference regressions. The dependent variable is the first difference of the tax multiplier for the business (Model I and II) and property tax (Model III and IV) of municipalities in North Rhine-Westphalia and Lower Saxony in 2003. The treatment variable is a dummy for the reforms to the local equalization law (GFG) in North Rhine-Westphalia in 2003.

[b] Models I and III are estimated with all municipalities; Models II and IV are estimated with border municipalities only.

[c] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).

[d] Heteroscedasticity robust standard errors in parentheses.

Table 2: Differences in municipal characteristics between interior and border municipalities in Lower Saxony in the pre-treatment period

		Interior municipalities	Border municipalities	Difference		
Business tax	Mean	327.311	323.120	4.191	t-statistic	1.049
	Std. Error	0.883	3.894	3.993	p-value	0.294
	N	972	50			
Property tax	Mean	322.833	301.460	21.373	t-statistic	3.605
	Std. Error	1.311	5.782	5.928	p-value	0.000
	N	972	50			
Population share < 15	Mean	17.578	17.596	-0.018	t-statistic	-0.049
	Std. Error	0.082	0.358	0.367	p-value	0.961
	N	958	50			
Population share > 65	Mean	24.072	24.129	-0.057	t-statistic	-0.093
	Std. Error	0.136	0.596	0.611	p-value	0.926
	N	958	50			
CDU vote share	Mean	40.415	44.104	-3.689	t-statistic	-1.064
	Std. Error	0.767	3.382	3.468	p-value	0.288
	N	972	50			
SPD vote share	Mean	33.177	32.644	0.533	t-statistic	0.198
	Std. Error	0.595	2.623	2.689	p-value	0.843
	N	972	50			
FDP vote share	Mean	2.263	3.530	-1.267	t-statistic	-2.100
	Std. Error	0.133	0.588	0.603	p-value	0.036
	N	972	50			
GREEN vote share	Mean	2.409	2.968	-0.559	t-statistic	-1.081
	Std. Error	0.114	0.504	0.517	p-value	0.280
	N	972	50			
Income	Mean	31.178	31.220	-0.042	t-statistic	-0.059
	Std. Error	0.157	0.687	0.705	p-value	0.953
	N	958	50			

This table compares the characteristics of Lower Saxonian municipalities located at the border to North Rhine-Westphalia with those of other municipalities pre-treatment period. The 2002 values are taken for most variables. Data for income per tax payer is for 2001.

Table 3: MUNICIPAL BUSINESS TAX MULTIPLIERS IN LOWER SAXONY, SPATIAL LAG REGRESSIONS WITH TRADITIONAL INSTRUMENTS, SECOND STAGE

	W^{cont}		W^{dist}		W^{pop}	
	(I)	(II)	(III)	(IV)	(V)	(VI)
Δ W $\times$ Business tax$_{-i}$	1.468***	1.156***	1.258***	1.270***	0.446	0.794***
	(0.400)	(0.332)	(0.338)	(0.420)	(0.313)	(0.180)
IV type	Demographic	Political	Demographic	Political	Demographic	Political
Sample period	2002-2003	2001-2010	2002-2003	2001-2010	2002-2003	2001-2010
Cragg-Donald Wald F	12.741	2.947	13.414	1.963	9.957	13.409
Kleibergen-Paap Wald F	9.614	3.332	9.510	2.171	17.780	15.845
Hansen-J (p-value)	0.872	0.218	0.228	0.990	0.004	0.448
N	995	995	981	981	995	995

[a] This table presents spatial lag regressions. The dependent variable is the multiplier for the business tax of municipalities in Lower Saxony and North Rhine-Westphalia. The covariate of interest is the weighted average of the neighbors' tax multipliers.
[b] Three weighting procedures are used to calculate the weighted average of neighbors' tax multipliers: (i) W^{cont} = unweighted contiguity, (ii) W^{dist}= weights for all surrounding municipalities according to distance from municipality i's centroid (municipalities with a distance of more than 10 km receive a weight of 0), (iii) W^{pop} = contiguous municipalities receive weights according to population size.
[c] Results for municipal characteristics are omitted. Municipal characteristics are included in the second stage according to the type of instruments.
[d] The data in Models II, V, VIII are averaged over the 2001-2005 and 2006-2010 legislative periods before taking first differences.
[e] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).
[f] Heteroscedasticity robust standard errors in parentheses.

Table 4: Municipal property tax multipliers in Lower Saxony, spatial lag regressions with traditional instruments, second stage

	W^{cont}		W^{dist}		W^{pop}	
	(I)	(II)	(III)	(IV)	(V)	(VI)
Δ W $\times$ Property tax$_{-i}$	1.143***	1.926***	1.110***	0.919**	0.365	0.972**
	(0.382)	(0.545)	(0.311)	(0.454)	(0.384)	(0.389)
IV type	Demographic	Political	Demographic	Political	Demographic	Political
Sample period	2002-2003	2001-2010	2002-2003	2001-2010	2002-2003	2001-2010
Cragg-Donald Wald F	10.486	2.643	13.691	2.078	4.976	4.362
Kleibergen-Paap Wald F	10.581	3.228	13.043	2.575	6.379	2.656
Hansen-J (p-value)	0.778	0.245	0.709	0.527	0.196	0.001
N	995	995	981	981	995	995

[a] This table presents spatial lag regressions. The dependent variable is the multiplier for the property tax of municipalities in Lower Saxony and North Rhine-Westphalia. The covariate of interest is the weighted average of the neighbors' tax multipliers.
[b] Three weighting procedures are used to calculate the weighted average of neighbors' tax multipliers: (i) W^{cont} = unweighted contiguity, (ii) W^{dist}= weights for all surrounding municipalities according to distance from municipality i's centroid (municipalities with a distance of more than 10 km receive a weight of 0), (iii) W^{pop} = contiguous municipalities receive weights according to population size.
[c] Results for municipal characteristics are omitted. Municipal characteristics are included in the second stage according to the type of instruments.
[d] The data in Models II, V, VIII are averaged over the 2001-2005 and 2006-2010 legislative periods before taking first differences.
[e] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).
[f] Heteroscedasticity robust standard errors in parentheses.

Table 5: Reform of GFG 2003 in North Rhine-Westphalia and municipal business tax multipliers in Lower Saxony, spatial lag regressions

	$\mathbf{W^{cont}}$ (I)	$\mathbf{W^{dist}}$ (II)	$\mathbf{W^{pop}}$ (III)
First stage			
Border municipalities	4.557***	2.481***	9.425***
	(0.748)	(0.919)	(0.879)
Second stage			
Δ W $\times$ Business tax$_{-i}$	-0.179	-0.291	-0.087
	(0.252)	(0.494)	(0.119)
Cragg-Donald Wald F	33.975	8.459	116.675
Kleibergen-Paap Wald F	37.146	7.294	115.067
Sample period	2002-2003	2002-2003	2002-2003
N	995	981	995

[a] This table presents spatial lag regressions. The dependent variable is the first difference of the multiplier for the business tax in NDS municipalities. The covariate of interest is the weighted average of the neighbors' tax multipliers.

[b] Three weighting procedures are used to calculate the weighted average of neighbors' tax multipliers: (i) W^{cont} = unweighted contiguity, (ii) W^{dist}= weights for all surrounding municipalities according to distance from municipality i's centroid (municipalities with a distance of more than 10 km receive a weight of 0), (iii) W^{pop} = contingent municipalities receive weights according to population size.

[c] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).

[d] Heteroscedasticity robust standard errors in parantheses.

Table 6: Reform of GFG 2003 in North Rhine-Westphalia and municipal property tax multipliers in Lower Saxony, spatial lag regressions, second stage

	$\mathbf{W^{cont}}$ (I)	$\mathbf{W^{dist}}$ (II)	$\mathbf{W^{pop}}$ (III)
First stage			
Border municipalities	14.170***	9.393***	23.784***
	(1.219)	(1.613)	(1.565)
Second stage			
Δ W $\times$ Property tax$_{-i}$	0.077	0.134	0.046
	(0.116)	(0.176)	(0.069)
Cragg-Donald Wald F	198.024	72.862	427.589
Kleibergen-Paap Wald F	135.113	33.911	230.810
Sample period	2002-2003	2002-2003	2002-2003
N	995	981	995

[a] This table presents spatial lag regressions. The dependent variable is the first difference of the multiplier for the property tax of NDS municipalities. The covariate of interest is the weighted average of the neighbors' tax multipliers.

[b] Three weighting procedures are used to calculate the weighted average of neighbors' tax multipliers: (i) W^{cont} = unweighted contiguity, (ii) W^{dist}= weights for all surrounding municipalities according to distance from municipality i's centroid (municipalities with a distance of more than 10 km receive a weight of 0), (iii) W^{pop} = contingent municipalities receive weights according to population size.

[c] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).

[d] Heteroscedasticity robust standard errors in parentheses (the unit of clustering is the municipality).

Table 7: Reform of GFG 2003 and municipal tax multipliers, spatial lag regressions, delayed responses, municipalities in Lower Saxony

	2004 (I)	2005 (II)	2006 (III)	2007 (IV)	2008 (V)
Business tax					
$\mathbf{W}^{\mathbf{cont}}$	-0.126	0.100	-1.728**	0.016	0.438
	(0.222)	(0.472)	(0.786)	(0.165)	(0.346)
$\mathbf{W}^{\mathbf{dist}}$	-0.209	0.201	-3.230*	0.033	0.854
	(0.421)	(0.890)	(1.901)	(0.311)	(0.706)
$\mathbf{W}^{\mathbf{pop}}$	-0.061	0.048	-0.837**	0.008	0.212
	(0.108)	(0.228)	(0.334)	(0.080)	(0.167)
Property tax					
$\mathbf{W}^{\mathbf{cont}}$	0.040	-0.119	-0.104***	-0.032	-0.061
	(0.105)	(0.081)	(0.033)	(0.061)	(0.043)
$\mathbf{W}^{\mathbf{dist}}$	0.076	-0.176	-0.158***	-0.048	-0.090
	(0.160)	(0.126)	(0.056)	(0.094)	(0.067)
$\mathbf{W}^{\mathbf{pop}}$	0.023	-0.070	-0.061***	-0.019	-0.036
	(0.062)	(0.048)	(0.019)	(0.036)	(0.025)

[a] This table presents standard spatial lag regressions. The dependent variable is the tax multiplier for the business and property tax of municipalities in Lower Saxony in t=2004, 2005, 2006, 2007, and 2008. The covariate of interest is the weighted average of the neighbors' tax multipliers. For further notes, see Tables 5 and 6.

Table 8: REFORM OF GFG 2003 IN NORTH RHINE-WESTPHALIA AND TAX MULTIPLIERS IN LOWER SAXONY, SPATIAL LAG REGRESSIONS, SUBSAMPLES, SECOND STAGE RESULTS

	Business tax			**Property tax**		
	W^{cont}	W^{dist}	W^{pop}	W^{cont}	W^{dist}	W^{pop}
	(I)	(II)	(III)	(IV)	(V)	(VI)
10 km						
Δ W $\times$ Multiplier$_{-i}$	0.044	0.086	0.026	0.058	0.108	0.037
	(0.287)	(0.439)	(0.172)	(0.159)	(0.249)	(0.101)
Cragg-Donald Wald F	34.772	10.893	65.751	82.782	22.853	111.183
Kleibergen-Paap Wald F	34.955	10.893	65.984	83.429	22.853	111.713
N	99	98	99	99	98	99
30 km						
Δ W $\times$ Multiplier$_{-i}$	0.022	0.053	0.012	0.074	0.128	0.046
	(0.223)	(0.384)	(0.124)	(0.124)	(0.194)	(0.077)
Cragg-Donald Wald F	60.432	14.957	153.723	215.911	62.871	348.316
Kleibergen-Paap Wald F	47.322	10.858	112.357	129.717	31.173	206.667
N	240	238	240	240	238	240
50 km						
Δ W $\times$ Multiplier$_{-i}$	0.122	0.208	0.069	0.123	0.193	0.077
	(0.194)	(0.291)	(0.112)	(0.112)	(0.164)	(0.071)
Cragg-Donald Wald F	100.781	33.604	238.243	289.204	111.162	469.662
Kleibergen-Paap Wald F	61.240	18.078	136.216	148.766	41.223	230.977
N	383	379	383	383	379	383

[a] This table presents regression results for subsamples defined according to the distance of a NDS municipality's centroid from the border to NRW. All municipalities with distance below 10 km, 30 km, and 50 km are included. For further notes, see Tables 5 and 6.

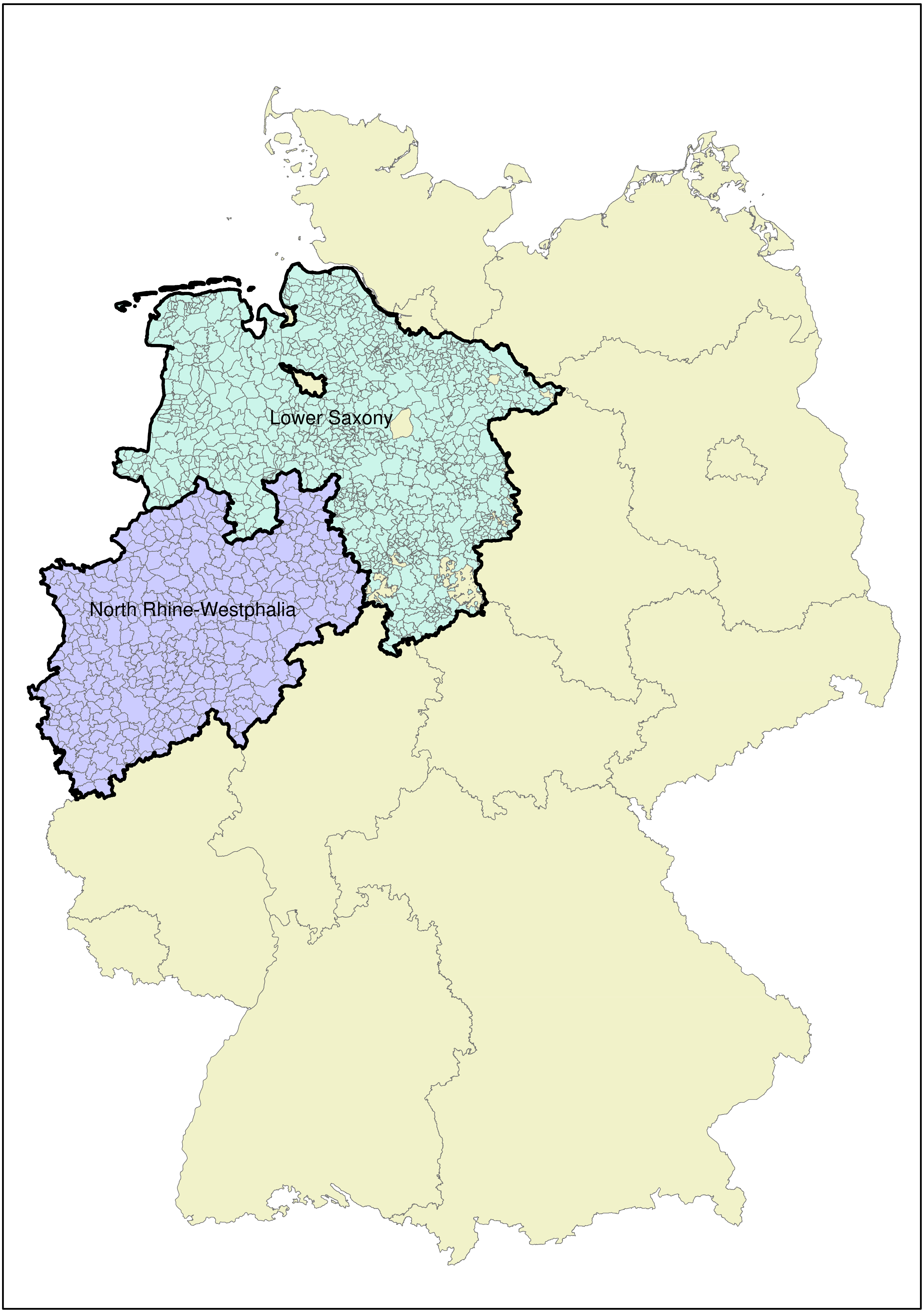
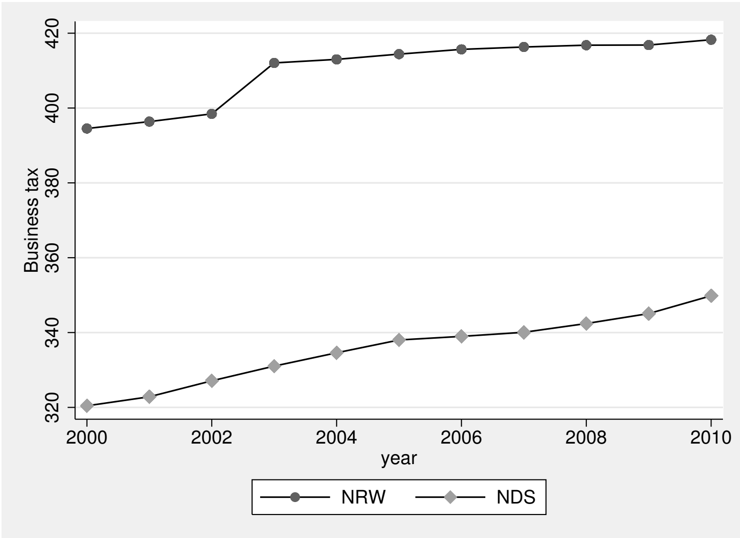
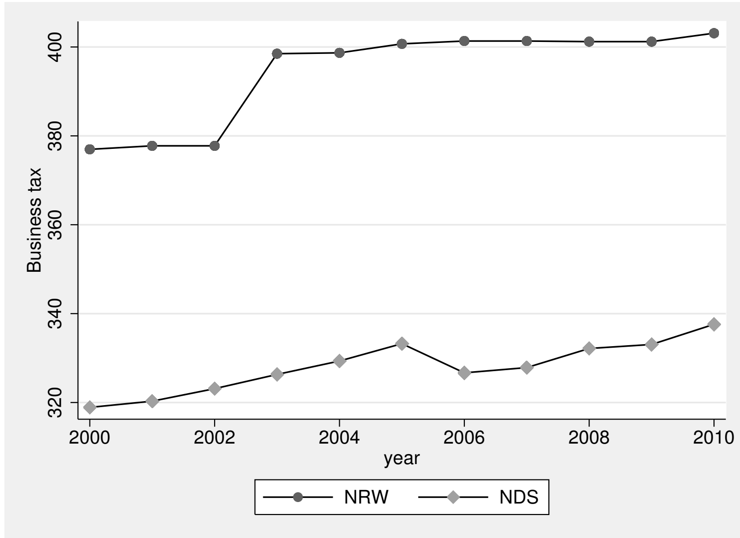


Figure 1: North Rhine-Westphalia and Lower Saxony in Germany. This figure presents municipal borders in North Rhine-Westphalia and Lower Saxony. Forest areas and the state of Bremen (located within Lower Saxony) are colored yellow.

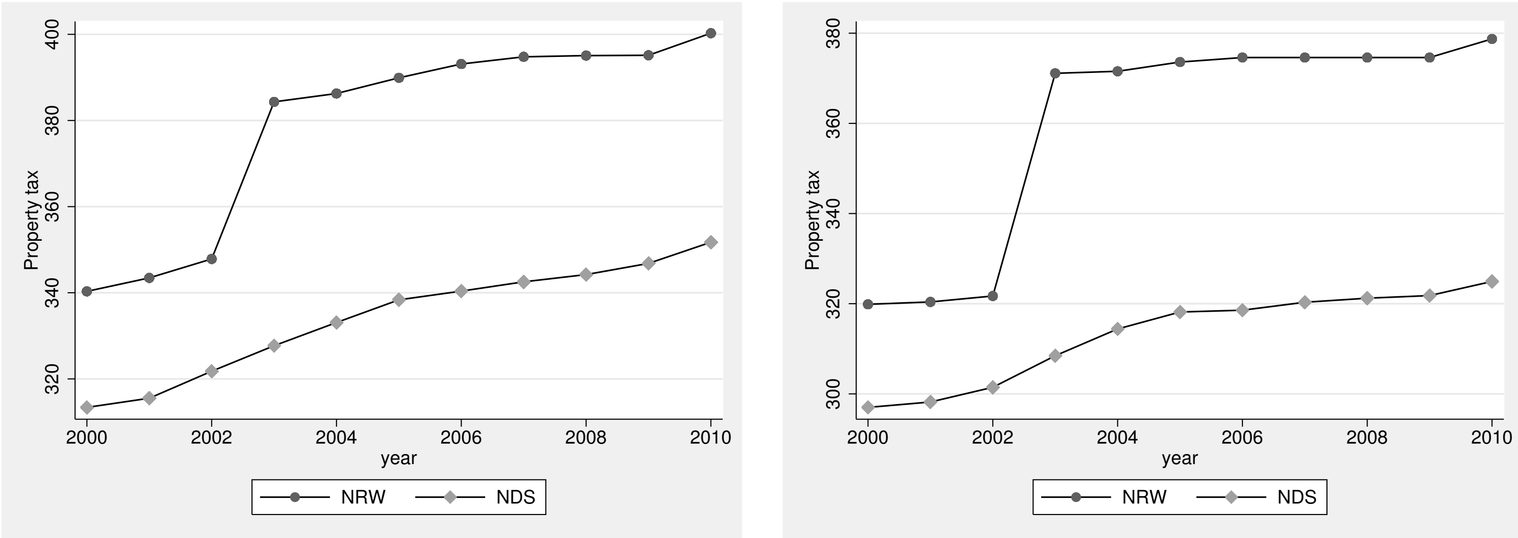


(a) Full sample



(b) Border municipalities

Figure 2: Business tax multipliers in North Rhine-Westphalia and Lower Saxony, 2000-2010. This figure presents the development of the business tax multiplier over the 2000-2010 period in (a) all municipalities in North Rhine-Westphalia and Lower Saxony and (b) municipalities located at the border.



(a) Full sample

(b) Border municipalities

Figure 3: Property tax multipliers in North Rhine-Westphalia and Lower Saxony, 2000-2010. This figure presents the development of the property tax multiplier over the 2000-2010 period in (a) all municipalities in North Rhine-Westphalia and Lower Saxony and (b) municipalities located at the border.

Table A.1: Definition and Source of Variables

Label	Description	Source
Business tax	Tax multiplier for the business tax (*Gewerbesteuerhebesatz*).	North Rhine-Westphalian and Lower Saxonian State Statistical Offices
Property tax	Tax multiplier for the Property tax B (*Grundsteuer B Hebesatz*) on non-agricultural property.	North Rhine-Westphalian and Lower Saxonian State Statistical Offices
Population share < 15	Share of population below 15.	North Rhine-Westphalian and Lower Saxonian State Statistical Offices
Population share > 65	Share of population above 65.	North Rhine-Westphalian and Lower Saxonian State Statistical Offices
CDU vote share	Seat share of CDU.	North Rhine-Westphalian and Lower Saxonian State Statistical Offices
SPD vote share	Seat share of SPD.	North Rhine-Westphalian and Lower Saxonian State Statistical Offices
FDP vote share	Seat share of FDP.	North Rhine-Westphalian and Lower Saxonian State Statistical Offices
GREEN vote share	Seat share of the Green Party.	North Rhine-Westphalian and Lower Saxonian State Statistical Offices
Income	Gross income divided by number of taxpayers.	North Rhine-Westphalian and Lower Saxonian State Statistical Offices

Table A.2: SUMMARY STATISTICS FOR MUNICIPAL TAX RATES IN LOWER SAXONY AND NORTH RHINE-WESTPHALIA

Variable		**Mean.**	**Std.**	**Min.**	**Max.**	**Obs.**
		Lower Saxony				
		Interior municipalities				
Business tax	overall	335.8761	30.30	240.00	460.00	10690
	between		26.50	270.00	460.00	972
	within		14.71	245.88	437.69	11.00
Property tax	overall	335.2245	44.11	50.00	530.00	10690
	between		40.15	177.27	530.00	972
	within		18.28	207.95	464.77	11.00
		Border municipalities				
Business tax	overall	328.0527	25.91	250.00	425.00	550
	between		22.24	266.36	414.09	50
	within		13.62	282.60	430.69	11.00
Property tax	overall	313.1382	26.03	250.00	430.00	550
	between		22.87	255.45	415.45	50
	within		12.80	255.68	351.32	11.00
		North Rhine-Westphalia				
		Interior municipalities				
Business tax	overall	411.927	26.509	300.000	490.000	3938
	between		24.113	310.000	486.364	358
	within		11.080	349.018	452.018	11.000
Property tax	overall	381.213	47.403	200.000	590.000	3938
	between		40.001	236.364	530.000	358
	within		25.516	297.304	519.759	11.000
		Border municipalities				
Business tax	overall	394.419	16.087	320.000	432.000	418
	between		11.181	344.546	413.364	38
	within		11.695	350.782	420.782	11.000
Property tax	overall	359.581	33.181	240.000	433.000	418
	between		21.387	292.727	381.636	38
	within		25.584	265.036	422.309	11.000

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