Discussion Paper No. 15-081

Let's Stay in Touch – Evidence on the Role of Social Learning in Local Tax Interactions

Sebastian Blesse and Thorsten Martin

ZEW
Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

Discussion Paper No. 15-081

Let's Stay in Touch – Evidence on the Role of Social Learning in Local Tax Interactions

Sebastian Blesse and Thorsten Martin

Let's stay in touch - Evidence on the role of social learning in local tax interactions*

Sebastian Blesse
ZEW Mannheim

Thorsten Martin
University of Potsdam †

Abstract: This paper exploits detailed information on local political and socioeconomic networks and a reform of local fiscal equalization in North Rhine-Westphalia (NRW) to identify the role of learning in local tax rate interactions. Using this policy change in spatial lag IV regressions, we find that institutions like counties and jointly used administrations yield significant positive tax interactions whereas geographical neighbors do not react to each other. Common local media trigger tax policy interactions as well. Short-lived reform effects support our findings that social learning within certain networks intensifies tax rate interactions via coordination of local decision makers.

Keywords: Tax mimicking, Local business tax, Social learning, Institutions, Tax competition, Fiscal equalization schemes
JEL classification: H20, H71, H77

*We would like to thank Felix Arnold, Thushyanthan Baskaran, Steve Bond, Rainald Borck, Thiess Büttner, Dirk Foremny, Frank Fossen, Ronny Freier, Irem Guceri, Martin Simmler, Frank Streif, Alfons Weichenrieder and the participants of the CesIfo Workshop on regional economics, the Annual Conference at the Oxford University Centre for Business Taxation, the Potsdam Research Seminar, the IEB Research seminar and the Research seminar at the University of Frankfurt for valuable comments and suggestions. Isabel Geisler from the Ministry of the Interior of North Rhine-Westphalia graciously shared data with us. Moreover, we thank Adrian Blattner for his excellent research assistance. The usual disclaimer applies.

†Contact information: Thorsten Martin (corresponding author), thmartin@uni-potsdam.de, Universität Potsdam, August-Bebel-Str. 89, G-14482 Potsdam, Tel.: 0049-331 9773394.

1 Introduction

Who interacts with whom in local taxation? Local governments have several motives to set tax rates with respect to neighboring jurisdictions. In particular, local tax choices of neighboring jurisdictions might be a subject of competition for mobile tax bases, a benchmark or even a learning device for local politicians. However, it is not clear to whom local politicians refer in their tax policies, i.e. who are their effective neighbors for local tax mimicking. In particular, we investigate which channels particularly matter local tax interactions, for e.g. we ask whether institutional proximity intensifies interactions compared to pure geographical distance. Understanding the exact nature of local tax interactions is important for the implications of the spatial distribution of income in the long run. Moreover, a benevolent social planner should harmonize taxes if local tax interactions are motivated by a harmful competition over mobile resources in a race to the bottom style and rather follow a laissez-faire policy if taxes rate strategies are communicated between local governments and no tax base effects are present.

Traditional empirical studies on tax rate interactions typically define neighbors as a (weighted) average of neighboring jurisdictions.[1]. However, local governments in most federations are strongly interrelated with respect to the institutions they share both horizontally (e.g. joint administration bodies like courts or tax offices) and vertically, for example in overlapping jurisdictions like counties and municipalities. Therefore, local politicians might have different social or professional ties to other local decision makers. Based on this, tax interactions might be stronger in settings where local politicians or bureaucrats interact more intensely with each other rather than only with geographically close jurisdictions. Our contribution is to provide evidence on the importance of several coordination channels for tax interactions. In particular, we intend to show that local institutions and media via an inherent information transfer might be more important than pure geographical criteria for the significance of local tax interactions.

We use detailed geocoded data from local networks of institutions and media coverage to construct neighbor matrices consisting of municipalities sharing the same institutions as well as geographically close municipalities to identify local tax interactions. Weighting matrices usually assign the average values of the neighboring tax rates, which are

[1]Geographical distance is either measured by the adjacency of neighbors, the N nearest number of neighbors or the inverse distance between two jurisdictions. See Revelli (2005) for a review.

in our setting institutional or geographical neighbors. Our setting is particularly interesting as potential vertical externalities from higher tier institutions which are shared with other local governments are unlikely as we focus on institutions with no own tax autonomy rights. Therefore, institutions function as a coordination device of political actions and not as a competitor for local tax bases. Using this we are able to separate the coordination effect of institutions from their potentially depriving effects on common tax bases. Moreover, NRW is interesting for institutional coordination effects as it is described as the most professionalized state in Germany regarding local political decision making (Arnold, Boettcher, Freier, Geißler, and Holler, 2015).

To identify local tax mimicking, we use a policy reform of local fiscal equalization in the German state of NRW as a quasi-experimental setting that created an incentive for municipalities to increase their tax rates. We construct an instrumental variable that predicts reform incentives to increase tax rates for neighboring municipalities by constructing the so called predicted imposed increase in tax rates (Lyytikäinen, 2012). Using this policy reform in the commonly applied spatial lag IV estimation, we yield three main findings for business tax rates in NRW.

Using counties as our baseline weighting matrix, first, we find, positive significant tax rate interactions. Moreover, shared administration services and common access to local media yield similar results. However, interactions with geographical neighbors are not significant in our setting which contrasts most of the traditional literature. Unlike geographical neighbors, political and social proximity might be asymmetric in distance and adjacency. Even though geographical neighbors are more likely to be in the same institution, political and social proximity weights might be asymmetric in distance and adjacency to their geographical counterparts, for e.g. with neighboring municipalities in different counties or across intermunicipal cooperations. Therefore, we find that some institutions indeed elevate tax rate interactions when there are in fact no interactions over geographical distance.

Second, there are positive and significant tax interactions during the reform. However, significant effects phase out already two years after the reform. Therefore, tax interactions are not a general phenomenon but only reform-induced in the present study.[2]

[2]Changes in tax rates are often only triggered by reforms of local fiscal equalization (Baskaran, 2014), changes in minimum tax rates (Lyytikäinen, 2012), integration of new regions into a federation (Baskaran, 2015b) or election dates (Foremny and Riedel, 2014).

Third, we find suggestive evidence for local tax interactions via social learning processes through institutions and common local media. Several reasons provide evidence for a learning process. For instance, tax interactions are short-lived, which provides supportive evidence for a one-time learning process rather than continuous tax interactions. In addition, interaction is strongest when common institutions are considered as a neighbor framework. In fact, institutions where local politicians and bureaucrats can be thought to be the most interactive with each other, namely within the same county and the same administrations. Therefore, counties, joint administrations as well as local media are effective coordination mechanisms for local tax policies during the reform. However, other channels like inter-municipal cooperation in individual projects or regional marketing and tourism as well as interest group coverage do not intensify tax interactions.

We also argue that other forms of tax mimicking are unlikely in our setting.[3] We rule out tax rate interactions via tax competition due to the absence of tax base effects of neighboring tax rate changes during the reform, interactions through institutions being stronger than geographical criteria and the short term adjustment during the reform. Additionally, we rule out yardstick competition because it implies that municipalities with majorities have less intensely interactions than those without. We do not find evidence for this. Moreover, a subtle change in local fiscal equalization might also not be visible or important to voters even though the impact on local tax rates is strong. Although we find media to be an important transmission channel for local tax interactions (Revelli, 2008), there seems to be no voter effect of local media but rather a coordination of local decision makers via media over issues like local tax policies. Furthermore, benefit spillovers are unlikely in the present context as there is no negative interaction effect.

Our findings are consistent with recent quasi-experimental evidence that local tax rate interactions are not a general phenomenon (Baskaran, 2014; Lyytikäinen, 2012; Isen, 2014; Eugster and Parchet, 2011).[4] In particular, we show that there are significant tax rate interactions but that they are only short-lived and not relevant in the common

[3] See Section 2 for a detailed overview of theoretical motives on local tax interactions.

[4] Agrawal (2015a) finds horizontal and vertical interactions via local sales tax rates for states in the US by taking state border discontinuities into account. Agrawal (2015b) exploits state border discontinuities to show interaction among local sales tax rates at state borders. Eugster and Parchet (2011) find small scale tax competition effects of the local income tax in Switzerland along cultural borders. Parchet (2012) finds that personal income tax rates are strategic substitutes in Switzerland. Holzmann and Schwerin (2015) find tax rate interactions in a highly integrated economic area. (Traditional) studies not using quasi-experimental methods to identify tax rate interactions also find strong tax rate interactions; for a survey see Allers and Elhorst (2005).

adjacent neighbor definitions but rather arise within certain channels.

We contribute to the literature on who competes with whom in tax policy. We explicitly distinguish institutional and geographical distance using detailed information on different local institutions, for example administration and cooperation, media, and standard geographical criteria. Hence, we are among the first to show that institutions also matter in local tax interactions. Revelli (2003) and Agrawal (2015a), however, show that vertical interactions matter in local taxation for British and US local governments, respectively. We find evidence for the relevance of counties for interactions of local fiscal policy in a multi-tier federation (Borck, Fossen, Freier, and Martin, 2015; Agrawal, 2015a; Buettner, 2001; Büttner and von Schwerin, forthcoming).

Moreover, we add to a small literature which defines factors that determine tax interactions like cultural borders (Eugster and Parchet, 2011), integration of economic areas (Holzmann and Schwerin, 2015; Baskaran, 2014) or regions (Baskaran, 2015b), metropolitan areas versus periphery (Brueckner and Saavedra, 2001; Kauder, 2014; Charlot and Paty, 2010; Koh, Riedel, and Böhm, 2013), and borders for both states (Geys and Osterloh, 2013; Cassette, Porto, and Foremny, 2012; Baskaran, 2014; Agrawal, 2015b) or nations (Cassette, Porto, and Foremny, 2012), respectively.[5]

The paper proceeds as follows. In Section 2, we describe several motives for local tax interactions. Section 3 outlines the institutional framework, most notably the system of local fiscal equalization of NRW and its reform in 2003. Section 4 and 5 describe the empirical approach and results, respectively. Section 6 concludes.

2 Theoretical motives for local tax interactions

Local governments can have several motives to interact in tax rates. An important one is certainly discussed in the tax competition literature, where local jurisdictions try to attract a mobile capital tax base by setting lower tax rates (Wilson, 1999; Zodrow and Mieszkowski, 1986). Tax rates become interdependent as the tax reduction of one jurisdiction lets others experience a fiscal externality in form of an outflow of capital. In

[5]Moreover, Reiter (2015) provides a survey on the question of who competes with whom in international tax competition. In a centre-periphery framework, Janeba and Osterloh (2013) show that metropolitan and rural jurisdictions compete sequentially over mobile tax bases.

a symmetric setting, tax competition results in a harmful race to the bottom. However, asymmetries in the assumptions of the model can make the sign of tax interdependence ambiguous. Secondly, jurisdictions might experience informational spillovers in tax choices when comparing themselves to neighboring units as yardsticks (Besley and Case, 1995). Here, voters can use tax rates of other municipalities ceteris paribus as a benchmark to determine how successful the respective incumbent is and accordingly, either punish or reward him at the polls. Thus, in order to get re-elected local politicians might mimic tax choices of neighboring places. Therefore, one would expect positive tax interactions in the presence of yardstick competition. However, a prominent reason for negative tax interactions are benefit spillovers (Case, Rosen, and Hines, 1993). The idea is that local public goods provision in a given municipality entails positive externalities in other units due to the non-excludable character of quasi-public club goods. Hence, spending needs of the neighboring jurisdictions are lower and allow for lower tax rates.

Beside these traditional theories of local tax interactions, the literature has recently discussed other transmission channels of tax rate mimicking. Potentially relevant to our setting are especially interactions through social learning or (partial) tax coordination.

For instance, Glick (2014) sets up a model where social learning can overcome situations with substantial uncertainty about policy outcomes such as policy reforms. Thus, learning from others' tax choices with limited information of policy makers on the consequences of one's own tax rate decisions can be efficient. Accordingly, tax mimicking should constitute a positive sign if social learning or knowledge diffusion is present. Moreover, Becker and Davies (2013) show that tax mimicking via social learning is lower if adjustment costs are present. For example intensive communication of local governments might lower adjustment costs between policy makers and can elevate tax interactions.

There are also incentives to coordinate local tax choices as competing over a mobile tax base might lead to an inefficient underprovision of public goods. Whereas most of the literature discusses difficulties of jurisdictions to coordinate their tax choices (Keen and Konrad, 2012), we believe that multi-tier federations like Germany indeed offer scenarios in which coordination might be effective. For instance, institutions (like counties) and joint administration (bureaucracy) shared by multiple municipalities might provide a platform for knowledge diffusion with respect to tax strategies or even actively provide guidelines for setting tax rates. Given coordination, one would expect perfect harmonization of tax rates within that specific area of coordination. In the presence of asymmetries

of regions, however, one would not expect identical tax rates as some municipalities might be harmed by coordination (Kanbur and Keen, 1993). However, strong institutions like counties might potentially initiate coordination if their members are sufficiently similar.

Partial tax coordination takes place in similar regions if tax competition takes place repeatedly (Cardarelli, Taugourdeau, and Vidal, 2002; Cotenaro and Vidal, 2006). With partial coordination, groups of similar jurisdictions compete over resources with other regions and yield harmonized tax rates just as with with social learning. For example, jurisdictions belonging to the same county or particularly similar or close neighborhoods within the same county might entail sufficient homogeneity of municipalities for partial tax coordination to take place. Note that partial coordination implies a fiscal externality (between similar regions) unlike tax harmonization or social learning.

3 Institutions

3.1 Local governments and public bodies in Germany

In the present paper we want to show the relevance of learning across different institutions for local tax interactions in the German federal state of NRW. German local governments display a high degree of fragmentation and heterogeneity. Generally one can distinguish jurisdictions and non-jurisdictional bodies, each with substantial differences in terms of autonomy and accountability.[6]

Jurisdictions are constitutionally recognized units with own territories and directly elected representatives. There are many jurisdictions in Germany, such as states (2011: 16), counties (295), and municipalities (11,442). NRW is the most populous state in Germany with about 17.6 Million residents and 396 municipalities, including 30 counties and 23 district-free cities. Local governments are usually part of several jurisdictions in a multi-tier federation like Germany. Municipalities, for example, belong to a certain county and state. Below state-level all local governments are subject to the constitutional right of self-governance (Article 26 II Grundgesetz). Like in other countries, municipalities offer several local public goods such as general administration, infrastructure, waste

[6]For a detailed overview of the German local government system, see Zimmermann (1999).

disposal, and culture activities. However, municipalities also share duties with other jurisdictions, for example with counties or other municipalities, or even with private firms. Municipalities have substantial spending and also some revenue autonomy (see Section 3.2). Counties, however, cooperate with municipalities in service provision. They do not have tax autonomy and rely largely on contributions and grants.

Non-jurisdictional bodies are not legitimated by elections and also do not possess revenue autonomy, i.e. they do not have taxation rights. NRW for instance, has semi-autonomous bodies like regional districts (*Regierungsbezirke*), which are administrative districts of the state government, and various general or single purpose inter-municipal cooperations. Cooperations in administration or local economy issues are initiated locally and represent horizontal cooperation. They usually serve to exploit economies of scale or increase bargaining power in political issues. Regional districts, however, follow a classical top-down model of bureaucracy and are a typical example of local institutions which do not pass legislation but implement arm's length decisions from the state.

In this study, we exploit information on institutions which could either elevate horizontal or vertical tax interactions at the municipal level. Vertical tax interactions refer to the coordination of tax policies by (or passively in the area of) a higher tier of government, for example within a county or regional district. Jurisdictions might also interact horizontally with other units from the same tier, for example between municipalities. Local governments might also be influenced by non-governmental interest groups. Economic, political or cultural associations might lobby for certain policies at the local level.

3.2 Local business taxation

Municipalities can set the tax rate for the business and property tax autonomously. In fact, the business tax (*Gewerbesteuer*) is the most important source of local revenues under own discretion in Germany. Municipalities in NRW earn on average 18-24% of their overall revenues from business taxes. Note that the municipalities can only levy a business tax multiplier τ_i, but as it is applied to the respective tax base B_i with a percental surcharge which is fixed throughout the federation (S), the tax multiplier actually represents the effective tax rate[7]:

[7] Therefore, we use the terms tax rate and tax rate multiplier interchangeably.

$$T_i = \tau_i \cdot S \cdot B_i \tag{1}$$

where T_i is the business tax revenue of a given municipality i. The surcharge S (*Steuermesszahl*) is fixed and equals 3.5% since a corporate tax reform in 2008 (Büttner, Scheffler, and von Schwerin, 2014). [8] Business taxes are levied by a municipality on all firms located in that municipality. The respective tax base is the firms' net profits (*Gewerbeertrag*), although there are some exceptions.[9].

Municipalities can also tax housing and land property within their borders. The tax base is the assessed value determined by the respective local tax office. There are separate property taxes for agricultural (*Grundsteuer A*) and both residential and commercial usage (*Grundsteuer B)*. Overall, property taxation is less important to German municipalities than income from business tax. Note that we focus in the following on the business tax.

However, municipalities also receive income from taxes which are shared vertically across governmental tiers (*Gemeinschaftssteuern*). Note that shared income taxes and VAT income accounted for about 19.34% and 1.84% of municipal revenues in NRW, respectively. Although municipalities receive certain shares of tax revenues from related economic activities within their borders, they do not possess tax autonomy on these taxes.

3.3 Local fiscal equalization and its reform in 2003

The present paper exploits a reform in local fiscal equalization in NRW in 2003 to study its effect on local tax interactions and related transmission channels. Indeed, the single most important source of local revenues are transfers from the state government, provided within a local fiscal equalization scheme. They account for about 50% of overall

[8] Before, the surcharge depended on the business type of the firm with incorporated and most non-incorporated firms facing a 5% surcharge rate. Non-incorporated companies like private business partnerships faced a maximum rate of 5% when taxable income for business tax exceeded 48,000 euro and a minimum rate of 1% when earnings were below 12,000 euro.

[9] For instance, local business tax payments can be deducted from either personal income or corporate income tax, for non-incorporated and incorporated companies, respectively (Büttner, Scheffler, and von Schwerin, 2014)

municipal revenues in NRW. Whereas grants can be either discretionary[10] or rule-based (*Schlüsselzuweisungen*), the latter are within the focus of this paper as they are economically more important and are also subject to our natural experiment.

Rule-based transfers from the federal state target on giving municipalities sufficient funds to provide local public goods in an sufficient quantity and quality. Fiscal equalization mainly intends to balance out differences in municipal fiscal need and fiscal capacity according to some formula apportionment. First, fiscal need is some benchmark level of (obligatory) spending per inhabitant to meet citizen's needs. Second, fiscal capacity, however, is a measure of the municipal ability to finance these spending needs.[11]

Specifically, the rule-based transfers per capita $g_{i,t}$ from the federal state are distributed to the $i = 1, ..., N$ in order to reduce the difference between the *fiscal need* $n_{i,t}$ and the *fiscal capacity* $c_{i,t}$ in a given year t. This fiscal equalization reads as follows

$$g_{i,t} = \begin{cases} 0.9(n_{i,t} - c_{i,t}) & \text{if } n_{i,t} > c_{i,t} \\ 0 & \text{else,} \end{cases} \tag{2}$$

with 0.9 being the equalization rate in our sample period. Therefore, municipalities with lower fiscal capacity than fiscal need will receive 90% of that fiscal gap from state equalization transfers. With fiscal capacity at least as high as the respective need, the municipality does not receive rule-based transfers at all (i.e. it is fiscally abundant).

Fiscal need $n_{i,t}$ is a standardized amount of spending fixed by the state government (*Grundbetrag*) in the previous fiscal year to avoid manipulations of the assumed costs of service provision. It is also determined by municipality-specific characteristics, mostly by population size. Whereas all localities should receive similar revenues per capita, more populous regions have disproportionately higher fiscal needs to compensate for assumed higher costs of public goods provision with increasing population size (Brecht, 1932).[12]

The reform of fiscal equalization in 2003 leaves fiscal need unaffected but changes a parameter referring to the fiscal capacity. Fiscal capacity is defined as the sum of tax

[10] Discretionary or purpose-related grants (*Zweckzuweisungen*) are occasional transfers from the state-government to municipalities and are paid in form of matching grants for which municipalities have to apply. Frequently granted transfers are for example infrastructure projects.

[11] For details on local fiscal equalization in German federal states, see Lenk and Rudolph (2004).

[12] However, also other factors like municipal centrality or the number of school children matter (GFAG NRW, several years).

revenues from all tax bases, i.e. from autonomously set taxes and vertically shared taxes with no autonomy, such as VAT or federal income tax. Specifically, it is given by:

$$c_{i,t} = \frac{T_{i,m,t-1}}{\tau_{i,m,t-1}} \cdot \overline{\tau_{t,m}} + T_{shared,t-1}, \tag{3}$$

where $c_{i,t}$ is the fiscal capacity in the current year, $T_{i,m,t-1}$ the tax revenues for m which denotes the three local taxes (business tax, property tax A and B) whose tax multipliers municipalities are free to set as well as vertically shared tax revenues $T_{shared,t-1}$ from the previous year[13]. Each tax base m is divided by actual tax rates $\tau_{i,m,t-1}$ from the previous year, respectively. Moreover, the latter term is multiplied with the so called hypothetical tax rate $\overline{\tau_{t,m}}$ (*fiktiver Hebesatz*), which is set by the state government and is constant across municipalities.

The transfer system aims at providing sufficient equality in relative fiscal power but also does not want municipalities to rely strategically on transfer payments. Municipalities should also engage in tax competition and therefore, the focus of fiscal capacity is shifted from actual to potential revenues. In particular, revenues are normalized by dividing actual revenues with tax multipliers and are then multiplied with a statewide reference rate, i.e. the hypothetical tax rate. This procedure makes transfer payments independent of actual tax revenues (and hence, actual tax multipliers) but instead relying on effective tax capacity. This procedure prevents the state to perceive low-tax municipalities as fiscally weak via mechanically lower tax revenues and vice versa for high-tax jurisdictions. Therefore, the hypothetical tax rate should have no direct effect on transfer payments and therefore, on actual tax rates. However, actual tax rates respond strongly and increase as a response to an increase in the hypothetical rate in 2003 as will be shown below.

The state government of NRW increased the hypothetical multiplier for the business tax from 380 to 403%. The same applied to the reform of hypothetical property tax rates. NRW changes hypothetical tax rates occasionally and usually in large steps. Changes occur when the hypothetical multiplier does not align with the (weighted) population average of recent realized tax rates (Ministry of Interior NRW, 2010;Lenk and Rudolph (2004)). Therefore, one might argue that some cities with large tax bases might be

[13]More precisely, the tax multipliers and revenues applied in the formula apportionment use figures from July two years ago and June 30th of last year. For instance, fiscal capacity in 2003 is calculated from tax revenues between July 1st 2001 and June 30th, 2002 (GFAG NRW, 2003).

important drivers of the level of the hypothetical tax rate. For small municipalities which cannot individually influence the weighted average of tax rates, the policy change is arguably exogenous. Nonetheless, we also show later that our findings are robust to different population classes and several placebo reforms in pre-reform years. Moreover, changes in hypothetical tax rates by the state government are irregular and come only with little prior notice. Therefore, the timing of these reforms is hardly predictable, especially from the viewpoint of an individual municipality.[14] The reform should also increase municipalities' tax effort and incentivizes them to rely less on fiscal grants.

Hypothetical tax rates are essentially a normalization of tax bases and there should be no direct negative effects on transfers in equ. (2) by an increase in the hypothetical multiplier. Thus, no significant effects on actual tax rates can be expected. A change in the hypothetical multiplier changes the assessed fiscal capacity of all municipalities. Total transfer payments, however, would only change if the total amount of allocated transfers would change too or the relative fiscal gap changed. First, the state government of NRW did not change the amount of grants from 2002 to 2003. Specifically, grants were constant with 4.576 billion euro and 4.581 billion euro, respectively (NRW GFAG, 2002, 2003). Therefore, fiscal need had to decrease proportionately per capita as the fiscal capacity increased but total transfers were constant. Second, the fiscal gap could actually change via an increase in the hypothetical multiplier but these effects on relative distribution on transfers were minor.[15] Thus, the increase in the hypothetical multiplier should not have substantial effects on rule-based transfer payments and therefore on actual tax rates.

However, the hypothetical tax rate is a strong reference rate for actual business tax multipliers. Figure 1 shows the development of average tax rates and hypothetical tax rates over time. Note that the increase in the hypothetical tax rate in 2003 led to an accompanying increase in the average business tax rate in the following years. On average, the business tax rates are always significantly above the hypothetical tax rates and indeed most municipalities choose a tax rate which is at least as high as the hypothetical multiplier. Moreover, the number of municipalities with tax rate changes per year increased in 2003 substantially up to 250 out of 396.

[14] We provide evidence on the absence of potential anticipation effects in the robustness checks.

[15] An increase in the hypothetical multiplier raises the fiscal capacity for municipalities with larger tax bases disproportionately. Hence, richer municipalities might transfer more resources to poorer municipalities (Baskaran, 2014, 2015a). However, the respective amount should be fairly small and thus, not have an effect on actual tax rates.

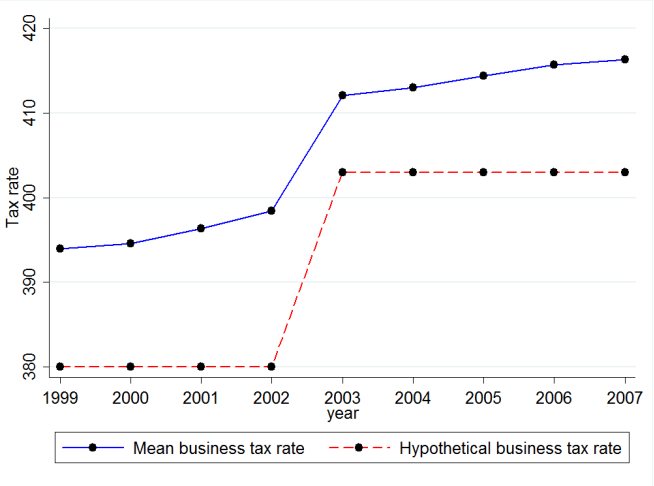

Figure 1: Reform and Impact 2003.

Several reasons may account for this. First, the hypothetical tax rate punishes efforts to attract a mobile tax base because a higher multiplier implies that larger tax bases reduce transfers received in equ. (2). Thus, own tax efforts are diminished by higher hypothetical tax rates and thus imply higher tax rates. Fiscal equalization schemes are shown to have such effects on local tax rates both theoretically and empirically (Kelders and Koethenbuerger, 2010; Egger, Köthenbürger, and Smart, 2010; Büttner, 2006). Holzmann and Schwerin (2015) argue that tax rates are not set too low for another reason. Often, federal states in Germany make it a condition for municipalities applying for a discretionary grant to make a sufficient tax effort themselves. Therefore, if tax rates are too low municipalities might have less of a chance to receive task-related grants from the state government. Hence, municipalities should not set their tax rates too low below the hypothetical tax rate which is essentially a tax rate of which the state government thinks that municipalities can tax appropriately.

Second, political economy considerations might play a role. When increasing the hypothetical tax rate the state government might lower the political costs of own tax increases by local policy-makers. They can use the veil of the state-wide tax increase to hide increases in their own tax rates. Parts of the tax increase can be attributed to the state government to avoid the loss of voter support. Moreover, Baskaran (2014) argues that hypothetical tax rates are means for firms lobbying for lower tax rates in municipalities if actual tax rates exceed this reference rate. Hypothetical tax rates are also important

because of the common misbeliefs of local politicians and the local media that even a tax rate that is negligibly lower than the hypothetical rate leads ceteris paribus to direct losses in rule-based transfer payments (DIHK, 2009). However, fiscal capacity and therefore transfer payments are ceteris paribus independent from actual tax rates. Therefore, politicians of municipalities below the reference rate might increase the respective actual tax rate due to an increase in the hypothetical tax rate, even though no direct negative effects on grant allocation are to be expected without it. This establishes a ratchet-effect, where the actual tax rate should be at least as high as the hypothetical rate.

4 Methodology

4.1 Spatial lag models

This paper estimates municipal tax reactions to a change of neighboring municipalities' tax rates. A common procedure to address this question is the spatial lag model, which explicitly incorporates neighbor outcomes into the regression. The standard model is estimated as follows:

$$\tau_{i,t} = \rho \sum_{j \neq i} w_{i,j} \tau_{j,t} + \beta x_{i,t} + \mu_i + \epsilon_{i,t}, \tag{4}$$

where $\tau_{i,t}$ is the tax rate from municipality i in year t and $\tau_{j,t}$ represents the averaged tax rates of all neighbor municipalities j of municipality i in period t. Moreover, significant estimates of ρ are interpreted as strategic tax rate interactions with neighbors. We also include $x_{i,t}$ as control variables, μ_i as municipality fixed effects and the error term $\epsilon_{i,t}$.

The spatial weighting matrix $w_{i,j}$ assigns the averaged tax rates of a pre-defined set of neighbors. Averaging via row normalization ensures the stability of the estimator. Note that the true weighting matrix is unknown. Traditionally, weighting matrices are either based on common borders, distances or population weights. Generally, adjacent units or close municipalities are assumed to have stronger interactions.

However, policy interactions might not only be triggered by geographical closeness but also by political or social ties. To separate distinct channels of tax interactions, we

also introduce several weighting matrices for institutional or local media networks in addition to standard geographical weights. For instance, county membership (*County*) of municipalities is an important institutional network. Moreover, we use rich institutional data from Blotevogel, Münter, and Terfrüchte (2009) and Terfrüchte (2015) to construct our institutional weights. We assign neighbors based on joint access to local media (*Media*), administration (*Administrative*), municipal cooperation projects (*Cooperation*), cooperation in regional marketing and tourism (*Regional marketing*) and interest groups for social and economic issues (*Social and economic*). The definitions from Blotevogel, Münter, and Terfrüchte (2009) follow a heuristic approach and aim to resemble given borders. The same institutional weighting matrices are also proposed by Terfrüchte (2015), using the regional correlation of local institutions to assign the resp borders.[16]

In the baseline regressions we consider all municipalities in the same county as neighbors because of a superior model fit compared to other weighting matrices (for related Akaike and Schwartz criteria, see Table 2) and due to the expected interactions within counties[17].

Taking first differences of equ. (4) removes the municipality fixed effect μ_i and gives:

$$\Delta\tau_{i,t} = \rho\Delta\sum_{j\neq i} w_{i,j}\tau_{j,t} + \beta\Delta x_{i,t-1} + \Delta\epsilon_{i,t}. \tag{5}$$

Specifically, equ. (5) measures whether the change in the weighted average of neighboring business tax rates affects the change in the business tax rates of a given municipality.

However, the neighboring tax changes $\Delta\sum_{j\neq i} w_{i,j}\tau_{j,t}$ might be biased due to several sources of endogeneity. First, there is the issue of reverse causality, i.e. whether a municipality's tax rates influence neighbors tax rates or vice versa. Second, unobserved shocks during the reform might influence tax rates of a certain municipality and its neighbors jointly. For instance, this might be an exogenous reform that increases tax rates (like in our setting) or spatially correlated macro shocks affecting both the tax base and tax rates.

[16] For detailed descriptions of non-geographic weighting matrices, see Appendix C and Table C.1. The mapping of the institutions by Blotevogel, Münter, and Terfrüchte (2009) is shown in Figure B.2 of Appendix B and the mapping of the institutions using a functional approach based on Terfrüchte (2015) is show in Figure B.1 of Appendix B.

[17] We discuss the role of various institutional and geography-based weighting matrices for local tax interactions in Section 5.4.

There are several ways to deal with this endogeneity problem. Traditional spatial lag IV regressions instrument the weighted average of neighboring tax rates with socioeconomic or political characteristics of the neighboring municipalities. However, it is unlikely that this solves potential endogeneity concerns (Gibbons and Overman, 2012).[18] First, municipal tax rates might not be well predicted by neighboring control variables because the weighting matrix might misspecify the exact influence of neighbor characteristics on neighboring tax rates. Second, observable neighboring control variables might have a direct significant effect on the tax rates as well. Moreover, there might be omitted variables that influence both the neighboring characteristics and the error term $\epsilon_{i,t}$.

However, recent quasi-experimental literature used exogenous variation from policy changes to identify causal tax rate reactions at the local level. Accordingly, the next subsection will propose an instrumental variable strategy based on a policy change in NRW to take the endogeneity problem in the common spatial lag framework into account.[19]

4.2 Identification using an exogenous policy change

We use the 2003 reform in NRW to identify reactions towards neighboring tax changes using the empirical method of Lyytikäinen (2012). This paper exploits exogenous variation from a country-wide statutory property tax increase in Finland as a natural experiment to identify tax mimicking behavior at local level. Unlike the Finish setting, we do not have a strictly binding minimum tax rate for business tax in NRW but municipalities have nevertheless strong incentives to increase tax rates as a response to the increase in the hypothetical tax rate. Hence, we believe that our instrument is relevant.

To capture the incentive to increase tax rates as a response to increased hypothetical tax rate we calculate the predicted imposed tax increase as we cannot observe the counterfactual of tax rate choices without the increase in the hypothetical rate. The update of the hypothetical tax rate is an arguably exogenous event and hence we can use the neighboring imposed increase to predict neighboring tax changes. In other words, we instrument tax rate choices of a municipality's neighbors with their incentives to increase tax rates.

[18] Another method in traditional spatial econometrics is quasi-maximum likelihood (QML) estimation (LeSage and Pace, 2009). The underlying assumption with QML is that the true spatial interaction is known, which is a strong assumption (Gibbons and Overman, 2012).

[19] We report results of traditional Spatial IV estimations in the robustness checks in Section 3.

Therefore, we propose the calculation of neighbors' predicted imposed increases from the reform in the first stage as follows:

$$\sum_{j \neq i} w_{i,j} \tau_{j,2003} = \sum_{j \neq i} w_{i,j} D(\overline{\tau_{2003,m}} > \tau_{j,2000,m})(\overline{\tau_{2003,m}} - \tau_{j,2000,m}) \tag{6}$$

The term $(\overline{\tau_{2003,m}} - \tau_{j,2000,m})$ calculates the difference of the actual tax rate in 2000 to the new hypothetical tax rate in 2003.[20] First, this term gives substantial information about the intended magnitude and probability of the tax increase as a response to the reform. We use the year 2000 as a base year since the respective tax rate should be a strong predictor for the tax rate in 2003, given the persistence of tax rates. Second, the choice for the year 2000 ensures exogeneity of the instrument of the newly updated hypothetical tax rate in 2003 because tax rates in 2000 should be uncorrelated with the error term in equ. (5).

Furthermore, $D(\overline{\tau_{2003,m}} > \tau_{j,2000,m})$ is a binary variable taking the value of 1 if the tax rate in 2000 is below the new hypothetical tax rate in 2003. This ensures, that our instrument only captures the local average treatment effect of municipalities which have a positive pre-reform distance of their realized tax rates to the later standard multiplier. This is because of the widely observed incentive of municipalities to perceive the hypothetical tax rate as a minimum value for their own tax rate choices. Moreover, except for one municipality all tax rate changes are positive. The previous discussion on municipal incentives to use the hypothetical tax rate as a benchmark for own tax rate choices and therefore, incentives to increase tax rates as a response to the reform in 2003, indicates how strongly our instrument predicts tax rate increases after the reform. Moreover, Figure 2 shows some preliminary evidence on the correlation of the predicted imposed increase with actual tax increases due to the reform. In fact, there is a positive correlation between these variables and thus, our instrument strongly predicts tax increases from 2002 to 2003.

Note that tax rates of municipalities are spatially correlated and hence, so are the predicted imposed increases. Not taking this into account would cause endogeneity since

[20] Moreover, it is unlikely that in 2000 politicians already strategically reacted to the reform of 2003. Note, that the reform was only decided in late 2002. Rule-based grants are calculated on the basis of the 1st of June 2001 until the 1st of July 2002. Therefore the year 2000 is the first year not affected by the reform.

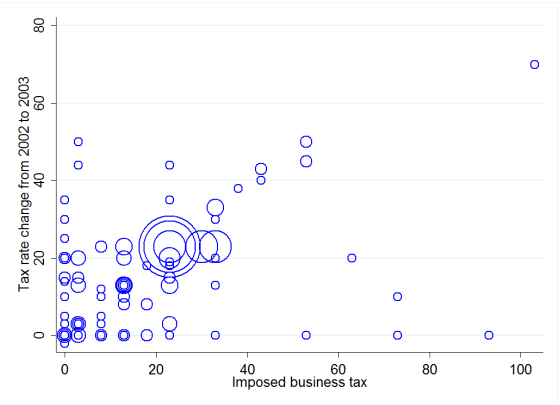

Figure 2: Correlation of reform incentives and actual tax increases. *Notes*: The magnitude of municipal tax rate changes are depicted with dots. Note that the size of dots represents the frequency of certain tax rate changes in the sample.

spatial autocorrelation would feed into the error term through our instrumental variable. By including the predicted imposed increase for a given municpality i as well we control for the direct reform effect on this municipality. Hence, we can avoid endogeneity through the overall incentive of the reform to increase tax rates and the related issue of spatial autocorrelation from neighbors tax rates to own tax increases. Conditional on the own imposed increase in a given municipality, we can measure the causal effect of tax rate interactions of a given municipality to its neighbors in response to the tax reform.

5 Results

5.1 Data and descriptive statistics

We use a balanced panel for all 396 municipalities of NRW from 1993-2008. In the baseline IV regressions we only exploit data from 2000 onwards as all identifying variation for our instrument is from this period. In Section 3 we also perform placebo tests using information from previous years starting from 1993. Data about local tax rates, population, population structure (young and old), employment situation as well as received overall grants[21] and short- and long-term debt are obtained from the Statistical Office

[21] This variable contains the overall sum of transfers (discretionary plus rule-based grants).

of NRW. The respective hypothetical tax rates are collected from laws on local fiscal equalization from the Ministry of Interior NRW (GFAG NRW, several years).

Descriptive statistics for the main observation period between 2002 and 2003 are shown in Table A.1 in Appendix A. The upper and lower panel show summary statistics for the variables in levels of 2003 and in first-differences from 2002 to 2003, respectively. Business tax rates in NRW have a large variation from 310 up to 490. Therefore, municipalities are both below and above the hypothetical tax rate in 2003. However, more than 60% of all municipalities change their tax rates. The change is 13.6 percentage points on average although it ranges from -2 to 70 percentage points. Grants also vary greatly across municipalities with a range from 0 to more than 600 euro per capita. NRW is also a highly urbanized state with comparably high municipal debt levels.

Moreover, the left panel of Figure 3 shows the spatial distribution of business tax rates in the year 2000. The right panel displays the distribution of related tax rate changes during the reform. Whereas it is clear that business tax rates are generally spatially correlated in NRW (left panel), the right panel shows that also the changes in tax rates are clustered in space. To see whether the spatial autocorrelated tax rate changes are the outcome of strategic interactions or only spurious correlations, we employ our spatial lag IV estimations using the policy change in 2003 as a source of exogenous variation.

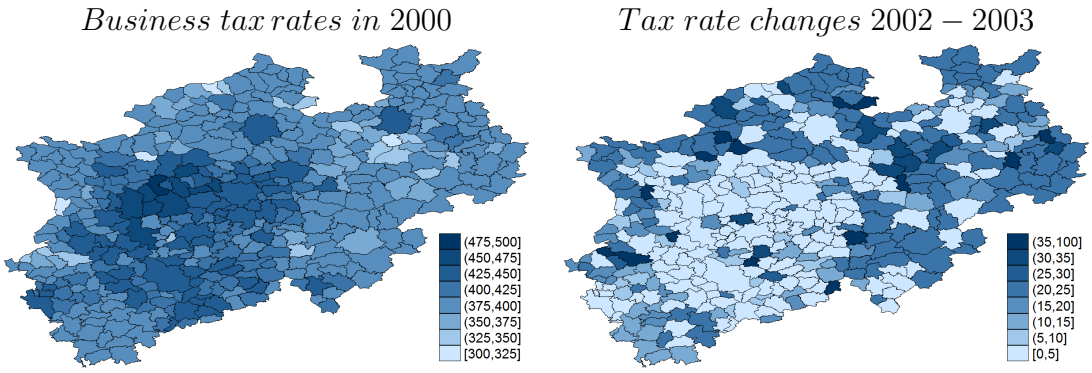

Figure 3: Spatial distribution of tax rates

5.2 Baseline results

The main results using municipalities in the same county as neighbors are displayed in Table 1. Model I gives the second stage results as depicted in equ. (5) and Model II shows the first stage results using the instrument as outlined in equ. (6).

Table 1: Main Results

	Dependent Variable: $\Delta\tau_{i,2003-2002}$	
	2SLS	OLS
	(I)	(II)
	Second Stage	First stage
ρ	0.314**	
	(0.157)	
Non-zero own imposed	6.403***	1.706**
increase (1/0)	(2.085)	(0.690)
Own imposed increase	0.176**	0.000
	(0.089)	(0.020)
$\Delta Population_{i,2002-2001}$	-0.001	0.000
	(0.001)	(0.000)
$\Delta Share\ young_{i,2002-2001}$	-377.162	-333.537***
	(366.944)	(128.285)
$\Delta Share\ old_{i,2002-2001}$	424.271	-161.037
	(333.013)	(114.365)
$\Delta Employed\ per\ capita_{i,2002-2001}$	55.290	7.811
	(62.953)	(19.177)
$\Delta Short\ term\ debt\ per\ capita_{i,2002-2001}$	-0.011**	-0.004**
	(0.005)	(0.002)
$\Delta Core\ debt\ per\ capita_{i,2002-2001}$	-0.002	0.001
	(0.002)	(0.001)
W × own imposed increase		0.456***
		(0.033)
Constant	-0.320	4.842***
	(1.750)	(0.668)
Kleibergen-Paap F	190.255	
Adjusted R^2	-	0.726
N	396	396

Notes: W assigns all municipalities in the same county as neighbors with equal weights. Neighboring tax rates are instrumented with their predicted imposed increase based on the year 2000. Robust standard errors are in parentheses. Stars indicate significance levels at 1% (*), 5%(**) and 10%(***).

Our policy change-based instrument proves to be a relevant instrument in the first stage in Model II. The Kleibergen-Paap F-test of about 190 in the first stage indicates the strong predictive power of our instrumental variable. Moreover, the neighboring imposed increase indicates the relevance of our instrument in statistical and economic means.[22] These findings show that municipalities indeed respond strongly to the incentive caused by the increase in the hypothetical tax rate as outlined in Section 3.3.

The second stage shows that the spatial interaction effect is positive and significant. Therefore, municipalities seem to have reacted strategically to neighboring municipalities in their own county regarding their tax rate choices after the reform. An increase in one

[22] An increase in one standard deviation (SD) of average neighboring tax imposed increase results in an increase in 75 % of the SD of the neighboring average increase in the tax rates.

SD of the neighbors tax increase results in a substantial increase in the own tax rate by 20% $(0.314 \times 7.760)/12.822)$. Moreover, the influence of the predicted imposed tax increase is 48.028 % of the SD.[23] Both effects allow for an interesting comparison because we can determine the degree of a direct response to the reform and to the response of neighboring decisions. Since the effect of 'own imposed increase' is larger than the neighboring interaction effect, we infer that politicians foremost respond to the policy change. This is an interesting result, since tax mimicking is mainly driven by the reform but is done only residually after adjusting ones' own tax rate to the policy change.

We also re-estimate our baseline model for various weighting matrices of both geographical and non-geographical nature. We present the most interesting results in Table 2 and a detailed overview of the results in Table A.2 in Appendix A. Interestingly, some institutional weighting matrices are of significance, whereas the geographical weighting matrices are not significant.[24] This might indicate that institutional proximity is more important for tax interactions in our setting than mere distance. Counties, administrations and functional media neighbor regions yield significant estimates and appear as important networks for local tax interactions. However, functional administrative regions do not show significant results. We attribute this to the large number of islands in this weighting matrix. Also aggregated media regions are not significant but we believe that the functional and more disaggregated media regions capture local variation in media access better. Functional cooperation in individual projects yields slightly significant tax interactions but, nevertheless, does not turn out to be robust against sensitivity checks. Cooperation in regional tourism and interest groups for political and societal issues are not significant either. Table A.3 in Appendix A shows the robustness of selected institutional networks for local tax interactions. The disaggregated measure of common access to local media yields robust results. Joint administrations also appear widely robust but fail one placebo test in the pre-reform period.

We proceed with extensive robustness tests for the county matrix as our baseline weighting scheme and discuss the implications of different institutional matrices in Section 5.4.

[23] Using the SD of the dummy 'Non-zero own imposed increase (1/0)' (46.64 %) and the SD of own imposed increase (17.65), the effect on SD of the own tax increase is 48.03%. $((6.403 \times 0.4664) + ((17.647 \times 0.176)/12.687)$.

[24] Note that the confidence intervals of the institutional and geographical weighting matrices partly overlap. Nevertheless, the coefficients of the significant institutional matrices are have substantially larger interaction effects and model fit in terms of information criteria. For example, comparing the best best performing institutional and geographical matrix, the county and binary contiguity matrix, the interaction effect is 42% higher in the county matrix.

Table 2: Institutional versus geographical weights

Model	Weighting type	ρ	SE	Kleibergen-Paap	AIC	BIC	N
(I)	Counties	0.314**	(0.157)	190.255	2960.422	3000.236	396
(II)	Administrative	0.271**	(0.137)	1607.584	2968.263	3008.077	396
(III)	Media functional	0.355***	(0.120)	1527.115	2966.355	3006.169	396
(IV)	Cooperation functional	0.229*	(0.124)	133.447	2969.105	3008.919	396

Notes: All presented matrices are row normalized. Control variables are the long differences of the population, the share young (<15yrs.) and old (>65yrs.), employed per capita, core budget debt per capita and short term debt per capita. Neighboring tax rates are instrumented with neighboring predicted imposed increase based on the year 2000. Furthermore, we also include the own imposed increase based on the year 2000 as well as a dummy whether own imposed increase is unequal to zero. Robust standard errors are in parentheses. Stars indicate significance levels at 10% (*), 5%(**) and 10%(***).

5.3 Robustness tests

For the reform to be arguably exogenous, own tax decisions during the reform should not be influenced by neighbors' tax decisions prior to the reform. We test this prediction with several placebo tests in Table 3. In Model I-III we regress the predicted tax changes of neighboring municipalities from 2002 to 2003 on tax changes in a municipality of years preceding the reform. In Model IV, we assigned a municipality to an arbitrary county. We do this by assigning a given municipality to all other municipalities in a county with the next higher county identifier number. This ensures that each county is only assigned once. Alternatively, we use historical county borders from 1960 as an additional placebo test in Model V to show the exogeneity of county borders.[25] County borders in West German states changed in an extensive wave of county and municipal merger reforms in the 1960s and 1970s. Hence, most county borders of today do not overlap with historical borders. If tax interactions between municipalities were biased by spatial autocorrelation of tax rates, tax rates should also be correlated across historical borders. If in fact today's institutions mattered for current tax decisions, interactions should be insignificant.

Note that throughout all specifications and years our instrument proves to be a strong predictor of neighboring tax rate changes. Regarding the robustness tests of Model I-III, the interaction effect of current neighboring tax changes on past tax changes is insignificant. This shows that our instrument significantly predicts the actual reform but is not correlated via the error terms with earlier decisions. We also run placebo regressions

[25]The number of municipalities and counties decreased from 2365 to 396 and and from 57 to 30, respectively. There were more district-free cities, which results in 38 units without neighbors in our sample. For simplicity, we assume them to be each others' neighbors. However, dropping these observations does not change the results.

Table 3: Robustness checks

	Model	ρ	SE	Kleibergen-Paap F	N
(I)	Tax changes 1994 - 1993	-0.081	(0.112)	194.389	396
(II)	Tax changes 1995 - 1994	-0.018	(0.118)	204.934	396
(III)	Tax changes 1996 - 1995	-0.054	(0.135)	198.969	396
(IV)	W = Arbitrary county	-0.045	(0.083)	493.748	396
(V)	W = Counties 1960	0.173	(0.142)	127.085	396

Notes: *W* assigns all municipalities in the same county as neighbors with equal weights in Models I-III. Model IV assigns municipalities form the county with the next higher county identifier as neighbors. Model V assigns municipalities based on the same county prior to the county mergers in 1960. Neighboring tax rates are instrumented in all models with their predicted imposed increase based on the year 2000. Control variables are the same as in Table 1. Model I uses the first difference of the control variables from 1992 until 1993. Model II uses the first difference of the control variables from 1993 until 1994. Model III uses the first difference of the control variables 1994 until 1995. Model IV and V use the first difference of the control variables from 2001 until 2002. Robust standard errors are in parentheses. Stars indicate significance levels at 10% (*), 5%(**) and 10%(***).

where we gradually drop municipalities with more than 150,000 and 100,000 inhabitants. Results do not change qualitatively and show that large municipalities do not drive the effects of the reform. In addition, an insignificant interaction effect in Model IV indicates that the municipal decision to increase tax rates solely depends on its own county. In Model V we do not find significant effects which shows that not geographical proximity but current institutions of the county matter for local tax interactions. Counties seem to effectively coordinate contemporary tax policies at the local level.

We conduct further robustness checks in Table A.4 in Appendix A. Here, we omit control variables, cluster on the county level, include different regional dummies to account for regional heterogeneity and added accumulated contributions per county (*Kreisumlage*) as a control. Since our coefficient of interest does not differ much when excluding control variables in Model II, unobservable variation should not affect our variable of interest and we have suggestive evidence that our instrument is in fact exogenous (Altonji, Elder, and Taber, 2005).[26] When clustering on the county level in Model III, the interaction effect remains significant. The addition of regional variables in row IV and V and county grants in row VI also do not change our findings qualitatively. Note that Model IV and Model V show that our results are not only accrue to a metropolitan area (Holzmann and Schwerin, 2015) or specific to a certain regional district, respectively. Moreover, we can show that contributions to the county are insignificant in Model VI (not reported)

[26]Note that we keep the dummy's 'Non-zero own imposed tax increase' and 'Own increase' in our set of control variables as we only introduce exogeneity with our IV conditional on own incentives to increase the tax rates and avoid issues of spatial autocorrelation (Lyytikäinen, 2012). When omitting these factors tax interactions become highly overestimated.

and thus, we can rule out the presence of vertical externalities Revelli (2003).[27]

We also compare our results to traditional estimates of tax interactions. Traditional IV estimates use neighbors characteristics as instruments for neighbors tax rates. Results are displayed in Table A.5 in Appendix A. F-statistics are much lower compared to our policy-change based instrument but are still nonweak by conventional standards. Both traditional spatial lag models and QML estimations yield tax interactions of higher significance and magnitude than our baseline model. In line with recent quasi-experimental literature on local tax interactions, our findings cast some doubt on the validity of traditional instruments (Gibbons and Overman, 2012).

5.4 Discussion

5.4.1 Social learning and institutions

In Section 2 we argued that social learning is a likely motive for tax mimicking during the reform in question. Here, we present suggestive evidence to support this notion. Social learning is needed as individual municipalities or local politicians in particular are unlikely to be successful in predicting the outcomes, for example future grant allocation, as a result of the reform. This holds particularly for a reform of the complex grant system of local fiscal equalization in NRW. Instead, local politicians and bureaucrats need to communicate tax strategies to resolve the inherent uncertainty of the reform.

Moreover, social learning during the reform should be a one-step learning process rather than a continuous process as new information has to be communicated only once. In fact, we find supportive evidence for this in Table 4, where tax interactions become insignificant two years after the reform and effects disappear gradually. The sharp drop of the effect from 2007-2008 might reflect a federal reform of the business tax.[28]

[27] As a further exercise, we interacted tax interactions in different regressions with municipalities under fiscal supervision and municipalities that do not receive rule grants (i.e. are abundant). Tax interactions always remains significant but abundant and fiscally supervised municipalities, respectively do not react to their neighbors during the reform. The results are available from the authors upon request.

[28] Büttner, Scheffler, and von Schwerin (2014) show that this reform induced municipalities with many non-incorporated firms to increase their tax rates as a response of the new business tax deductability to the income tax to be paid by those firms.

The structure of tax interaction intensity provides another argument for social learning. Tax policies should be communicated on platforms where politicians or bureaucrats are likely to meet such as the county parliament or joint administration offices. Also local media might be an effective means of knowledge spillovers for tax policies. Other institutional cooperations such as inter-municipal cooperation for individual projects, cooperation in tourism or regional marketing or interaction with local interest groups are, however, less reasonable channels of information for local tax policies. Accordingly, we only find significant interactions within similar institutions and media as shown in Table A.2 in Appendix A, but not for neighbors measured by geographical distance only. This leads us to the conclusion, that we indeed observe social learning through the reform as reform outcomes are hard to predict for individual municipalities and coordination via counties, media and within bureaucracies is a feasible coping mechanism.

The absence of effects with geographical distance matrices shows that tax interactions can be triggered by shared institutions or media rather than by geographical distance only. Moreover, while counties, common administrations and media are valuable communication platforms and intensify tax interactions during the reform, voluntary project cooperation of municipalities is only slightly significant.[29] Table A.2 in Appendix shows that also local interest groups and cooperation in regional marketing and tourism do not yield significant interactions. Table A.3 in Appendix shows the robustness of selected weighting schemes. Administration and media weights prove to be widely robust and show similar effects as the county weights. Single project cooperation, however, yields only significance at the 10% level and depends largely on the inclusion of control variables.

Table 4: Long run results

	Dependent Variable: $\Delta\tau_{i,t-2002}$					
	(I) t = 2003	(II) t = 2004	(III) t = 2005	(IV) t = 2006	(V) t = 2007	(VI) t = 2008
ρ	0.314**	0.345***	0.204	0.195	0.165	0.047
	(0.157)	(0.134)	(0.135)	(0.131)	(0.161)	(0.169)
Kleibergen-Paap F	190.255	258.486	242.926	186.253	178.527	169.204
Control Variables	$\Delta 2002-2001$	$\Delta 2003-2001$	$\Delta 2004-2001$	$\Delta 2005-2001$	$\Delta 2006-2001$	$\Delta 2007-2001$
N	396	396	396	396	396	396

Notes: W assigns all municipalities in the same county as neighbors with equal weights. All control variables are the same like in Table 1. Neighboring tax rates are instrumented with their predicted imposed increase based on the year 2000. Robust standard errors are in parentheses. Stars indicate significance levels at 10% (*), 5%(**) and 10%(***).

[29] We regard the interaction effects of the inter-municipal cooperation scheme as a lower bound, since not all cooperation's could be included in our cooperation variable (Terfrüchte, 2015).

5.4.2 Evidence on competing explanations for tax interactions

We provide suggestive evidence in this section that social interactions and not other competing motives are the reason for the observed tax mimicking instead.

Table 5 tests for the presence of yardstick competition as well as tax competition. Both Model I and II interact local tax interactions with a measure of absolute majorities in the local council which represents a standard test of the yardstick competition hypothesis Allers and Elhorst (2005); Elhorst and Fréret (2009). Majorities in the local council should decrease tax interactions if neighbor tax policies were effective yardsticks. Since the interaction effects with the majority term are insignificant, we are able to rule out yardstick competition as an explanation.

Moreover, Model III and IV test for tax base effects during the reform, i.e. the new dependent variable is the tax base of a given municipality. If competition for mobile tax bases was in place, one would observe significant effects in the respective models. Tax base effects also do not seem to be present and therefore, tax competition is not an issue in the present context. Also Baskaran (2015a) does not find significant tax revenue or base effects of the reform in question. The timing of treatment effects is another reason against tax competition. We only find short-term effects whereas tax competition for mobile resources can be expected to trigger a continuous tax game. We also rule out benefit spillovers as we do not observe any negative tax interactions.

Another explanation for local tax interactions is (partial) coordination. While we do observe a strong role of counties in local policy making, active coordination through counties is unlikely as this implies a perfect harmonization of tax rates within a given county. However, business tax rates are still somewhat heterogeneous although they were synchronized substantially after the reform. There is no anecdotal evidence either that county executives dictate new tax rates for member communes. After all, counties also do not have legal tax autonomy. Therefore, counties and other institutions can be rather understood as a platform for local politicians or bureaucrats to communicate individual tax strategies. The effect of media does not seem to be voter driven as there are no differences between municipalities with or without narrow majorities. Therefore, media could also work as a mere communication platform for politicians and bureaucrats themselves to pick up information which are not spread in other ways such as county parliaments, joint bureaucracies or other forms of inter-municipal cooperation. Therefore,

not active but rather passive coordination in form of knowledge diffusion seems to be in place.

Partial coordination is also unlikely to be present as it implies a repeated game structure and one would therefore expect to observe continuous tax interactions. However, tax interactions phase out quickly after the reform and have no effects on the tax base.

Table 5: Determination of interaction channels

Dependent Var:	$\Delta_{i,2003-2002}$ tax rate		$\Delta_{i,2003-2002}$ Taxbase per capita	
	subset: Majority $> 50\%$ (I)	subset: Majority $> 55\%$ (II)	$W =$ County (III)	$W =$ Binary contiguity (IV)
ρ	0.307*	0.346**	-0.179	-0.145
	(0.176)	(0.167)	(0.319)	(0.268)
$\rho\times$ subset	0.010	-0.065		
	(0.080)	(0.076)		
Kleibergen-Paap F	93.856	93.025	189.555	141.540
N	396	396	396	396

Notes: W assigns all municipalities in the same county as neighbors with equal weights. Neighboring tax rates as well as the interactions are instrumented with their predicted imposed increase based on the year 2000. All control variables are the same like in Table 1. Majority always represents an interaction term with the neighboring tax rate, when a party in the council has more than x percent of the seats in the municipal council. Robust standard errors are in parentheses. Stars indicate significance levels at 10% (*), 5%(**) and 10%(***).

6 Conclusion

This paper exploits a quasi-experimental setting in local fiscal equalization in the German state of NRW, to show the existence of local tax interactions for various weighting matrices. Using instrumental variable techniques and detailed information on local networks, we show that the reform in question triggered positive tax interactions immediately after the reform only. Our results are robust to various specification tests, including several placebo tests and random institution allocation.

Municipalities of the same county, those with the same bureaucrats or local media interact most intensely with each other. Other platforms like project-wise inter-municipal cooperation or interest group coverage do not intensify tax interactions. Hence, counties, joint administration and media are effective coordination mechanisms for local tax policies during the reform in question. These are typically also networks where local politicians and bureaucrats exchange information on salient political issues. We also show that institutional rather than geographical proximity matters for tax interactions.

These results are in line with the idea that municipalities engage in social learning in reform times. As reforms entail substantial political uncertainty, institutions like counties or joint bureaucracies may offer a communication platform for local politicians and bureaucrats to cope with uncertainty regarding future tax policy choices. Local media offer similar coordination devices. Baskaran (2015b) finds similar evidence on social learning in local tax choices between East German border municipalities with their West German counterparts immediately after German reunification. Tax or yardstick competition and benefit spillovers, however, do not seem to be drivers of the results.

Our results can be extended to other multi-tier federal contexts where federal and central state legislation (vertically) influences local parameters of fiscal policy, for example other German states (Büttner and von Schwerin, forthcoming), the US (Agrawal, 2015a), England (Revelli, 2003) or France (Breuillé, Vigneron, and Anne-Laure, 2011). Büttner and von Schwerin (forthcoming) show the importance of federal or state-wide institutional tax rates (for e.g. the hypothetical tax rate) which represent reference rates for most German states. NRW might be, however, a special case as municipal debt, tax rate levels and the share of aggregate local to state expenditures are comparably high in the German context (Arnold, Boettcher, Freier, Geißler, and Holler, 2015). Also its high average municipal size compared to other German states may imply that NRW municipalities are on average more professional in local policy making.

Future research might ask whether social learning via institutions is an efficient mechanism to coordinate local responses during a fiscal macro shock. Also knowledge diffusion through institutions or media for other local policies should be examined. Other policies of high relevance that might need central coordination are for example the provision of kindergarten places or the efficient allocation of refugees at the local level.

References

Agrawal, D. R. (2015a): "Local fiscal competition: An application to sales taxation with multiple federations," *Journal of Urban Economics*, (0), –.

Agrawal, D. R. (2015b): "The tax gradient: spatial aspects of fiscal competition," *American Economic Journal: Economic Policy*, 7(2), 1–29.

Allers, M. A., and J. P. Elhorst (2005): "Tax mimicking and yardstick competition among local governments in the Netherlands," *International Tax and Public Finance*, 12, 493–513.

Altonji, J., T. Elder, and C. Taber (2005): "Selection on observed and unobserved: assessing the effectiveness of Catholic schools," *Journal of Political Economy*, 113, 151–184.

Arnold, F., F. Boettcher, R. Freier, R. Geissler, and B. Holler (2015): "Kommunaler Finanzreport 2015," Bertelsmann Stiftung.

Baskaran, T. (2014): "Identifying local tax mimicking with administrative borders and a policy reform," *Journal of Public Economics*, 118, 41 – 51.

——— (2015a): "The revenue and base effects of local tax hikes: Evidence from a quasi-experiment," Discussion paper, Discussion Papers, Center for European Governance and Economic Development Research.

——— (2015b): "Tax mimicking in the short- and long-run: Evidence from German reunification," *Mimeo: University of Göttingen*.

Becker, J., and R. B. Davies (2013): "Learning and international policy diffusion: the case of corporate tax policy," Working Papers 1319, Oxford University Centre for Business Taxation.

Besley, T., and A. Case (1995): "Does electoral accountability affect economic policy choices?," *Quarterly Journal of Economics*, 110, 769–798.

Blotevogel, H. H., A. Münter, and T. Terfrüchte (2009): "Raumwissenschaftliche Studie zur Gliederung des Landes Nordhrein-Westfalen in regionale Kooperationsräume," TU Dortmund Fakultät Raumplanung.

Borck, R., F. M. Fossen, R. Freier, and T. Martin (2015): "Race to the debt trap? Spatial econometric evidence on debt in German municipalities," *Regional Science and Urban Economics*, 53, 20 – 37.

Brecht, A. (1932): *Internationaler Vergleich der öffentlichen Ausgaben*. Teubner, Leipzig.

Breuillé, M.-L., P. D. Vigneron, and S. Anne-Laure (2011): "To assemble to resemble? A study of tax disparities among French municipalities," *Documents de treball IEB*, (13), 1–37.

Brueckner, J., and L. Saavedra (2001): "Do local governments engage in strategic property tax competition?," *National Tax Journal*, 54(3), 231–253.

Buettner, T. (2001): "Local business taxation and competition for capital: the choice of the tax rate," *Regional Science and Urban Economics*, 31(2), 215–245.

Büttner, T. (2006): "The incentive effect of fiscal equalization transfers on tax policy," *Journal of Public Economics*, 90(3), 477–497.

Büttner, T., W. Scheffler, and A. von Schwerin (2014): "Die Hebesatzpolitik bei der Gewerbesteuer nach den Unternehmensteuerreformen [Tax setting policy of the local business taxes after a reform]," *Perspektiven der Wirtschaftspolitik*, 15(4), 346 – 354.

Büttner, T., and A. von Schwerin (forthcoming): "Yardstick Competition and Partial Coordination: Exploring the Empirical Distribution of Local Business Tax Rates," *Journal of Economic Behaviour & Organization*.

Cardarelli, R., E. Taugourdeau, and J.-P. Vidal (2002): " A Repeated Interactions Model of Tax Competition," *Journal of Public Economic Theory*, 4(1), 19–38.

Case, A. C., H. Rosen, and J. Hines (1993): "Budget spillovers and fiscal policy interdependence: evidence from the States," *Journal of Public Economics*, 52(3), 285–307.

Cassette, A., E. D. Porto, and D. Foremny (2012): "Strategic fiscal interaction across borders: Evidence from French and German local governments along the Rhine Valley," *Journal of Urban Economics*, 72, 17 – 30.

Charlot, S., and S. Paty (2010): "Do agglomeration forces strengthen tax interactions?," *Urban Studies*.

Cotenaro, M., and J.-P. Vidal (2006): "Implicit tax co-ordination under repeated policy interactions," *Recherches Economiques de Louvain*, 72(1), 5–18.

DIHK (2009): "Standort Deutschland - Standortfaktor Gewerbesteuer: Argumente für die kommunalpolitische Diskussion," Deutscher Industrie- und Handelskammertag.

Egger, P., M. Köthenbürger, and M. Smart (2010): "Do fiscal transfers alleviate business tax competition? Evidence from Germany," *Journal of Public Economics*, 94, 235–246.

Elhorst, J. P., and S. Fréret (2009): "Evidence of political yarstick competition in France using a two-regime spatial durbin model with fixed effects," *Journal of Regional Science*, 49(5), 931–951.

Eugster, B., and R. Parchet (2011): "Culture and Taxes: Towards Identifying Tax Competition," Mimeo: University of Lausanne.

Foremny, D., and N. Riedel (2014): "Business taxes and the electoral cycle," *Journal of Public Economics*, 115, 48 – 61.

Geys, B., and S. Osterloh (2013): "Borders as boundaries to fiscal policy interactions? An empirical analysis of politicians opinions on rivals in the competition of firms," *Journal of Regional Science*, 53(4), 583–606.

Gibbons, S., and H. G. Overman (2012): "Mostly pointless spatial econometrics," *Journal of Regional Science*, 52, 172–191.

Glick, D. M. (2014): "Learning by Mimicking and Modifying: A Model of Policy Knowledge Diffusion with Evidence from Legal Implementation," *The Journal of Law, Economics & Organization*, 30, 339 – 370.

Holzmann, C., and A. v. Schwerin (2015): "Economic Integration and Local Tax Mimicking," *Mimeo*.

Isen, A. (2014): "Do local government fiscal spillovers exist? Evidence from counties, municipalities, and school districts," *Journal of Public Economics*, 110, 57 – 73.

Janeba, E., and S. Osterloh (2013): "Tax and the city - A theory of local tax competition," *Journal of Public Economics*, 106, 89 – 100.

Kanbur, R., and M. Keen (1993): "Jeux Sans Frontieres: Tax Competition and Tax Coordination When Countries Differ in Size," *American Economic Review*, 83(4), 877–92.

Kauder, B. (2014): "Spatial administrative structure and intra-metropilitan tax competition," *Journal of Regional Science*.

Keen, M., and K. Konrad (2012): "The theory of international tax competition and coordination," Max Planck Institute for Tax Law and Public Finance Working Paper 2012-06.

Kelders, C., and M. Koethenbuerger (2010): "Tax incentives in fiscal federalism: an integrated perspective," *Canadian Journal of Economics*, 43, 683–703.

Koh, H.-J., N. Riedel, and T. Böhm (2013): "Do governments tax agglomeration rents?," *Journal of Urban Economics*, 75, 92–106.

Lenk, T., and H.-J. Rudolph (2004): "Die kommunalen Finanzausgleichssysteme in der Bundesrepublik Deutschland: Die Ermittlung der Finanzkraft," Mimeo (University of Leipzig).

LeSage, J., and R. Pace (2009): *Introduction to Spatial Econometrics*. Chapman-Hall.

Lyytikäinen, T. (2012): "Tax competition among local governments: evidence from a property tax reform in Finland," *Journal of Public Economics*, 96, 584–595.

Parchet, B. (2012): "Are local tax rates strategic complements or strategic substitutes?," Mimeo (Universities of Lausanne and Basel).

Reiter, F. (2015): "Who Competes with Whom? The Structure of International Tax Competition," .

Revelli, F. (2003): "Reaction or interaction? Spatial process identification in multi-tiered government structures," *Journal of Urban economics*, 53(1), 29–53.

Revelli, F. (2005): "On spatial public finance empirics," *International Tax and Public Finance*, 12, 475–492.

Revelli, F. (2008): "Performance competition in local media markets," *Journal of Public Economics*, 92(7), 1585–1594.

Terfrüchte, T. (2015): "Regionale Handlungsräume - Gliederung und Einflussfaktoren am Beispiel Nordrhein-Westfalens [Regional action spaces - Structure and influential factors using the example of Northrhine - Westphalia]," Ph.D. thesis, School of Spatial Planning at TU Dortmund University.

Wilson, J. D. (1999): "Theories of tax competition," *National tax journal*, pp. 269–304.

Zimmermann, H. (1999): *Kommunalfinanzen – Eine Einführung in die finanzwissenschaftliche Analyse der kommunalen Finanzwirtschaft*. Berliner Wissenschaftsverlag, Baden-Baden.

Zodrow, G. R., and P. Mieszkowski (1986): "Pigou, Tiebout, property taxation and the under-provision of local public goods," *Journal of Urban Economics*, 19, 356–370.

A Appendix - Tables

Table A.1: Descriptive statistics

	Mean	Std. Dev.	Min	Max
	2003			
Business tax rate	412.058	23.150	310	490
Change business tax rate (1/0)	.646	.479	0	1
Own imposed increase	16.475	17.648	0	103
Own imposed increase (1/0)	0.682	0.466	0	1
Population	45,655	86,863	4261	965,954
Share young	0.171	.018	.127	.238
Share old	0.174	.020	.115	.259
Employed per capita	0.252	.091	.052	.560
Rule-grants per capita	197.867	117.177	0	607.474
Total grants per capita	195.342	102.503	3.317	563.457
Short term debt per capita	147.289	315.416	0	2775.493
Core debt per capita	881.916	583.296	0	3739.515
	$\Delta 2002 - 2003$			
Δ Business tax rate	13.609	12.687	-2	70
Δ Population	8.412	637.410	-2685	8865
Δ Share young	-0.003	0.002	-0.009	0.0008
Δ Share old	0.005	0.002	-0.002	0.011
Δ Employed per capita	-0.006	0.008	-0.057	0.027
Δ Rule-grants per capita	-14.531	56.392	-188.359	198.959
Δ Total grants per capita	-56.265	56.019	-227.347	194.742
Δ Short term debt per capita	52.672	114.59	-181.78	638.62
Δ Core debt per capita	34.732	133.14	-1090.79	862.62

Source: Own calculations based on official statistics provided by the Federal Statistical Office.

Table A.2: Comparison of action space based weighting matrices

Weighting type	ρ	Kleibergen-Paap	AIC	BIC	Rank AIC & BIC
Institutional weighting matrices					
Counties	0.314**	190.255	2960.422	3000.236	(1)
	(0.157)				
Administration	0.271**	1607.584	2968.263	3008.077	(14)
	(0.137)				
Media	0.119	2555.645	2973.952	3013.767	(21)
	(0.141)				
Social and economic	0.188	249.789	2966.875	3006.689	(8)
	(0.154)				
Regional marketing	0.227	1069.799	2970.831	3010.645	(19)
	(0.142)				
Cooperation	0.225	2247.738	2972.044	3011.858	(20)
	(0.140)				
Media functional	0.355***	1527.115	2966.355	3006.169	(5)
	(0.120)				
Cooperation functional	0.229*	133.447	2969.105	3008.919	
	(0.124)				
Social functional	0.218	189.078	2961.399	3001.213	(2)
	(0.147)				
Administration functional	0.114	235.091	2970.377	3010.191	(18)
	(0.160)				
Geographical weighting matrices					
Binary Contiguity	0.221	140.628	2963.362	3003.176	(3)
	(0.145)				
Contiguity Second Order	0.209	404.886	2966.4	3006.214	(6)
	(0.176)				
5 nearest neighbors	0.119	151.059	2967.266	3007.08	(10)
	(0.152)				
10 nearest neighbors	0.221	240.567	2968.184	3007.998	(13)
	(0.166)				
15 nearest neighbors	0.188	413.748	2966.703	3006.517	(7)
	(0.163)				
20 nearest neighbors	0.191	556.770	2969.169	3008.984	(16)
	(0.162)				
25 nearest neighbors	0.195	872.759	2969.666	3009.48	(17)
	(0.170)				
Inverse Distance 15 km	0.201	158.857	2967.598	3007.412	(12)
	(0.152)				
Inverse Distance 20 km	0.257	227.420	2967.028	3006.843	(9)
	(0.165)				
Inverse Distance 25 km	0.250	353.036	2965.198	3005.012	(4)
	(0.168)				
Inverse Distance 30 km	0.245	617.861	2967.386	3007.2	(11)
	(0.167)				

Notes: All presented matrices are row normalized. Control variables are the same as in Table 1. Neighboring tax rates are instrumented with their predicted imposed increase based on the year 2000. All control variables are the same like in Table 1. Robust standard errors are in parentheses. Stars indicate significance levels at 10% (*), 5%(**) and 10%(***).

Table A.3: Robustness of relevant institutional weighting matrices

Model	W = Administration ρ	Kleibergen-Paap	W = Media functional ρ	Kleibergen-Paap	W = Cooperation functional ρ	Kleibergen-Paap
Baseline	0.271**	1607.584	0.355***	1527.115	0.229*	133.447
	(0.137)		(0.120)		(0.124)	
No covariates	0.241*	1562.300	0.327***	1651.484	0.190	167.551
	(0.138)		(0.120)		(0.124)	
Placebo tests						
Tax changes 1994 - 1993	0.044	1608.995	0.031	1642.932	-0.088	159.853
	(0.098)		(0.099)		(0.081)	
Tax changes 1995 - 1994	-0.200**	1611.568	-0.085	1707.909	-0.045	161.812
	(0.094)		(0.088)		(0.088)	
Tax changes 1996 - 1995	-0.130	1631.992	-0.161	1767.639	-0.041	162.615
	(0.136)				(0.110)	
Long run results						
Tax changes 2004 - 2002	0.251*	1634.552	0.351***	1397.958	0.249**	124.360
	(0.131)		(0.115)		(0.119)	
Tax changes 2005 - 2002	0.141	1186.243	0.221*	983.390	0.163	222.830
	(0.137)		(0.119)		(0.103)	
Tax changes 2006 - 2002	0.174	819.592	0.240**	688.715	0.160	213.374
	(0.139)		(0.122)		(0.107)	
Tax changes 2007 - 2002	0.133	857.318	0.191	645.068	0.148	174.992
	(0.148)		(0.136)		(0.116)	
Tax changes 2008 - 2002	0.057	723.986	0.117	477.690	0.058	172.563
	(0.164)		(0.148)		(0.121)	

Notes: All presented matrices are row normalized. Control variables are the same as in Table 1. Neighboring tax rates are instrumented with their predicted imposed increase based on the year 2000. All control variables are the same like in Table 1. Robust standard errors are in parentheses. Stars indicate significance levels at 10% (*), 5%(**) and 10%(***).

Table A.4: Robustness checks

	Model	ρ	SE	Kleibergen-Paap F	N
(I)	Baseline	0.314**	(0.157)	190.255	396
(II)	No covariates	0.297*	(0.156)	201.232	396
(III)	Clustering county	0.314**	(0.137)	26.322	396
(IV)	Ruhr region FE	0.287*	(0.167)	177.150	396
(V)	Nuts2 FE	0.287*	(0.161)	208.064	396
(VI)	Share county	0.310*	(0.160)	188.643	396

Notes: W assigns all municipalities in the same county as neighbors with equal weights. Neighboring tax rates are instrumented with their predicted imposed increase based on the year 2000. All control variables are the same like in Table 1. Model II does not include control variables except the own imposed increase and the respective dummy. Model III clusters standard errors at the county level. Model IV includes a dummy that indicates the affiliation of the municipality to the Ruhr region. Model V includes dummy's that indicate the respective NUTS2 region. Model VI include the first-difference of the shared costs of the county from 2001 to 2002 (*Kreisumlage*) in the set of control variables. Robust standard errors are in parentheses. Stars indicate significance levels at 10% (*), 5%(**) and 10%(***).

Table A.5: Traditional Spatial Econometric estimates

	Traditional Spatial IV (I) $\Delta\tau_{i,2003} - \tau_{i,2002}$	Quasi Maximum Likelihood (II) $\Delta\tau_{i,2003} - \tau_{i,2002}$
ρ	0.874***	0.540***
	(0.102)	(0.056)
Kleibergen-Paap	71.962	
Hansen J (p-val)	0.6575	
N	396	396

Notes: W assigns all municipalities in the same county as neighbors with equal weights. Model I uses the neighboring changes of all control variables as instrumental variables for neighboring tax changes. Model II performs a quasi-maximum likelihood estimation on equ. (5) above. All control variables are the same like in Table 1. Robust standard errors are in parentheses. Stars indicate significance levels at 10% (*), 5%(**) and 10%(***).

B Appendix - Figures

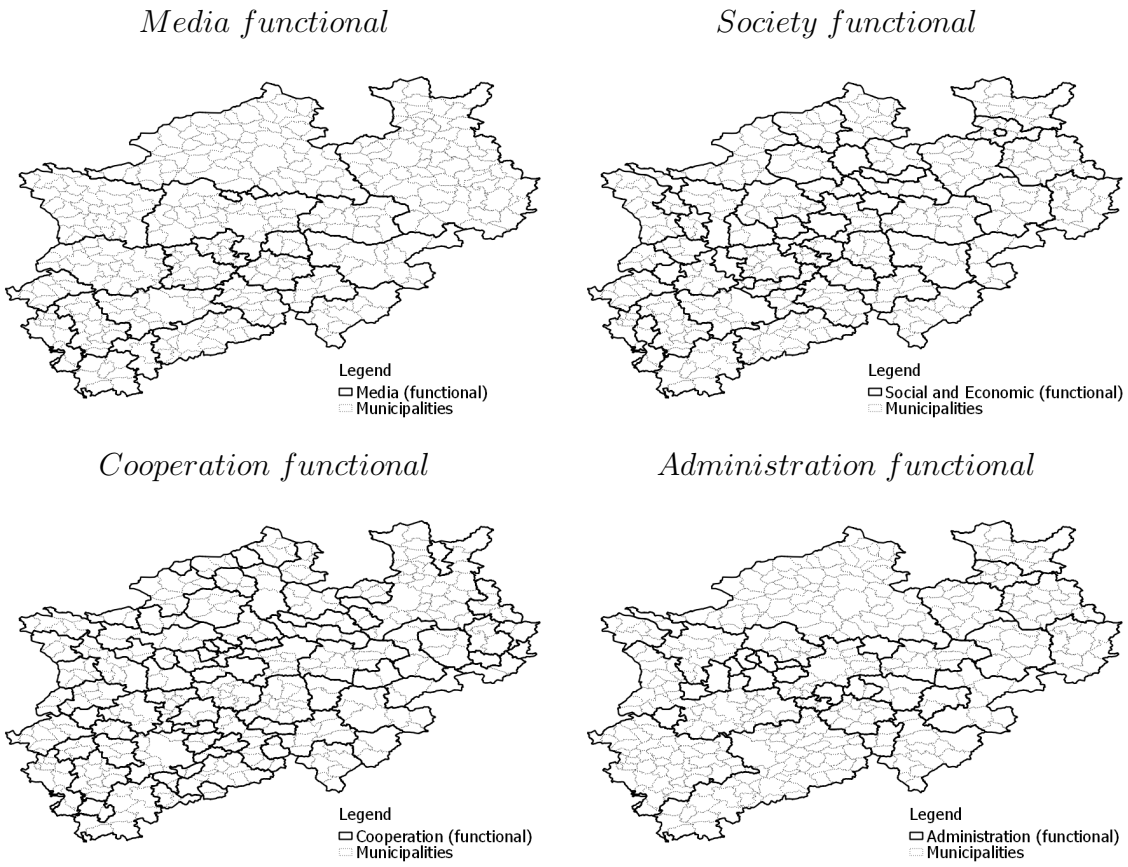

Figure B.1: Institutional functional weighting matrices. Notes: Own coding and mapping based on Terfrüchte (2015)

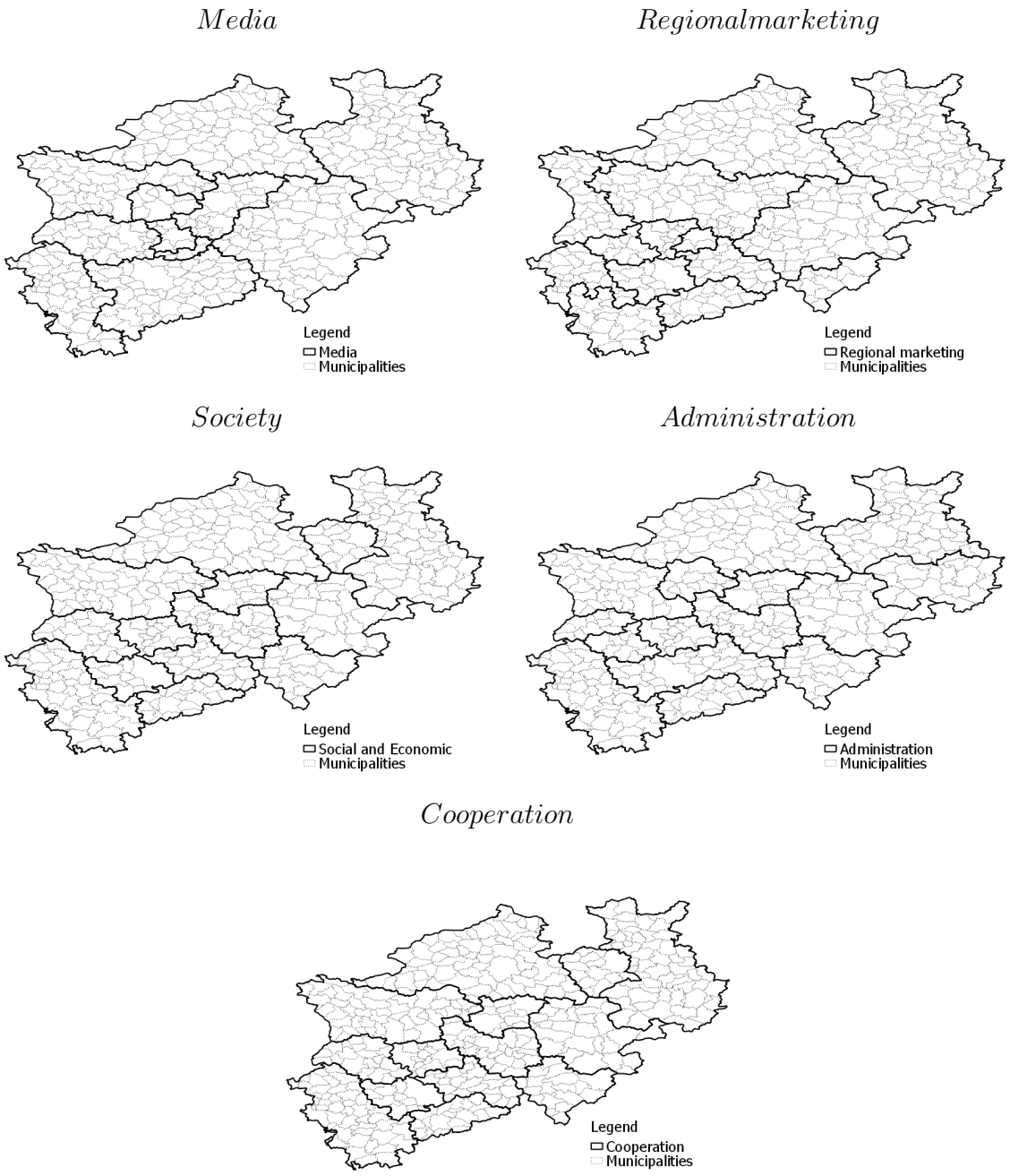

Figure B.2: Illustration of the institutional weighting matrices. Notes: Own coding and mapping based on Blotevogel, Münter, and Terfrüchte (2009).

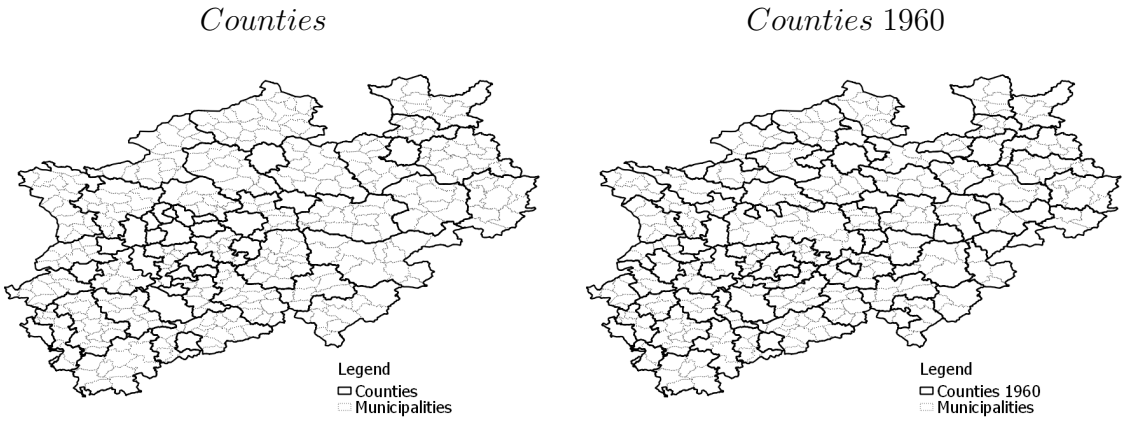

Figure B.3: County weighting matrices

C Appendix - Data description

C.1 Description of the institutional weighting schemes

The county weights reflects the existing counties. All other weighting schemes are obtained from Blotevogel, Münter, and Terfrüchte (2009) and Terfrüchte (2015). Blotevogel, Münter, and Terfrüchte (2009) use a more heuristic approach that observes whether different institutions within the same category share the same border. For each region, the authors plotted the radii of each institution on a map and aggregated municipalities to the regions, when they shared borders along these different institutions. Terfrüchte (2015) uses a functional approach where regional correlations between the institutions are used to construct regional action spaces. Whereas the approach by Blotevogel, Münter, and Terfrüchte (2009) is more oriented on existing borders, the approach by Terfrüchte (2015) is more functional. The first approach maps the borders of existing institutions and aggregates these by common overlaps, whereas the second approach measures the related regional correlation of institutions and constructs regions from these correlations. These action spaces are the basis for our weighting matrices in Table A.2. In certain institutional setups, some municipalities end up as islands, i.e. do not have any neighbors. For simplicity, we assign these municipalities a zero for neighboring tax changes.

Table C.1: Definitions of non-geographical weighting matrices - institutional proximity and media

Weighting scheme	Aggregated institutions	Units (excl. islands)	Mean links	Islands
Administrative (functional)	Labor court districts, bureau of standards districts, Chamber of agriculture. land court districts, Bau- und Liegenschaftsbetrieb NRW, NUTS2 regions, regional forestry commission office, public road construction, social court districts, local rail transports, regional planning institutions and administrative court districts	15 (24)	35.22 (31.67)	0 (12)
Cooperation (functional)	Voluntary local cooperation projects between municipalities	9 (75)	58.19 (8.24)	1 (5)
Media (functional)	Local newspapers, local radios and local television	11 (22)	49.72 (33.34)	0 (0)
Social and economic (functional)	Industrial chamber of commerce and chamber of crafts districts, regional associations of political parties, districts of employers' associations and unions and districts of environmental associations	14 (47)	37.55	0 (5)
Regional marketing	Local tourist associations and regional marketing initiatives	14	43.01	0

Notes: *Source*: All institutional characteristics were obtained by Blotevogel, Münter, and Terfrüchte (2009). Institutional setups with the suffix "functional" are obtained from Terfrüchte (2015).