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Abstract

This paper provides empirical evidence for interdependence of jurisdictions' tax policies. We study tax policy interdependence between municipalities in the economically integrated *European Metropolitan Area Frankfurt/Rhein-Main*, that spreads across two German states, Hesse, and Rhineland-Palatinate. For empirical identification, we exploit two reforms in the Hessian local fiscal equalization scheme in the 1990s that induced quasi-experimental variation in Hessian metropolitan municipalities' business tax rates. In response to the Hessian metropolitan municipalities' tax rate increase, Rhineland-Palatine metropolitan municipalities increase their local business tax rates more moderately as compared to a matched control group of Rhineland-Palatine non-metropolitan municipalities. We argue that primarily tax competition considerations drive the results, as the average tax-rate differential between metropolitan municipalities in Rhineland-Palatinate and Hesse stays stable during the analysis period. We conclude that an arguably strong economic integration of municipalities seems a key determinant for the interdependence of their tax policies.

Keywords: fiscal interdependence; tax mimicking; local business tax; tax competition; fiscal equalization schemes

JEL classification: H20; H71; H77

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1 Introduction

The theoretical literature on fiscal federalism features several reasons for interdependence of taxation and spending decisions among jurisdictions (for an overview see Wilson, 1999). Empirical studies that analyze fiscal interdependence typically face the problem of endogeneity due to simultaneity in jurisdictions' fiscal policy decisions. The body of empirical literature on fiscal interdependence can be split into two strands according to the empirical methodology used to solve the endogeneity problem. The first strand, the early empirical literature, estimates reaction functions using spatial econometric methods. Typically, endogenous fiscal policy variables are instrumented with jurisdictions' fiscal-policy relevant characteristics to resolve endogeneity. These studies find strong evidence for (usually positive) fiscal interaction among local governments (for an overview see Brueckner, 2003). The second strand of more recent empirical studies uses quasi-experimental designs to solve the simultaneity in fiscal policy decisions. In contrast to the early literature's findings, these quasi-experimental studies find no empirical evidence for fiscal interdependence (Lyytikäinen, 2012; Isen, 2014; Baskaran, 2014). The discrepancy between results is explained with the argument that previously used spatial econometric methods did not resolve endogeneity, resulting in upward biased estimates in favor of fiscal interaction (Isen, 2014; Baskaran, 2014). In principle, the quasi-experimental evidence for a non-existence of fiscal policy interdependence is in line with economic theories on efficient tax competition.[1] Nevertheless, the question arises whether fiscal policy interdependence can actually be ruled out in general, or whether the external validity of previous quasi-experimental studies' results might be limited.

[1] Tiebout (1956) describes a setting with many small jurisdictions, offering different bundles of public services to attract mobile households. Here, competition among jurisdictions ensures efficient use of public funds, resulting in an efficient equilibrium. Tiebout shows that in this setting under certain assumptions, amongst others symmetric information, non-distortionary taxes, and an absence of fiscal policy externalities, no fiscal interdependence arises. Similar models have also been formalized including different kinds of taxes, e.g. on property or capital. These models are referred to as Tiebout-type models, implying that the outcome is efficient.

In this paper, we study local tax policy interdependence in a region, which is characterized by a high degree of economic integration: the *European Metropolitan Area Frankfurt/Rhein-Main*[2] (FRM). FRM is an interesting case to study, as the literature on agglomeration and tax policy (Baldwin and Krugman, 2004; Borck and Pflueger, 2006) would suggest interdependence among FRM municipalities' tax policy. Further, a previous study describes standard tax competition dynamics in the closest vicinity of the region's geographic and functional center, i.e. the city of Frankfurt (Buettner and Kauder, 2009). FRM is located at the center of Germany and spreads across three German states: Bavaria, Hesse, and Rhineland-Palatinate. We argue that due to the high level of economic integration in the metropolitan area, the state borders cutting through the metropolitan area do not constitute a barrier for tax policy interactions. However, these state borders create a situation where municipalities, which are part of the same metropolitan area, are subject to different state institutions.

We study two reforms in the Hessian fiscal equalization scheme between 1994 and 2000. Both reforms induce exogenous variation in Hessian municipalities' local business tax multipliers. We exploit these quasi experiments to analyze Rhineland-Palatine FRM municipalities' response in their local business tax multipliers. The estimation results indicate statistically significant effects of tax policy interdependence. Both Hessian reforms increased Hessian metropolitan municipalities' tax multipliers on average. As a response, Rhineland-Palatine FRM municipalities increase their local business tax multipliers, too, however, on average more moderately as compared to a matched control group of Rhineland-Palatine non-FRM municipalities. Due to this moderation in local tax policy, the tax multiplier differential between Rhineland-Palatine and Hessian FRM municipalities stays stable during the time of our analysis. In the pre-reform year 1993, the tax multiplier differential is 15.4 points and amounts post-reform in 1999 to 16.4

[2] The eleven so-called European Metropolitan Areas in Germany were formally appointed in 1995 by the *Ministerkonferenz für Raumordnung (MKRO).*

points. Our difference-in-differences estimates indicate that due to tax policy interdependence, Rhineland-Palatine FRM municipalities decelerate the increase of their multipliers by approximately four points between 1994 and 1999, compared to the control group. Consequently, in the absence of tax policy interdependence, the tax multiplier differential between Hessian and Rhineland-Palatine FRM municipalities would have been 25% larger in 1999.

Tax competition theory suggests that the higher tax multiplier differential would have *ceteris paribus* implied lower investment in Rhineland-Palatine FRM municipalities. Referring to corporate investment literature (Devereux and Griffith, 1998), both the extensive and intensive margin of investment would have been affected, as local business tax multipliers determine both firms' effective average and marginal corporate tax rates. The high level of economic integration among municipalities in the metropolitan area should favor tax competition among FRM municipalities as firms could basically benefit from the entire agglomeration benefits independently from where they are actually located (or decide to locate) in the metropolitan area. Thus, we argue that primarily tax competition considerations are driving the observed tax policy interdependence. Referring to previous quasi-experimental studies that did not explicitly consider economic integration among municipalities in their analyses, we conclude that municipalities' economic integration seems to be a key determinant for the existence of interdependence of tax policy.

The paper proceeds as follows. Section 2 gives the theoretical background and summarizes previous empirical findings on local interdependence of fiscal policies. Section 3 describes the institutional background. Section 4 explains the empirical strategy. Section 5 presents the data and empirical results. Section 6 concludes.

2 Literature

Following Wilson (1999), the theoretical literature proposes different predictions for whether competition among local governments produces efficient results in terms of public service provision or not. On the one hand, there are models which feature the basic characteristics of the Tiebout (1956) model. The provision of public services in these models is pareto efficient in the way that in equilibrium a central government will not be able to increase utility of some households without decreasing the utility of others through an adjustment in tax policy (Wilson, 1999). In this case, tax policy of local governments is independent. On the other hand, there are models which produce inefficient levels of public good provision. Here, competition among governments may lead to interdependent tax policy.

The main adjustment mechanism in the standard Tiebout (1956) model is the mobility of each individual. It is assumed that these so-called *consumer-voters* have complete information regarding all jurisdictions and are fully mobile so that they can move to any jurisdiction, which offers their preferred fiscal policy. Tiebout states that the number of jurisdictions needs to be sufficiently large and public goods are financed through non-distorting taxes. Also, it is assumed that local fiscal policy exerts no externalities beyond jurisdictions' borders. In this setting, each individual will choose her preferred cost (tax) - benefit (public good) - combination, thus provoking competition among jurisdictions to attract households. It is important to note, however, that while this kind of competition ensures an efficient use of public funds, it does not lead to strategic interaction between jurisdictions in terms of tax policy (Wilson, 1999). Efficiency within the Tiebout model has been further explored by, amongst others, Brueckner (1983) and Wildasin (1987). Richter and Wellisch (1996) extend the model to account for mobility of firms and confirm its efficiency hypothesis under certain restrictions.

If however, assumptions within the Tiebout model are not met, this may lead to strategic interaction among municipalities and their tax policy, thus causing an inefficient public service provision. More specifically, three prominent cases are featured in the literature, in which local politicians may interact strategically with regards to their fiscal policy, making tax rates interdependent. These cases are (1) spillover effects, (2) distorting taxes and (3) asymmetric information.

First, Tiebout (1956) already states that it matters whether *external economics* exist. If for example a (local) public good provided by one jurisdiction, also benefits citizens from neighboring jurisdictions, one generally expects undersupply, (implicitly) assuming that local governments only consider marginal cost and marginal benefit of *their* citizens (Williams, 1966). However, taking governments' reaction to spillovers into account, Williams further shows that the question whether benefit spillovers will cause public services to be above or below efficient levels is in fact hard to predict: the reason being, that it is important to consider the effect of spillovers on public spending in neighboring jurisdictions. If for instance households are able to benefit from public goods provided by a neighboring jurisdiction (think of a public outdoor swimming pool), their local government could reduce own efforts (e.g. by closing down their old pool). On the other hand, if one municipality reduces law enforcement efforts, neighbors may have to increase their efforts and extend their police force. It therefore depends on the specific service (e.g. law enforcement, environmental policies, leisure facilities, roads and public transport etc.), whether jurisdictions' reaction to such a spillover is an increase or a decrease in public spending. In any case, if spillovers exist, tax policy of jurisdictions becomes interdependent and may be correlated positively or negatively (Brueckner, 2003).

Second, Oates (1972) emphasizes that competition among jurisdictions may lead to inefficiently low public service provision. If, for example local taxes are (contrary to Tiebout's

assumption) distorting, politicians will choose inefficiently low tax rates in order to attract mobile factors (i.e. act strategically), especially capital (Brueckner, 2003). Therefore, if distorting taxes are used to finance public goods, public spending is likely to fall below efficient levels. As other jurisdictions will be forced to also lower their tax rates, fiscal policy becomes interdependent. A *race to the bottom* is the result. In this context, the number and relative size of jurisdictions is important: if there are only a few jurisdictions, or if a jurisdiction is sufficiently large compared to others, some form of coordination or collusion among local governments may occur. If there are many jurisdictions and each jurisdiction's relative size is small, tax setting is is more likely to be purely competitive. The reason is that the tax policy of a relatively large jurisdiction will impact the net return of capital (Brueckner and Saavedra, 2001). In both cases however, tax rates become interdependent, if the tax base is mobile. Standard tax competition results are also analyzed by Baldwin and Krugman (2004) in the light of the *new economic geography*. They argue that even with capital being mobile, firms are not indifferent to potential locations. Instead, firms tend to *lump* together, i.e. agglomerate in areas, which offer suitable infrastructure and are economically integrated. Here, agglomeration rents are earned, that may be taxed by the government. Thus explaining, why higher tax rates are sustainable in the *core*, rather than in the *periphery* of an economic area. Baldwin and Krugman (2004) show that agglomeration rents follow a bell-shaped function and may lead to a temporary *race to the top* regarding tax rates. Borck and Pflueger (2006) revisit this result and show that it also holds in a more general setting of partial agglomeration.

The third approach to explain interdependence of local governments' tax policy is *yardstick competition*, which may arise when information is incomplete. Yardstick competition has been described by Salmon (1987) and Besley and Case (1995) as a situation where voters have incomplete information about the quality of their government. As they do not know, what the

efficient level of public goods is, that corresponds to a given tax rate, they engage in some form of benchmarking (Shleifer, 1985), referring to information on neighboring jurisdictions' performance as a reference. If tax rates in neighboring jurisdictions are lower, the own government is considered to be inferior or less efficient. In turn, politicians have an incentive, especially before elections, to reconcile tax policy with policies from neighbors. Thus, tax policy of local governments becomes interdependent.

Brueckner (2003) reviews the empirical literature and shows that previous studies use two basic models to analyze fiscal policy interdependence empirically. The *spillover model* can be used as a framework when externalities exist and for yardstick competition. The case of tax competition is generally described in a *resource-flow-model*. However, both of these models generate reaction functions, which can be estimated. Following Brueckner (2003), we can write the reaction function as:

$$z_i = \beta \sum_{j \neq i} \omega_{ij} z_j + X_i \theta + \varepsilon_i \tag{1}$$

The reaction function relates an outcome variable z_i (e.g. tax rate) of jurisdiction i not only to its own characteristics (X_i) but also to the respective (weighted) outcome choices of neighbors $\sum_{j \neq i} \omega_{ij} z_j$. The weights matrix ω_{ij} can be specified, depending on the exact definition of a *who is a neighbor* (e.g. contiguity, proximity etc.) and is generally row-normalized (Anselin, 1988).

A fundamental econometric problem with regards to estimating this reaction function is that the outcome variable (z_i) and the explanatory variable (z_j) are determined jointly (Brueckner, 2003). This, of course, is due to the fact that not only does *j's* fiscal policy influence *i's* policy, but also the other way round, i.e. a simultaneity issue. Therefore, the explanatory variables are correlated with the error term, causing OLS results to be inconsistent. The early econometric

literature mostly uses instrumental variables (IV) to appropriately address the endogeneity issue (Brueckner, 2003).

Allers and Elhorst (2005) summarize the results of almost 20 respective empirical studies, stating that generally a positive correlation is found between the fiscal policy of neighboring jurisdictions with elasticities of tax revenue interdependence ranging between 0.2 and 0.6. In detail, Ladd (1992), Case et al. (1993), Besley and Case (1995), and Hernandez-Murillo (2003) analyze total tax revenue, income tax, capital tax or sales tax for US counties or states using IV methods. Interaction effects are consistently strong. Brueckner and Saavedra (2001) use property tax data in the Boston metropolitan area, apply a maximum likelihood (ML) strategy, and find significant results. Bordignon et al. (2003), Solé Ollé (2006) and Feld et al. (2003) use IV regressions for Italy, Spain and France to analyze local property and business taxes. For Germany, Buettner (1999) and Buettner (2001) use IV and ML estimation to study local business taxes.

To solve the endogeneity problem in econometric analysis of fiscal policy interdependence, more recent studies rely on exogenous variation in fiscal policies that results from quasi experiments. Based on a reform of the property tax in Finland that (exogenously) increased minimum property tax rates, a study by (Lyytikäinen, 2012) does not find interdependence of neighboring municipalities' property tax rates. Examining local referenda in the US-state of Ohio that (exogenously) increased local taxation and spending, Isen's (2014) findings do not indicate neighboring jurisdictions' fiscal decisions to be interdependent. Baskaran (2014) studies a reform of the local fiscal equalization scheme in the German state of North Rhine-Westfalia that lead to an increase in North Rhineland-Westfalian municipalities business tax rates. His results indicate no response in business tax rates of Lower-Saxonian municipalities that directly neighbor North Rhine-Westfalian municipalities at the state border.

Therefore, all three previous quasi-experimental studies find no significant interdependence of local fiscal policy, which is in contrast to the early empirical literature's findings. As a robustness check, Baskaran (2014) and Lyytikäinen (2012) also apply spatial econometric methods (ML and IV) and compare the resulting estimates to their causal estimates. Both conclude that the spatial econometric methods used by the early literature tend to give upward biased estimates for the degree of fiscal interaction due to unresolved endogeneity.

Table 1: Rhineland-Palatine and Hessian municipalities' local business tax multipliers between 1988 and 2003

	Rhineland-Palatine(n=2301)									Hesse (n=426)								
	Non-FRM (n=2164)					FRM (n=137)				FRM (n=265)					Non-FRM (n=161)			
Year	**Mean**	**Med**	**p5**	**p95**	**Ref**	**Mean**	**Med**	**p5**	**p95**	**Mean**	**Med**	**p5**	**p95**	**Ref**	**Mean**	**Med**	**p5**	**p95**
1988	320.3	320	300	350	270	326.0	320	310	350	308.5	300	260	350	250	303.7	300	270	350
1989	320.4	320	300	350	270	326.4	320	310	350	308.4	300	265	350	250	303.7	300	270	350
1990	320.5	320	300	350	270	326.5	320	310	350	310.1	300	265	360	250	304.9	300	270	360
1991	320.8	320	300	350	270	326.7	320	310	350	312.1	300	265	360	250	305.9	300	270	360
1992	320.9	320	300	350	270	327.1	320	310	350	314.0	300	270	360	250	307.5	300	270	360
1993	323.1	320	300	350	270	330.3	320	310	360	314.9	300	270	360	250	307.6	300	270	360
1994	326.0	320	300	350	300	330.8	320	320	360	317.9	310	280	360	280	311.4	300	275	375
1995	331.6	320	320	360	300	336.3	330	320	370	319.4	310	280	370	280	311.9	300	275	380
1996	334.0	330	320	360	356	338.8	330	320	370	321.0	310	280	380	280	313.7	300	275	380
1997	335.2	330	320	360	356	339.3	330	320	370	321.7	315	280	380	287	313.8	300	275	380
1998	336.6	330	320	365	356	340.3	330	320	370	323.4	320	290	380	295	315.4	300	275	380
1999	337.1	330	320	370	356	340.4	330	320	370	324.0	320	290	380	302	316.1	300	280	380
2000	339.9	330	320	370	352	344.1	340	330	370	325.0	320	300	380	310	316.9	310	280	380
2001	343.5	345	320	370	352	349.0	350	330	370	325.1	320	300	380	310	316.3	310	275	380
2002	345.0	350	320	370	352	350.7	352	330	380	326.1	320	300	380	310	317.6	310	280	390
2003	346.2	350	330	370	352	351.1	352	330	380	326.1	320	300	380	310	318.3	310	280	390

Note: The table provides descriptive statistics on local business tax multipliers of municipalities in Rhineland-Palatinate and Hesse. For each state, municipalities are split into two groups, depending on their affiliation to the metropolitan area (FRM). Mean is the unweighted average, p5, Med and p95 are the 5%, 50% and 95% percentiles. Ref denotes the reference rate used within each state's fiscal equalization scheme. The years 1994 and 1997-2000 are reform years of the Hessian fiscal equalization scheme. For Rhineland-Palatinate up from 1996, the effective reference rate is the statutory reference rate (Ref) reduced by the federal multiplier (Landesvervielfältiger nach §6 Gemeindefinanzreformgesetz). The federal multipliers are: 48 from 1996-1997, 55 from 1999-2000, 59 in 2001, 65 in 2002 and 71 in 2003. Data source: *Statistisches Landesamt Hessen*, *Statistisches Landesamt Rheinland-Pfalz*, *Bundesgesetzblätter* (1988-2003), *Gesetz- und Verordnungsblätter Hessen und Rheinland-Pfalz* (1988-2003), own calculations.

3 Institutional background and geographic factors

3.1 German local business tax

The local business tax is for German municipalities an important source for tax revenue. Local business tax revenue accounts on average for approximately 70% of municipalities' total tax revenue.[3] In contrast to other sources of revenue over which municipalities have only limited influence[4], municipality governments have autonomy in setting local business tax rates.[5] Technically, municipalities do not directly set the local business tax rate, but decide on a multiplier that eventually determines the statutory local business tax rate. These multipliers are focus of our analysis. Formally, the statutory local business tax rate, τ^{stat}, is:

$$\tau^{stat} = b * m, \tag{2}$$

where m stands for the local tax multiplier, which is set by municipality governments, and b denotes the base rate, which is set by the federal government. Between 1988 and 2003, multipliers of Hessian municipalities within the *Frankfurt/Rhein-Main* metropolitan area range between 220 and 515. The base rate depends on a business' legal form and total business earn-

[3] In 1995, German municipalities had a (net) business tax revenue of approximately 34bn DM, compared to an overall revenue of own taxes (*Gemeindesteuern*) of approximately 49bn DM. Both figures are excluding the so-called *Gewerbesteuerumlage*. The few other taxes that fall into local authority, namely property taxes and some fees and surcharges for public services, altogether account for approximately 30% of local tax revenue (Statistisches Bundesamt, 1997, p.534).

[4] Besides local business taxes, municipalities generate tax revenues from other sources, too. In particular, municipalities receive a fixed fraction of the federal income tax revenue, that is collected on their grounds. Since 1998, municipalities also receive a fixed fraction of value added tax revenues collected in their territory. In Germany, income tax and value added tax revenues are shared between the three tiers of government: state, federal states, and local jurisdictions. In contrast to municipalities' autonomy in local business taxation, municipalities have no possibility to influence income taxation or value added tax.

[5] The German constitution provides municipalities with autonomy in setting local business tax rates (Art. 28 Abs. 2 GG).

ings.[6] For corporations, for instance, with a uniform base rate of 5%, the range of statutory local business tax rates within the metropolitan area FRM is, depending on the applicable local business tax multiplier, between 11.0% (5% of 220) and around 25% (5% of 515). This illustrates that a firm's location choice crucially effects its statutory local business tax rate. Table 1 presents detailed information on the variation in local business tax multipliers for Hesse and Rhineland-Palatinate for the years 1988 to 2003.

The effective local business tax rate for corporations can be written (Buettner, 1999):

$$t^{eff} = \frac{b * m}{1 + b * m}(1 - t_c) + t_c,$$

where base rate b is equal to 5% and t_c is the firm's effective federal corporate income tax rate on retained earnings.[7] Assuming a representative t_c of 48.4% in 1996, for local multipliers ranging from 220% to 515% within FRM, this translates into effective corporate tax rates on retained corporate earnings ranging between 53.5% and 59.0%. Thus, depending on the local multiplier of the municipality where a firm is located, the effective corporate tax rate varies by up to 5.5 percentage points. Moreover, the formula shows that local business tax multipliers affect both firms' effective average and marginal tax rates (in case of corporations both are equivalent) which has potential implications for the extensive and intensive margin of firm investment (Devereux and Griffith, 1998).

[6] Between 1988 and 2003, the base rate was structured in the following way: earnings of partnerships were only taxed if above 12,000 Euro, then subject to a base rate of 1%. For every increment of 12,000 Euro, the base rate increased by another percentage point. The maximum rate was 5%, for earnings exceeding 48,000 Euro. For corporations the base rate was a uniform 5% starting with the first Euro in earnings.

[7] To calculate firms' effective corporate tax rate, some details have to be considered. Firstly, local business tax payments reduce federal corporate tax base, thus are partially offset by tax benefits. Also, until 2008 local business tax payments reduced the local business tax base as they were treated as operating cost.

3.2 Fiscal equalization among municipalities and two reforms in Hesse

Besides tax revenue, the second important source for municipality finance are transfers from the state government, which are allocated through fiscal equalization schemes. While the specific design of these schemes varies across states[8], they all share some common features.[9]

The largest amount of transfers is paid in form of rule-based transfers *(Schlüsselzuweisungen)*. State governments provide rule-based transfers to ensure that municipalities have sufficient funds for an effective self-government. Rule-based transfers depend on municipalities' fiscal capacity and their fiscal need, which is based on standardized fixed spending obligations per inhabitant.[10] In case municipalities' fiscal need for an effective self-government exceeds their fiscal capacity, rule-based transfers are provided to (partially) close this budget gap. In the absence of such a budget gap, municipalities receive no rule-based transfers.

Municipalities' fiscal capacity depends on their designated share of federal income tax[11], as well as their capacity to raise own taxes, mainly local business and property taxes. The following analysis focuses on local business taxes. In order to not undermine municipalities' tax effort, the capacity to raise own business taxes is not determined by their actual business tax revenue. Instead the transfers are based on potential business tax revenue. The thinking behind this procedure is to prevent municipalities from strategically relying on rule-based transfers to finance their budgets, instead of showing own tax effort and collecting own business tax revenues. To calculate municipalities' business tax capacity, state-specific *reference rates* are applied. For a back-of-the-envelope calculation of a municipality's business tax capacity, the following formula applies: $\text{tax capacity}_t = \text{tax base}_{t-1} \times \text{reference rate}_t$. Last year's business tax revenue is

[8] The German constitution leaves the details of the law to the states (Article 106 (CII) GG).

[9] For the institutional description of the German local fiscal equalization schemes, we employ some of the terminology introduced by Baskaran (2014).

[10] Larger municipalities and cities receive a premium on the base transfers (*Einwohnerveredelung*).

[11] Only since 1998 municipalities also receive parts of federal value-added tax collected on their territory.

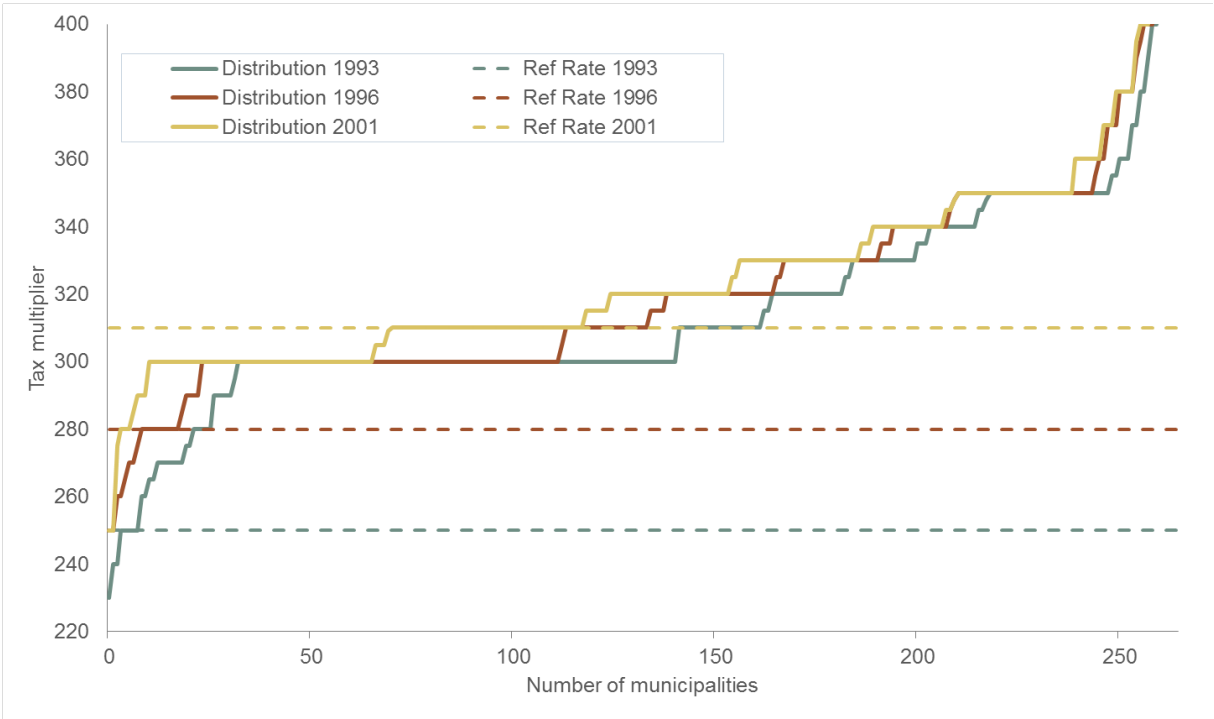
divided by the municipalitiy's last year's local business tax rate which gives the last year's tax base. This tax base is then multiplied with the current local business tax reference rate, resulting the municipality's business tax capacity. Consequently, rule-based transfers neither depend directly on a municipality's actual local business tax rate nor its actual local business tax revenue but on a standardized local business tax capacity.

Occasionally, states adjust their local business tax reference rates. In our empirical analysis, we consider two increases in the local business tax reference rate of the state of Hesse in the 1990s. The Hessian state government increased the reference rate between 1993 and 2000 in two reforms. The first reform took place in 1994, when the local business tax reference rate was increased from 250 to 280. The second reform took place between 1997 and 2000, when the local business tax reference rate was increased in four steps from 280 to 310.[12]

Lenk and Rudolph (2004) and Meffert and Mueller (2008) state that reference rates are usually adjusted if they systematically deviate from the (tax revenue weighted) state average of local business tax multipliers. A similar line of reasoning provides Baskaran (2014) for an increase in the Northrhine-Westphalian local business tax reference rate in 2003. Ministry officials[13] give another possible explanation for states' rational behind an increase in the local business tax reference rate. Accordingly, states intend to foster the incentive for municipalities to make sufficient use of their own tax bases and, in particular, not to levy tax rates, that are deemed too low. States are aware that local business tax reference rates have a strong signaling power for municipalities in terms of what level of local business tax multipliers is considered as appropriate by the state government. This signaling power is illustrated by the empirical fact that usually a high fraction of municipalities choose a local business tax multiplier which is at least as high as the current reference rate. Figure 1 shows Hessian FRM municipalities' local

[12] The four steps of the reference rate increase: 280 (1996), 287 (1997), 295 (1998), 302 (1999), 310 (2000).
[13] Expert interview with Dr. Walter Müller, Rhineland-Palatine Ministry of Finance, December 2013.

Figure 1: Hessian FRM municipalities' local business tax multipliers and reference rates in 1993, 1996, and 2001



Note: The solid lines show local business tax multipliers in the FRM area. The dashed lines indicate the corresponding reference rates applied in the respective year. The total number of municipalities is 265. For improved visualization the y-axis is capped at 400, thereby, excluding 7 high-tax municipalities (in 2001: Gießen (420), Darmstadt (425), Maintal (430), Hanau (430), Offenbach (440), Wiesbaden (460) and Frankfurt (490)). Data source: *Statistisches Landesamt Hessen*, own calculations.

business tax multipliers for the years 1993, 1996, and 2001. It is apparent, that the vast majority of multipliers seems to be located clearly above the reference rate in every year. In years where the reference rate is increased, municipalities generally tend to increase their multipliers, too. In particular, municipalities with low multipliers seem to respond accordingly.

A political economy explanation for why tax multipliers adapt to changes in the reference rate could be that increases in the reference rate decrease the political cost of tax rate increases. Given that the reference rate is considered as a reference for an appropriate tax multiplier, reference rate increases offer policy makers an opportunity to increase local business tax rates at relatively low political cost as politicians do not bear the entire responsibility for the tax increase but can (at least partially) blame the state government. Baskaran (2014) argues, further, that local business tax reference rates were a reference value for firms when it comes to lobbying

for tax reductions in cases where municipalities' actual business tax multiplier is higher than the reference rate.

With respect to rule-based transfers Baskaran (2014) argues that a misperception seemed to exist among local politicians that an increase in the reference rate would *ceteris paribus* have direct negative effects on rule-based transfers to those municipalities with a multiplier below the reference rate (DIHK, 2009). Local fiscal equalization schemes are constructed the way that rule-based transfers are independent from municipalities' actual business tax rates in order to prevent strategic tax rate setting. Therefore, by construction of the schemes, an increase in the business tax reference rate implies no such direct negative effects on rule-based transfers received by low-tax municipalities (Meffert and Mueller, 2008). However, if such misperception broadly exists this could explain the strong response of the actual tax rate distribution to reference rate changes. Consequently, one would expect municipalities with multipliers below the reference rate to increase their multipliers.

However, even if it can be established that policy responses are partially caused by a misperception, some cases may actually exist, where multiplier adjustments in response to a change in the reference rate could become necessary. As we have established earlier, rule-based transfers are granted, in order to close the gap between fiscal need and fiscal capacity. If no such gap exists, a municipality receives no rule-based transfers. In legal jargon a municipality without fiscal gap is called "abundant" *(Abundanz)*. If a higher reference rate causes a municipality *ceteris paribus* to be abundant, and, therefore, a cut of state rule-based transfers to zero, changing the local business tax multiplier might well be justified.

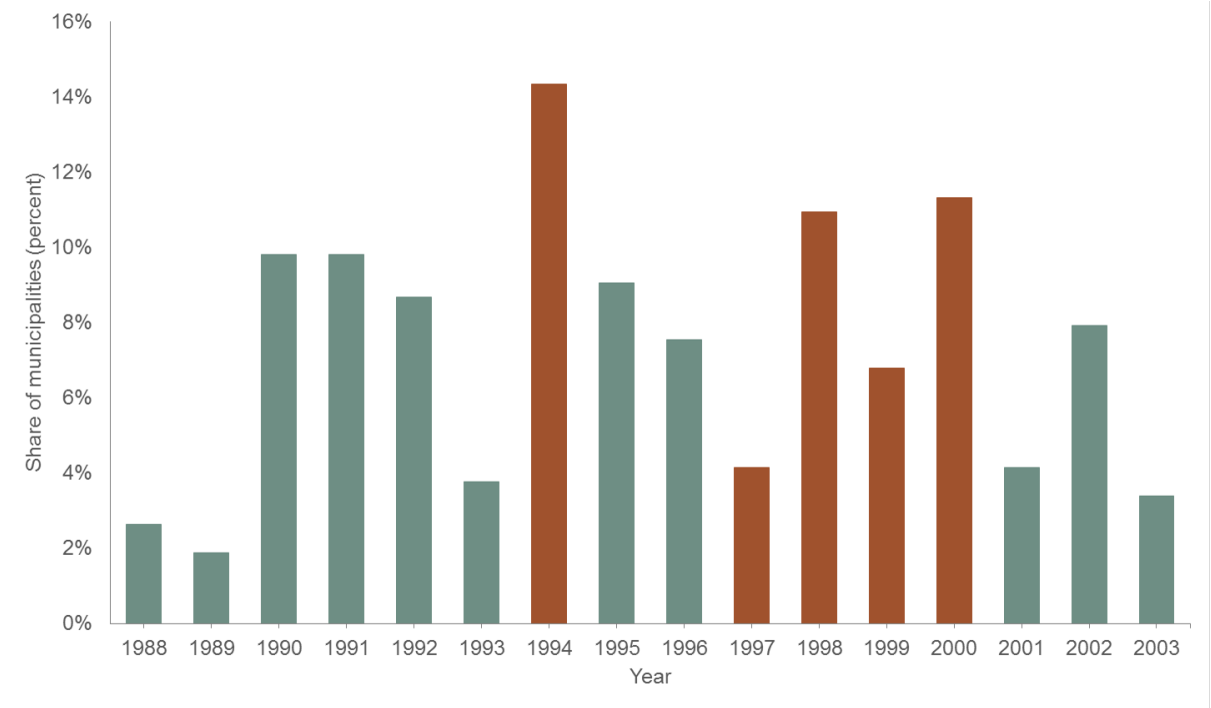
Furthermore, an increase in the reference rate might have adverse effects on rule-based transfers received by municipalities with relatively large local business tax bases and, therefore, affect municipalities' actual local business tax rates. As municipalities' fiscal capacity is calcu-

lated as the product of the last year's actual business tax base and the reference rate, Baskaran (2014) argues that the higher the reference rate, the more reduced an increase in a municipality's tax base its rule-based transfers. Assuming standard tax competition mechanisms under which municipalities' local business tax bases are negatively correlated with their local business tax rates, this implied that municipalities have less incentives to decrease tax multipliers in order to expand tax base. Here, Baskaran basically develops further the more general finding by Egger et al. (2010) that fiscal equalization implicitly acts as a tax coordination scheme, which deters municipalities from lowering taxes in order to attract a larger tax base (since it resulted in a reduction in transfers).

Following our argumentation, there are various reasons for municipalities to adapt their multipliers to changes in the reference rate. Figure 1 shows local business tax rates of the 265 Hessian metropolitan municipalities before, during and after the increases of the reference rate.[14] The dashed lines represent the reference rates before (green, 1993), during (red, 1996) and after (yellow, 2001) the reforms. The solid lines depict business tax multipliers of all Hessian FRM municipalities, again, before (green, 1993), during (red, 1996) and after (yellow, 2001) the reforms. The chart clearly reveals that Hessian metropolitan municipalities actually responded to the increases in the reference rate with increases in their tax multipliers. It is also evident that before the reforms more than 40% (109) of FRM municipalities had chosen a multiplier of 300, the mode of the distribution, i.e. were located well above the pre-reform reference rate of 250. Once the reference rate was increased to finally 310, half of these municipalities (53) subsequently increased their local business tax rates, too. The number of municipalities choosing a multiplier of 310, i.e. the new reference rate up from the year 2000, more than doubled (21 to 48) during the second reform period (1996-2000).

[14] As our empirical analysis of local tax policy of FRM municipalities in Rhineland Palatinate only goes until 1999, we included a similar chart as Figure 1 (see Figure A1) in the Appendix, which highlights the reform effects on Hessian FRM municipalities until 1999.

Figure 2: Annual share of Hessian FRM municipalities changing local business tax multipliers between 1988 and 2003

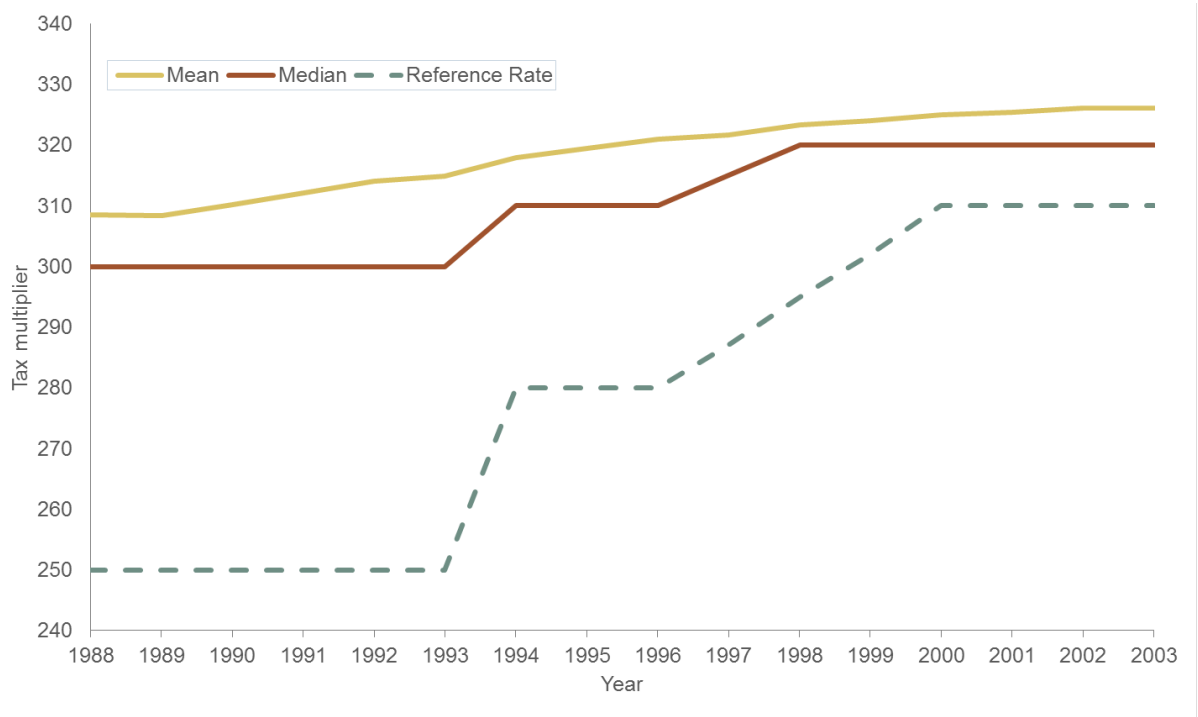


Note: The green bars indicate non-reform years, the red bars indicate reform years. Data source: *Statistisches Landesamt Hessen*, own calculations.

Figure 2 presents the annual fraction of Hessian FRM municipalities that change their local business tax rates between 1988 to 2003. The numbers provide strong suggestive evidence that a change in the business tax reference rate seems to spur local tax policy responses. The reform years 1994, 1998, and, 2000 show the highest fractions of municipalities changing their local business tax rates. The average fraction of municipalities that adjust their tax rates in a reform year is 9.5% (red bars), while it is 6.2% in non-reform years (green bars).

Figure 3 presents parameters of the annual tax multiplier distribution of Hessian FRM municipalities between 1988 and 2003. It depicts the average local business tax multiplier (yellow line), the median local business tax multiplier (red line), and the reference rate (green dashed line) for each year. The average multiplier increases over time, however, the increase is slightly steeper during the reform years. The median multiplier (orange line) is constant in non-reform years. However, during reform periods, when the reference rate is raised, the median multiplier

Figure 3: Graphical depiction of Hessian FRM municipalities' local business tax multipliers between 1988 and 2003

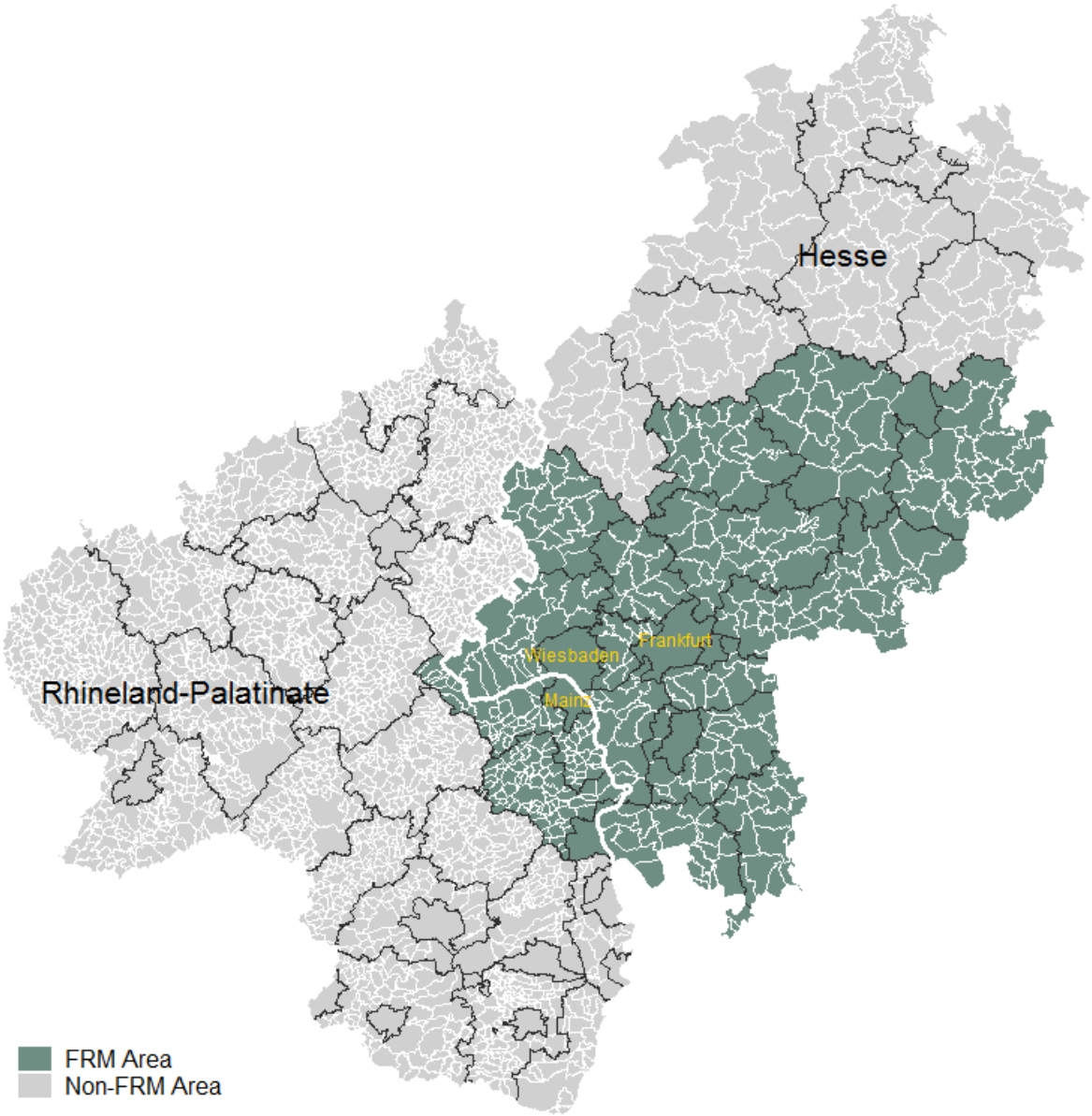


Note: The yellow line is the unweighted average, the red line is the median of the distribution. Reference rate in dashed green line. Data source: *Statistisches Landesamt Hessen*, own calculations.

rises, too. This provides additional suggestive evidence for the impact of the reference rate on the distribution of local business tax multipliers.

Table 1 presents more descriptive statistics of the Hessian annual tax multiplier distributions for the years 1988 to 2003. Interestingly, the table shows that the Hessian tax multiplier distribution is temporarily compressed due to the changes in the reference rate. In reform years, besides the median, also the 5% percentile of the distribution increases, while the 95% percentile does not respond immediately. This indicates that in particular low-tax municipalities tend to adapt their tax rates to the new higher reference rates.

Figure 4: Administrative map of Rhineland-Palatinate and Hesse



Note: White bold line marks the state border, county borders are shown with black lines and municipality borders with white lines. *European Metropolitan Area Frankfurt/Rhein-Main* (FRM) in green. Bavarian municipalities which belong to the FRM area are excluded.

3.3 Geographic and economic characteristics of the *European Metropolitan Area Frankfurt/Rhein-Main*

The *European Metropolian Area Frankfurt/Rhein-Main* is located in the center of Germany. It consist of 467 municipalities, which lie in the states of Hesse (265 municipalities), Rhineland-Palatinate (137 municipalities) and Bavaria (65 municipalities). The focus of our analysis is on

the Hessian and Rhineland-Palatine municipalities, which represent the green area in Figure 4 and include cities like Wiesbaden (state capital of Hesse), Mainz (state capital of Rhineland-Palatinate), and the city of Frankfurt (functional and geographic center of the region). The states of Hesse and Rhineland-Palatinate have a common border which runs along the River Rhine. This state border cuts through the FRM area (white bold line in Figure 4). The state border is roughly 200km long, half of it lies within the metropolitan area.

The metropolitan area counts around 5.5 million inhabitants which compares to approximately 7% of the entire German population. The area is economically highly integrated and its gross domestic product of 216 billion Euro in 2014 and GDP per capita of 72,500 Euro make it the most prosperous and important economic region in Germany (besides Munich). Frankfurt city is Germany's most important financial and service industry center. Frankfurt's international airport is the largest in Germany, and one of the busiest in Europe. The area incorporates a dense net of industrial installations, a large share of which is located alongside Rhine river. Also along the Rhine, there is a high density of bridges (cars and railroad) and ferries facilitating corporate logistics within the metropolitan area as well as daily commuting. As even local public transport systems expand beyond state borders, companies throughout the metropolitan area have in fact access to a large common labor market (Kropp and Schwengler, 2011).

The metropolitan area FRM was formally turned into a so-called European Metropolitan area in 1995 by the German Minister Conference for Regional Planning (*Ministerkonferenz für Raumordnung*). Since the official approval[15], member municipalities have even intensified their collaboration in the fields of economic development, mobility, and leisure. As each of these fields promotes a variety of objectives, various forums, panels and boards have been initiated to serve as platforms for economic, political, and cultural exchange and coordination.

[15] Since then, a public agency with full-time employees is deemed to govern the activities of this public association. As the closer area around Frankfurt had already been united in the so-called Regional Authority Frankfurt/Rhein-Main, this institution is also entrusted with governing the metropolitan area.

4 Empirical strategy and data

The institutional changes in the Hessian local fiscal equalization scheme in 1994 and between 1997-2000 triggered, as we argue, exogenous variation in Hessian municipalities' local business tax multipliers. We exploit this exogenous variation to study tax policy interdependence between Hessian and Rhineland-Palatine municipalities within the FRM area. To identify such interdependence, we employ a difference-in-differences (DD) approach, that is based on the before-after-reform change in local business tax multipliers between Rhineland-Palatine treatment and control municipalities. We consider Rhineland-Palatine municipalities, which are located within the FRM area (137), as our *treatment group*, as we expect for these municipalities tax policy interdependence with Hessian FRM municipalities. From the large number of Rhineland-Palatine municipalities outside FRM (2,164), we select a valid *control group*. In particular, we consider municipalities for our control group that are located in one of the 30 Rhineland-Palatine counties that are neither part of the FRM area, nor share a common border with Hesse[16], in the following called non-FRM municipalities. Figure 5 presents a map that depicts the respective areas.

We argue that Rhineland-Palatine non-FRM municipalities should in principle be a suitable control group for our DD analysis. Both Rhineland-Palatine FRM and non-FRM municipalities operate under Rhineland-Palatine state institutions including political election cycles[17] and local fiscal equalization, both of which supposedly have significant impact on local fiscal policy.

[16] Our identification strategy is inspired by Baskaran (2014) who studies tax mimicking in case of the German states North Rhine-Westphalia and Lower Saxony. He exploits an increase in the North Rhine-Westphalian tax reference rates to study tax mimicking of Lower Saxonian municipalities directly located at the North Rhine-Westphalian border.

[17] Elections of state government were in 1991, 1996, and 2001. Election of local governments took place in 1989, 1994, and 1999.

Figure 5: Map of Rhineland-Palatinate and Hesse: treatment and control groups (main analysis)

Note: White bold line marks the state border, county borders are shown in grey. Treatment group (red) includes FRM municipalities in Rhineland-Palatinate. Control group consists of matched Rhineland-Palatine municipalities (yellow). Other counties bordering Hesse are excluded from control group (light yellow). The state of Hesse is also split into FRM (light blue) and non-FRM (grey) municipalities.

Therefore, we argue that both groups should show similar fiscal policy patterns in the absence of Hessian reforms.[18]

We construct a panel dataset that includes information on 2,301 Rhineland-Palatine and 426 Hessian municipalities' local business tax multipliers for the years 1988 to 2000. Table

[18] See Buettner and von Schwerin (2015) for more information on the influence of state institutions on tax rate distributions.

1 gives an overview of the local business tax multipliers of Hessian and Rhineland-Palatine municipalities.

To analyze tax policy interdependence between Hessian and Rhineland-Palatine FRM municipalities, we estimate the following regression equation:

$$\text{tax rate}_{it} = \alpha + \beta \text{Hesse reform}_{it} + \gamma \text{municip}_i + \delta' \text{time}_t + \varepsilon_{it}, \tag{3}$$

where *tax rate* is the local business tax multiplier of Rhineland-Palatine municipality i at time t. *Hesse reform* is a binary variable that equals one in Hessian reform years for all Rhineland-Palatine FRM municipalities (and zero for non-FRM municipalities), i.e. $t = 1994$ and $t \geq 1997$. The coefficient of interest, β, measures the causal effect of tax policy interdependence. The DD approach takes into account unobserved factors that might affect a municipality's business tax multiplier by controlling for municipality effects and time effects: *municip* is a municipality fixed effect, *time* represents a set of indicator variables for each year in the analysis period 1988 to 2000, with γ and δ as coefficients. α denotes the constant, ε is the error term. Since our DD design uses repeated observations clustered in municipalities, we compute heteroscedasticity-robust clustered standard errors.

The DD approach requires a *common trend assumption*, which implies that in the absence of treatment, i.e. the (exogenously induced) increases in Hessian local business tax multipliers, the average local business tax multipliers of Rhineland-Palatine FRM and non-FRM municipalities follow parallel paths over time. The common trend assumption requires, for instance, that the state Rhineland-Palatinate did not implement institutional changes in its fiscal equalization scheme which, firstly, affected treatment and control municipalities' business tax policy on average differently and, secondly, happened simultaneously to the Hessian reforms. However, Rhineland-Palatinate changed its local business tax reference rate during the analysis period

twice. There was an increase in the Rhineland-Palatine reference rate from 270 to 300 in 1994, and a decrease in the reference rate by four points from 356 to 352 in 2000. It could be that Rhineland-Palatine FRM municipalities responded to these reference rate changes on average differently as compared to non-FRM municipalities due to the fact that both groups differ in characteristics which determine their fiscal policy. In this case, the common trend assumption for the DD approach would not be fulfilled and the DD estimates would not reveal the causal effect of tax policy interdependence between Hessian and Rhineland-Palatine FRM municipalities.

Figures A2 and A3 in the appendix show that Rheinland-Palatine FRM and non-FRM municipalities' average multipliers follow an approximate, however, not perfect common trend. To fully comply with the common trend assumption, we use Rhineland-Palatine FRM and non-FRM municipalities' demographic, geographic, fiscal, and political characteristics in the pre-reform years 1993 and 1996 (Hessian reforms) to match treatment and control municipalities according to their propensity for being a FRM municipality.[19] If treatment and control municipalities are not statistically significantly different in fiscal-policy-relevant characteristics on average, their changes in multipliers should be on average comparable during state-wide reforms between 1994 and 2000. Thus, after matching, both groups' average multipliers would follow in the absence of the Hessian reforms parallel paths over time. Based on the matched samples, DD estimates should reveal the causal effect of tax policy interdependence between Hessian and Rhineland-Palatine FRM municipalities.

As matching variables, we use fiscal, geographic, demographic, and political characteristics in the pre-reform year 1993, respectively 1996 (for details see Caliendo and Kopeinig, 2008).

[19] We collect information on municipalities' demographic, geographic, fiscal, and political characteristics for the two pre-reform years 1993 to 1996. Annual information on Rhineland-Palatine municipalities' demographic, geographic, fiscal, and political characteristics stems from the *Statische Landesamt Rheinland-Pfalz*. Complete information on demographic, geographic, fiscal, and political municipality characteristics is for the year 1993 available for 1,930 and for the year 1996 for 1,960 Rhineland-Palatine municipalities. See appendix for details on the variables.

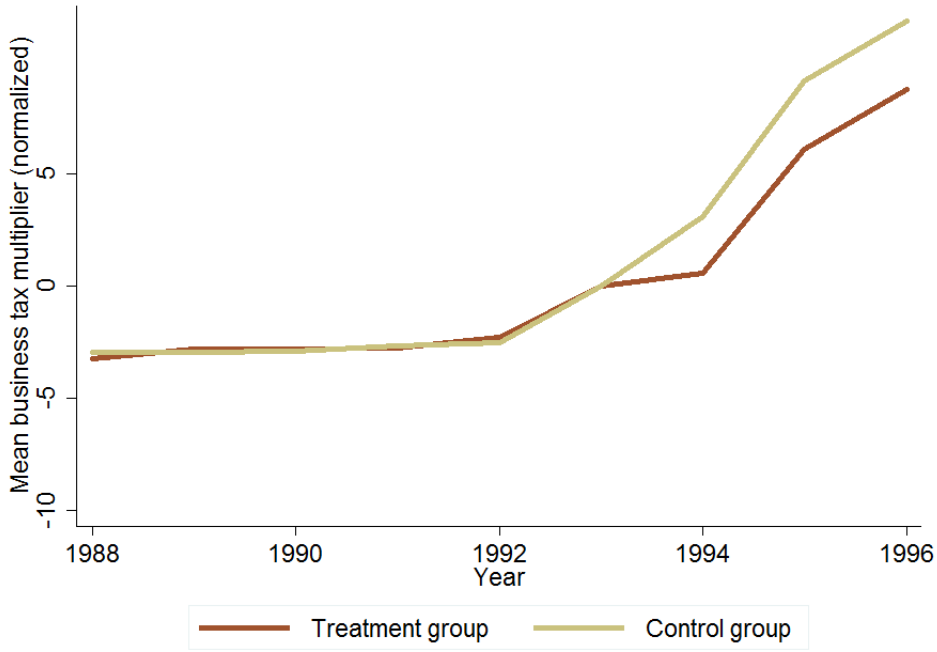
The set of matching variables includes municipalities' tax revenue per capita from business taxes and personal income taxes. Further, municipalities' cash effective revenue[20], local business tax and property tax (B) multipliers are considered. Amongst the matching variables, there are also municipalities' population density (per square kilometer), population share under age 20 and between age 20 and 60. In addition, shares of votes are included that the political parties CDU, SPD, Greens, FDP, and voting communities received in local government elections in 1989 and 1994 and which describe the political majorities at the municipality level in the pre-reform years 1993 and 1996 respectively. We provide an detailed descriptions of the matching variables in the appendix. We conduct a propensity score radius matching and match FRM and non-FRM municipalities using a caliper of 0.01.

We expect the matching to successfully establish the common trend between treatment and control group for the case of the 1994 Hessian reform. However, in case of the 1997-2000 reform, even with matching, the common trend assumption might not hold for the entire analysis period. The longer the time period between the matching in 1996 and the analysis year, the more probable the matched treatment and control groups might differ statistically significantly in their fiscal-policy-relevant characteristics. This should be particularly critical with respect to the last year of our analysis period, the year 2000. In particular, local government elections in Rhineland-Palatinate in 1999 (the newly elected local governments set the multipliers for the year 2000) might violate the common trend assumption for the year 2000. Therefore, being conservative, we exclude the year 2000 from our empirical analysis.

Applying the matching procedure for the year 1993, we match almost 92% of our FRM municipalities with at least one control municipality. Thus, our estimation sample consists of 126 FRM and 1,780 non-FRM municipalities. The matching procedure for the year 1996 provides at least one control municipality for almost 89% of our FRM municipalities. The respective

[20] *Kassenmäßige Bruttoeinnahmen im Verwaltungs- und Vermögenshaushalt.*

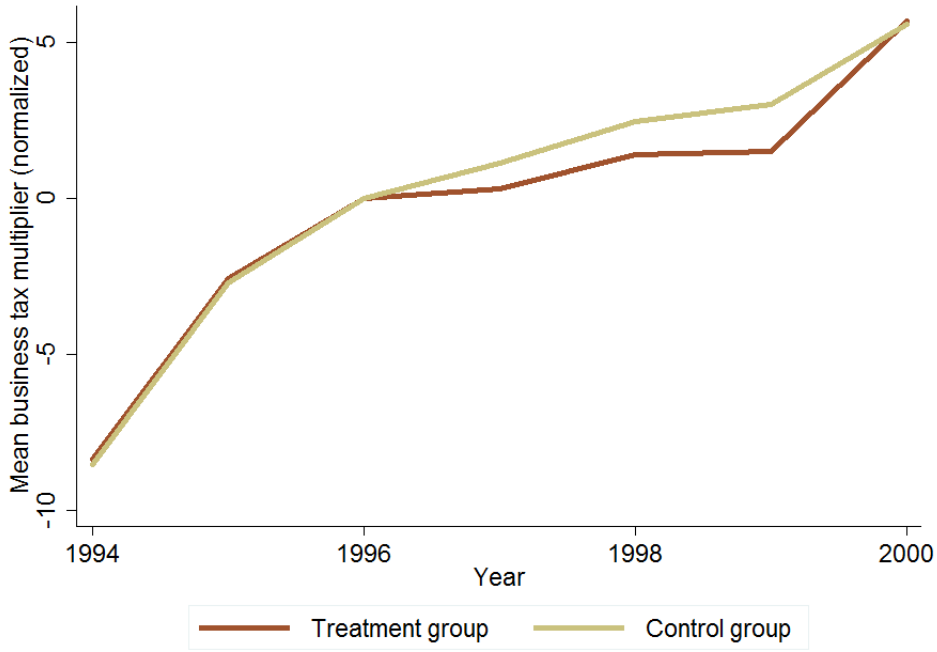
Figure 6: Local business tax multipliers of Rhineland-Palatine FRM and non-FRM municipalities from 1988 to 1996



Note: The graphs show the development of the average normalized business tax multiplier in Rhineland-Palatine metropolitan and interior municipalities after a radius propensity score matching (caliper 0.01) on municipality characteristics in 1993, the pre-treatment year. The normalization is conducted by subtracting from each municipality's business tax multiplier in each year the value of the tax multiplier in 1993. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

matched sample consists of 121 FRM and 1,819 non-FRM municipalities. Tables A1 and A2 in the appendix provide descriptive statistics for FRM and non-FRM municipalities before and after matching. For the matched samples, t-tests indicate no statistical significant difference in the matching variables' means of treatment and control group. Figures 6 and 7 show the time trends in average local business tax multipliers of matched treatment and control groups separately for for the pre-reform periods of the 1994 reform and the 1997-2000 reform. In case of the 1994 reform, the common time trend assumption holds pre-reform. There is a common time trend in average multipliers from 1988 until 1993, the last pre-reform year. In case of the 1997 reform, there is a common time trend in average multipliers from 1994 to 1996, the time trends deviate as expected from 1997, the reform year. In contrast to the negative treatment effects from 1997 to 1999, the graphs indicate a close to zero effect for the year 2000. However, as argued before,

Figure 7: Local business tax multipliers of Rhineland-Palatine FRM and non-FRM municipalities from 1994 to 2000



Note: The graphs show the development of the average normalized business tax multiplier in Rhineland-Palatine metropolitan and interior municipalities after a radius propensity score matching (caliper 0.01) on municipality characteristics in 1996, the pre-treatment year. The normalization is conducted by subtracting from each municipality's business tax multiplier in each year the value of the tax multiplier in 1996. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

the 2000 treatment effect is potentially biased either by the Rhineland-Palatine decrease in the reference rate or the political majority changes due to the local government elections in 1999. Excluding the year 2000, both graphics reveal clearly negative average treatment effects. In response to the Hessian increases in tax multipliers in 1994 and 1997-2000, Rhineland-Palatine FRM municipalities increase their multipliers more moderately as compared to the counterfactual trend of Rhineland-Palatine non-FRM municipalities' tax multipliers. While the treatment effect of the 1994 reform arises only in 1994, the treatment effect of the 1997 reform extends from 1997 to 1999.

Table 2: Reform 1994: Difference-in-differences estimation results

	Rhineland-Palatine FRM municipalities		
	1	2	3
Hesse reform	-2.890	-2.946	
	(0.000)	(0.000)	
Hesse reform in $t+5$			0.364
			(0.275)
Hesse reform in $t+4$			0.308
			(0.362)
Hesse reform in $t+3$			0.169
			(0.645)
Hesse reform in $t+2$			0.479
			(0.381)
Hesse reform in $t+1$			0.239
			(0.760)
Hesse reform year			-2.313
			(0.005)
Hesse reform in $t-1$			-2.805
			(0.016)
Hesse reform in $t-2$			-2.773
			(0.015)
Fixed time effects	✓	✓	✓
Fixed municipality effects	✓	✓	✓
Group specific linear time trend		✓	

Note: The dependent variable is a Rhineland-Palatine municipality's local business tax multiplier. The coefficients are estimated using a difference-in-differences approach after a propensity score radius matching (caliper 0.01) of Rhineland-Palatine FRM and non-FRM municipalities. For details on treatment and control group see Table A1. 17,152 municipality-year observations between 1988 and 1996. P-values in parentheses. Heteroscedasticity robust standard errors, clustered at municipality level.

Table 3: Reform 1997-1999: Difference-in-differences estimation results

	Rhineland-Palatine FRM municipalities		
	1	2	3
Hesse reform	-1.223	-0.598	
	(0.016)	(0.183)	
Hesse reform in $t+2$			-0.038
			(0.968)
Hesse reform in $t+1$			-0.160
			(0.872)
Hesse reform year 1			-0.983
			(0.327)
Hesse reform year 2			-1.229
			(0.242)
Hesse reform year 3			-1.656
			(0.115)
Fixed time effects	✓	✓	✓
Fixed municipality effects	✓	✓	✓
Group specific linear time trend		✓	

Note: The dependent variable is a Rhineland-Palatine municipality's local business tax multiplier. The coefficients are estimated using a difference-in-differences approach after a propensity score radius matching (caliper 0.01) of Rhineland-Palatine FRM and non-FRM municipalities. For details on treatment and control group see Table A2. 11,640 municipality-year observations between 1994 and 1999. P-values in parentheses. Heteroscedasticity robust standard errors, clustered at municipality level.

5 Empirical results

5.1 Main results

Tables 2 and 3 provide matched DD estimation results for interdependence between Rhineland-Palatine and Hessian metropolitan municipalities' local business tax multipliers. For the Hessian 1994 reform, the estimation results indicate a statistically significant average treatment effect of -2.9 on Rhineland-Palatine metropolitan municipalities' local business tax multipliers (Table 2, column 1). Thus, Rhineland-Palatine FRM municipalities increased their local business tax multipliers between 1994 and 1995 on average by 2.9 points less than Rhineland-Palatine non-FRM municipalities due to the institutionally induced multiplier increases in Hesse. For the Hessian 1997-2000 reform, the statistically significant average treatment effect is -1.2 (Table 3, column 1). During the Hessian reform period, Rhineland-Palatine FRM municipalities increased their multipliers on average by 1.2 points less then the non-FRM municipalities.

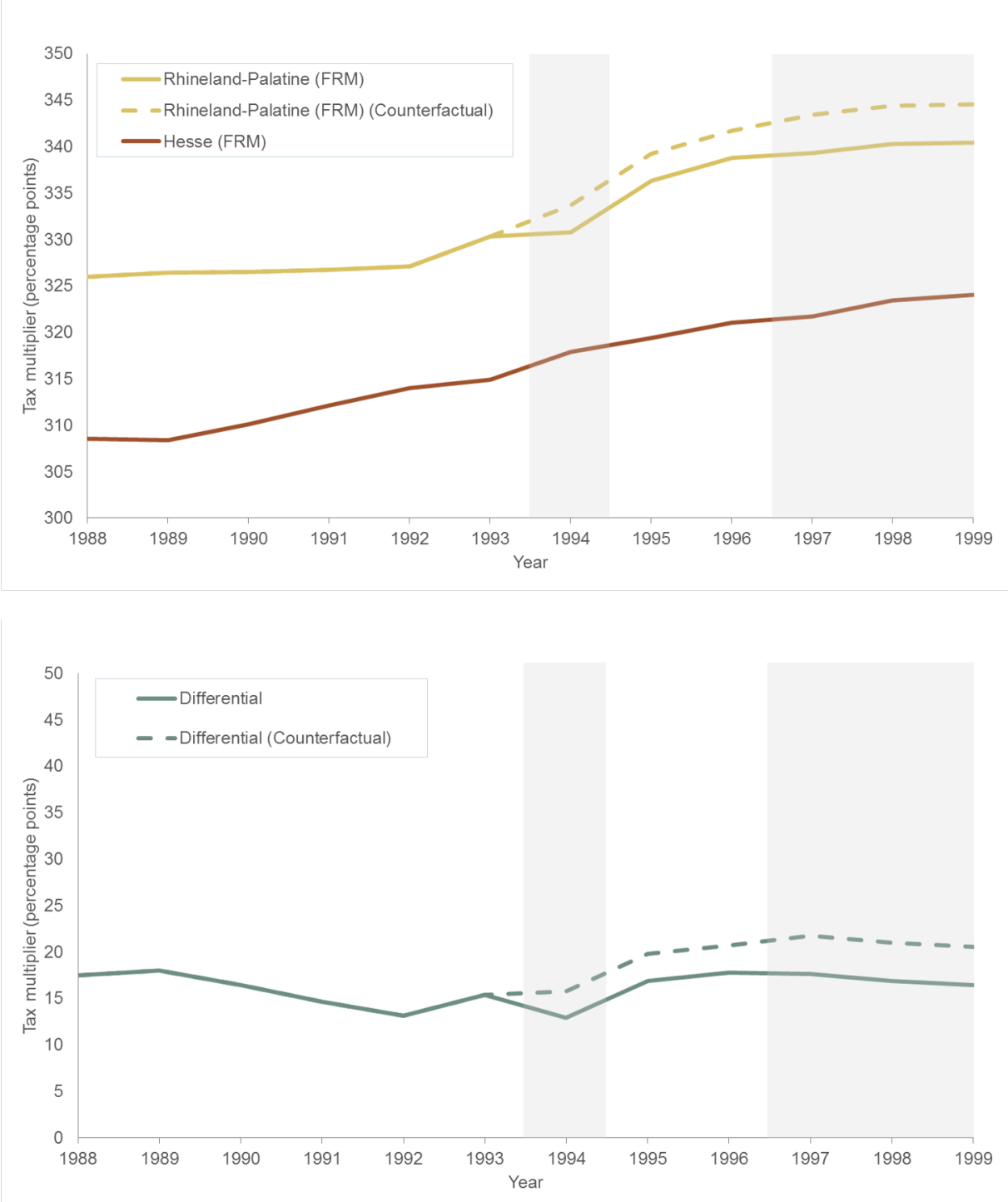
We perform two robustness checks to examine the sensitivity of our results with respect to the common trend assumption. First, we extend the basic specification in equation 3 by including a FRM-specific linear time trend. If a common time trend between FRM and non-FRM municipalities exists, the estimate of the treatment effect β should be robust with respect to the inclusion of the FRM-specific linear time trend (Angrist and Pischke, 2009). Our results are generally robust in case we include a FRM-specific linear time trend into our model. For the 1994 reform, the treatment estimates from the model with and without FRM-specific linear time trend are almost identical (-2.89 vs. -2.95). This result convincingly demonstrates that the treatment estimate is not affected by modeling a group-specific time trend. For the 1997-2000 reform, the treatment estimate is estimated to be lower once FRM-specific time trends are

included in the model specification. However, the parameters are not statistically significantly different, as a t-test does not reject the null hypothesis of equality of both parameters at the 5% level.

Second, we estimate an extended model to analyze the temporal development of the treatment effect. Column 3 in the Tables 2 and 3 represents the estimation results of an extended model specification. We interact the indicator for a municipality's location within the FRM metropolitan area with the year indicators which allows us to follow the evolution of the reform effects. For the 1994 reform, the results reveal that the treatment effect arises, as expected, already in the reform year 1994. Here, the effect is estimated to be 2.3. The treatment effect still slightly increases from 1994 to 1995 by approximately 0.4 points. The treatment effect is stable from 1995 to 1996 at around 2.8 points which indicates that the response to the treatment is completed with the year 1995. For the 1997-2000 reform, the single treatment effects in the three considered treatment years, 1997-1999, miss statistical significance at conventional levels. However, a F-test reveals a joint significance of the effects in the three reform years at the 5% significance level (p-value: 0.014). Considering the estimate sizes reveals that the treatment effect increased over time from -0.983 multiplier points in 1997 to -1.656 multiplier points in 1999. Our findings, therefore, generally indicate a statistically significant interdependence between Hessian and Rhineland-Palatine FRM municipalities' business tax policy.

Figure 8 presents the average tax multipliers in Hessian (red) and Rhineland-Palatine (yellow) FRM municipalities (upper panel). The chart shows that tax multipliers follow an upwards trend over time, with an increase of 14.4 percentage points in Hesse and 15.5 points in Rhineland-Palatine respectively. As the Rhineland-Palatinate average multiplier exceeds Hessian the average multiplier during the entire period, there is a positive tax multiplier differential. The lower panel depicts the evolution of the differential over time. The differential is stable

Figure 8: Development of the tax multiplier differential between 1988 and 1999



Note: The upper panel shows the average tax multipliers in Hessian (red) and Rhineland-Palatine (yellow) FRM municipalities. The dashed line represents counterfactual evolution in the absence of tax policy interdependence. The lower panel shows the tax multiplier differential between average tax rates of Hessian and Rhineland-Palatine FRM municipalities. The dashed line represents counterfactual evolution in the absence of tax policy interdependence. Years 1988-1999, reform periods marked with grey shading. Data source: *Statistisches Landesamt Hessen*, *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

during the analysis period, fluctuating around 16 points. Notably, Rhineland-Palatine FRM municipalities' moderation in raising tax multipliers held the tax multiplier differential stable in absolute terms. The counterfactual development of multipliers in Rhineland-Palatine non-FRM municipalities (dashed lines in both panels) indicates that the 1999 differential (16.4 points) would have been 4 points higher. Consequently, in the absence of tax policy interdependence the differential would have been almost 25% larger in 1999.

The Rhineland-Palatine multiplier adjustments fully coincide with the timing of the Hessian reforms. This temporal coincidence suggests that the Hessian increases in the reference rate raise policy makers attention for tax policy both in Hesse and in municipalities in the Rhineland-Palatine part of the metropolitan area. Increases in the Hessian reference rate are apparently salient and create, therefore, awareness among Rhineland-Palatine FRM municipalities with respect to the positive tax multiplier differential.

Concerning the effect size, an average treatment effect of -2.9 points of the 1994 reform and -1.2 points of the 1997-2000 reform could appear small. Assuming a base rate of 5%, -2.9 points are approximately equivalent to -0.14 percentage points in terms of local business tax rate, -1.2 multiplier points translate to approximately -0.06 percentage points respectively. However, Table 1 shows that the exogenously induced Hessian increase in local business tax multipliers from 1993 to 1994 as well as from 1996 to 1999 was in both cases on average with 3 points (around 0.15 percentage points in terms of local business tax rate) of rather small size, too.

There might be concerns that local business tax multipliers of Rhineland-Palatine non-FRM municipalities in counties located at Rhineland-Palatinate's state borders other than the Hessian border might be affected by institutional changes in neighboring (foreign) states during the analysis period. In particular, this would be critical if the control municipalities' business

Table 4: Difference-in-differences estimation results with modified control group of interior municipalities

	Rhineland-Palatine FRM municipalities			
	Reform 1993		Reform 1997-1999	
	1	2	3	4
Hesse reform	-5.001	-3.688	-0.859	-0.374
	(0.000)	(0.000)	(0.126)	(0.428)
Fixed time effects	✓	✓	✓	✓
Fixed municipality effects	✓	✓	✓	✓
Group specific linear time trend		✓		✓

Note: The dependent variable is a Rhineland-Palatine municipality's local business tax multiplier. The results refer to a treatment group consisting of Rhineland-Palatinate metropolitan municipalities. Estimated using a difference-in-differences approach with matching based on a nearest neighbor matching (caliper 0.01) of Rhineland-Palatine FRM municipalities and a modified control group. The modified control group consists of Rhineland-Palatine municipalities that are located in non-border counties. For details on treatment and control group see Tables A3 and A4. 6,507 municipality-year observations between 1988 and 1996, 4,602 municipality-year observations between 1994 and 1999. P-values in parentheses. Heteroscedasticity robust standard errors, clustered at municipality level.

tax multipliers were affected by changes during the treatment years 1994 and 1997 to 2000. Then, deviations from the common trend in average tax multipliers of treatment and control group could not be (entirely) attributed to the treatment. As a consequence, the matched DD estimates would not reveal causal treatment effects. As a robustness check, we restrict our potential control group to municipalities in one of the eight Rhineland-Palatine non-FRM counties that are not located at neither of Rhineland-Palatinate's state borders, in the following called *interior municipalities*. We construct a valid DD control group by applying a propensity score radius matching on FRM and interior municipalities' probability for being a FRM municipality (caliper 0.01). As matching variables, we use geographic, demographic, fiscal, and political municipality characteristics in the pre-reform years 1993 and 1996 respectively. For the 1993 matching, the matching procedure provides for almost 79% of the FRM municipalities at least one matched interior municipality. For the 1996 matching, this is the case for almost 85% of the FRM municipalities. The Tables A3 and A4 in the appendix provide descriptive statistics for FRM and interior municipalities before and after matching.

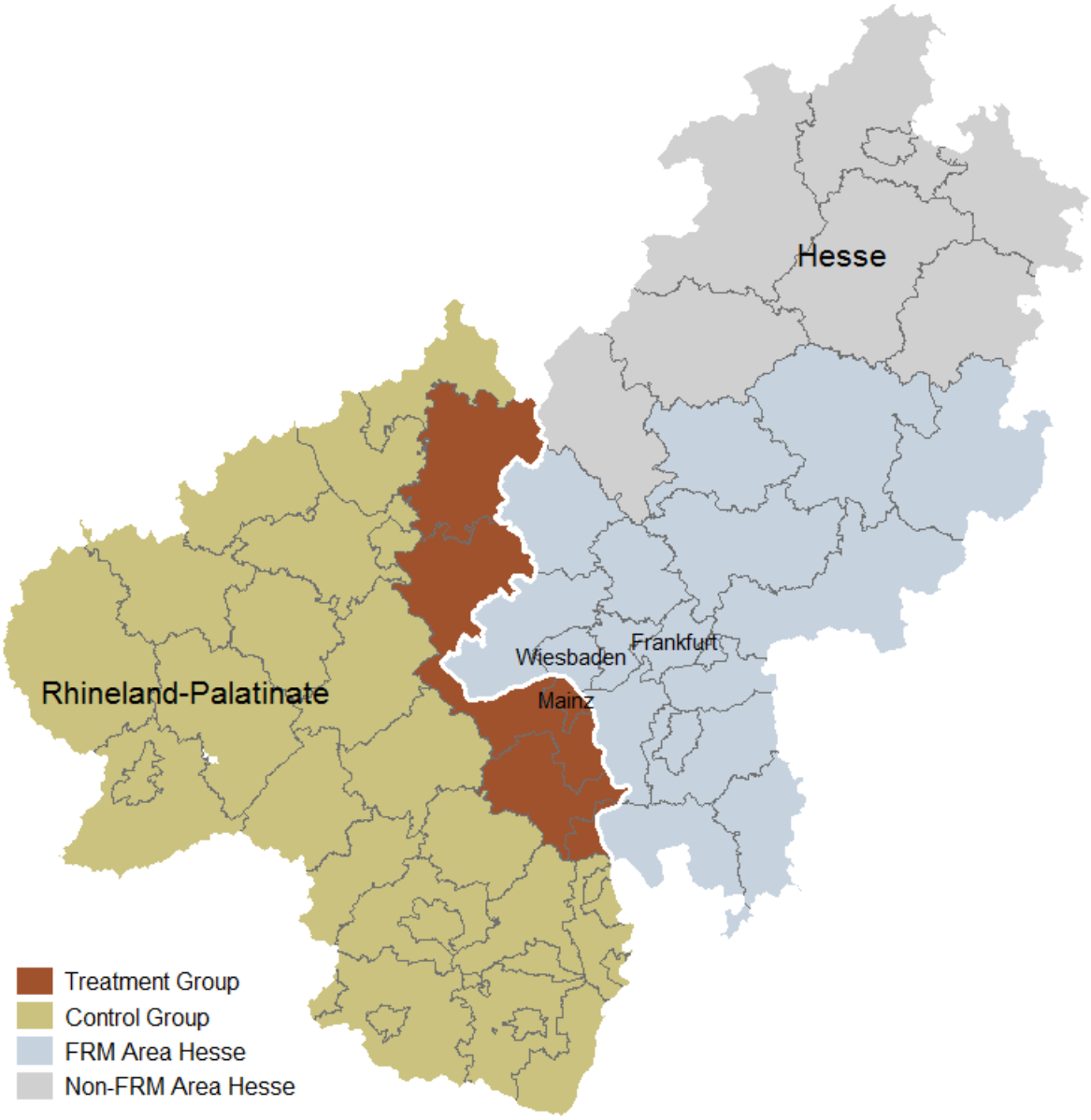
The matched DD estimates in Table 4 generally confirm our previous findings on statistically significant tax policy interdependence in the FRM area. For the 1994 reform, column 1 presents a statistically highly significant treatment effect of -5.0. Compared to the estimate of -2.9 from our preferred specification (Table 2, column 1), this estimate is almost twice as large in size. A t-test reveals that both estimates are not statistically significantly different from each other. For the 1997-2000 reform, column 3 indicates a treatment effect of -0.9 that misses significance at conventional levels. Again, a t-test reveals that the estimate is not statistically significantly different from the estimate from our preferred specification (Table 3, column 1). Similar to our previous results, we find negative treatment effects on Rhineland-Palatine FRM municipalities' average tax multipliers. Thus, our results generally seem to be robust with respect to the exclusion or inclusion of non-FRM municipalities located in counties at Rhineland-Palatinate's borders.

5.2 Extension

We provide an extension of our analysis with respect to the boundaries of the economically integrated area that defines our treatment group. One characteristic of the *European Metropolitan Area Frankfurt/Rhein-Main* is a high level of commuting within the entire metropolitan area, thus, also across the Hessian-Rhineland-Palatine state border.

Figure 9 shows the map of the FRM. The Hessian part of the metropolitan area is shown in light blue. The red area marks, besides the Rhineland-Palatine part of the metropolitan area, the two Northern Rhineland-Palatine counties, Rhein-Lahn-Kreis and Westerwaldkreis, that directly neighbor Hesse. Commuter stream analyses (e.g. Kropp and Schwengler, 2011) indicate that these northern counties are part of the economically integrated FRM area, too. Although these counties do not officially belong to the institution of the FRM, large numbers of com-

Figure 9: Map of Rhineland-Palatinate and Hesse: treatment and control groups (analysis extension)



Note: White bold line marks the state border, county borders are shown in grey. Treatment group (red) includes FRM municipalities in Rhineland-Palatinate and municipalities in border counties to the FRM area. Control group consists of matched Rhineland-Palatine municipalities (yellow). The state of Hesse is also split into FRM (light blue) and non-FRM (grey) municipalities.

muters regularly cross the state border on their ways to and from work. We argue that although the two Northern counties are not members of the official metropolitan area, commuter streams suggest a high economic integration into the metropolitan area of both counties and, therefore, the state border with Hesse should not prevent fiscal interactions. Thus, we expect to find tax policy interdependence between Hessian FRM municipalities and all Rhineland-Palatine

Table 5: Reform 1994: Difference-in-differences estimation results with modified treatment group of border-county municipalities

	Rhineland-Palatine border-county municipalities		
	1	2	3
Hesse reform	-3.907	-3.710	
	(0.000)	(0.000)	
Hesse reform in $t+5$			0.066
			(0.824)
Hesse reform in $t+4$			0.384
			(0.278)
Hesse reform in $t+3$			0.354
			(0.408)
Hesse reform in $t+2$			0.568
			(0.207)
Hesse reform in $t+1$			0.034
			(0.956)
Hesse reform year			-2.628
			(0.001)
Hesse reform in $t-1$			-4.085
			(0.000)
Hesse reform in $t-2$			-4.306
			(0.000)
Fixed time effects	✓	✓	✓
Fixed municipality effects	✓	✓	✓
Group specific linear time trend		✓	

Note: The dependent variable is a Rhineland-Palatine municipality's local business tax multiplier. The coefficients are estimated using a difference-in-differences approach after a nearest neighbor matching based on a propensity score (caliper 0.1) of Rhineland-Palatine border-county and non-FRM municipalities. For details on treatment and control group see Table A5. 7,180 municipality-year observations between 1988 and 1996. P-values in parentheses. Heteroscedasticity robust standard errors, clustered at municipality level.

municipalities located in counties at the Rhineland-Palatine-Hessian border, including the two Northern counties.

To construct a valid control group for our treatment group of Rhineland-Palatine border-county municipalities, we conduct a propensity score nearest neighbor matching (caliper 0.1) on municipalities' propensity to be located in a Rhineland-Palatine county neighboring Hesse. We consider the rest of Rhineland-Palatine municipalities for the potential control group.[21] We

[21] This potential control group is equivalent to the potential control group in our preferred specification, the non-FRM municipalities. In our preferred specification, we excluded the two Northern counties from our analysis (they now form part of our modified treatment group).

Table 6: Reform 1997-1999: Difference-in-differences estimation results with modified treatment group of border-county municipalities

	Rhineland-Palatine border-county municipalities		
	1	2	3
Hesse reform	-1.911	-0.180	
	(0.000)	(0.701)	
Hesse reform in $t+2$			-0.637
			(0.381)
Hesse reform in $t+1$			-1.126
			(0.128)
Hesse reform year 1			-1.837
			(0.015)
Hesse reform year 2			-2.640
			(0.002)
Hesse reform year 3			-3.020
			(0.001)
Fixed time effects	✓	✓	✓
Fixed municipality effects	✓	✓	✓
Group specific linear time trend		✓	

Note: The dependent variable is a Rhineland-Palatine municipality's local business tax multiplier. The coefficients are estimated using a difference-in-differences approach after a nearest neighbor matching based on a propensity score (caliper 0.1) of Rhineland-Palatine border-county and non-FRM municipalities. For details on treatment and control group see Table A6. 4,806 municipality year observations between 1994 and 1999. P-values in parentheses. Heteroscedasticity robust standard errors, clustered at municipality level.

use, again, geographic, demographic, fiscal, and political municipality characteristics in the pre-reform years 1993 and 1996 respectively for matching. The matching procedures for 1993 and 1996 provide for all border-county municipalities a matched non-border-county municipality. Tables A5 and A6 in the appendix present descriptive statistics for treatment and control group before and after matching.

Table 5 presents the results of the matched DD estimations for the 1994 reform. In line with our previous findings, column 1 shows a statistically highly significant treatment effect of -3.907. The result is robust against the inclusion of a group-specific time trend (column 2). Compared to the point estimate for tax policy interdependence from our preferred specification (Table 2, column 1), a t-test reveals that both estimates are not statistically significantly different from each other. For the 1997-2000 reform, Table 6 includes the matched DD estimates. Rhineland-Palatine border-county municipalities responded statistically significantly to the Hessian increase in local business tax multipliers. The average treatment effect on border-county municipalities' business tax multipliers is -1.911. The estimate is highly statistically significant at the 1% significance level. Similar to the results from our preferred specification (Table 3, column 1), the treatment effect evolves over time from -1.837 in 1997 to -3.020 in 1999. In terms of difference in effect size, the estimate is according to a t-test not statistically significantly different from the estimate from our preferred specification. Therefore, both estimates should with a high probability not be statistically different from each other.

In line with studies on commuter streams, the evidence for tax policy interdependence between Rhineland-Palatine border-counties and Hessian municipalities suggests that the economically integrated region in the broader area of Frankfurt/Main goes beyond the institutional border of the *European Metropolitan Area Frankfurt/Rhein-Main*.

6 Conclusion

This study provides quasi-experimental evidence for tax policy interdependence among municipalities in the *European Metropolitan Area Frankfurt/Rhein-Main*. We study two reforms in the fiscal equalization scheme of the German state of Hesse in 1994 and between 1997 and 2000. Both reforms induced exogenous variation in Hessian municipalities' local business tax multipliers. We exploit this exogenous variation to study tax policy interdependence between the municipalities in the Hessian and the Rhineland-Palatine part of the metropolitan area.

Our findings show that Rhineland-Palatine FRM municipalities decelerate their trend of increasing tax multipliers, as a response to the two Hessian reforms. This results in a more moderate increase in tax multipliers as compared to Rhineland-Palatine non-FRM municipalities. During the entire analysis period, there is a positive tax multiplier differential: Rhineland-Palatine FRM municipalites show on average higher multipliers than Hessian FRM municipalities. Interestingly, this multiplier differential stays stable over time fluctuating around 16 points. Notably, Rhineland-Palatine FRM municipalities' moderation in raising multipliers as a response to the Hessian reforms crucially determines the differential's stability over time. The counterfactual development of multipliers in Rhineland-Palatine non-FRM municipalities predicts that the 1999 differential would have been almost 4 points higher in the absence of tax policy interdependence, thus, around 20.4 points. Consequently, in the absence of tax policy interdependence the 1999 differential would have been almost 25% larger (actual 1999 differential 16.4 points).

Tax competition theory suggests that the larger tax multiplier differential would have *ceteris paribus* implied lower investment in Rhineland-Palatine FRM municipalities. Referring to corporate investment literature, both the extensive and intensive margin of investment would have been affected, as local business tax multipliers determine both firms' effective average and

marginal corporate tax rates (Devereux and Griffith, 1998). More specifically, a larger tax multiplier differential would, on the one hand, have lead to a decrease in capital in firms located in Rhineland-Palatine FRM municipalities in order to increase in the before-tax marginal product of capital. This implies a decrease in investment. On the other hand, the probability for firms' to choose a location in the Rhineland-Palatine part of the metropolitan are (as compared to the Hessian part) would have been negatively affected. The negative relation between local business tax rates and both firm investment and location decisions is empirically well documented (see e.g. Becker et al., 2012).

A high level of economic integration among the constituents of a metropolitan area is likely to spur tax competition between them: as firms can benefit from an *agglomeration rent* regardless of their specific location within the metropolitan area, tax rates become even more relevant for decisions on investment and (re)location. Thus, making tax policy interdependent. In short, our findings indicate that an arguably strong economic integration of municipalities seems to be a key determinant for tax policy interdependence. Previous quasi-experimental studies did not explicitly consider the level of economic integration as a relevant dimension. According to our results, commuter streams seem to be appropriate means to define an area of economically integrated municipalities.

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Appendix

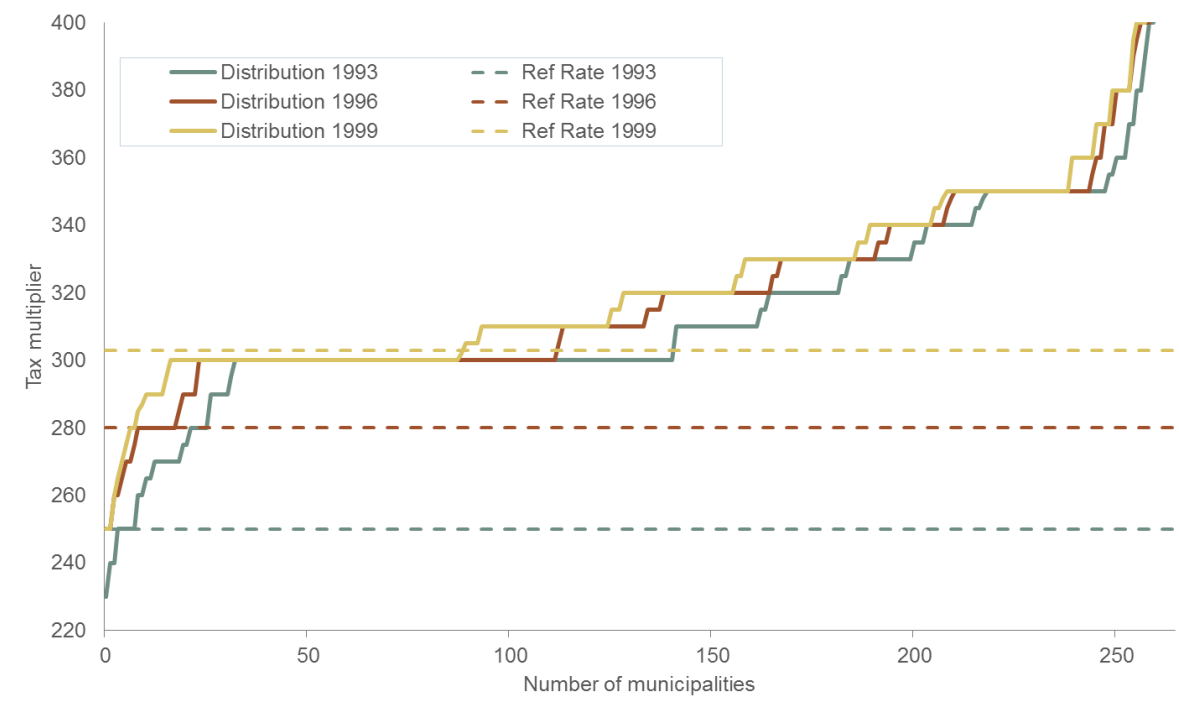
Supplementary material for

Economic Integration and Interdependence of Tax Policy

Contents

7 Local business tax multiplier adjustments between 1993 and 1999

Figure A1: Hessian FRM municipalities' local business tax multipliers and reference rates in 1993, 1996, and 1999

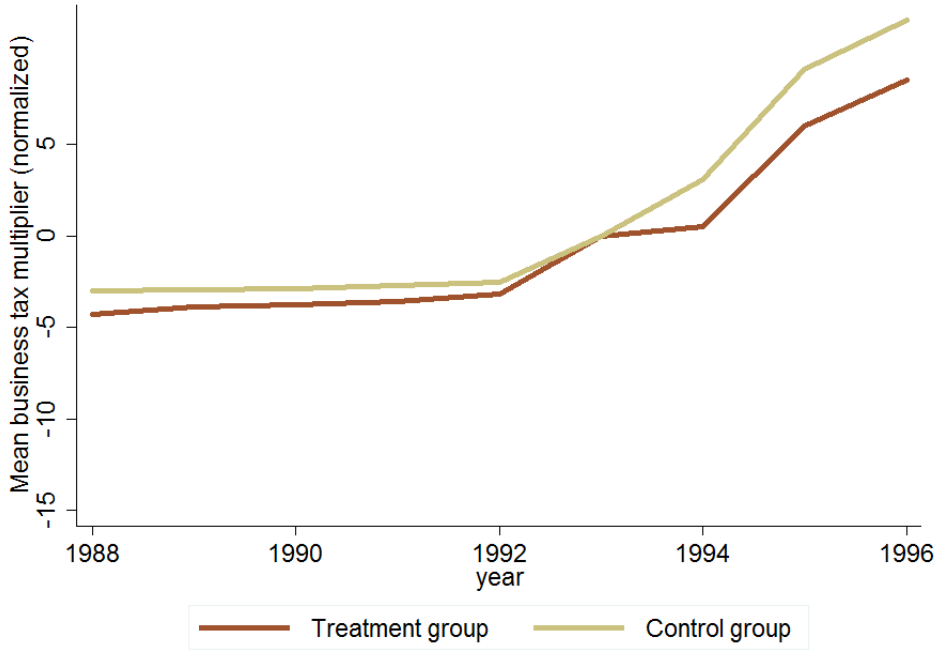


The solid lines show the distribution of business tax multipliers in the FRM area. The dashed lines indicate the corresponding reference rates determined in the Hessian local fiscal equalization scheme for the respective year. Total number of municipalities is 265. For improved visualization y-axis is capped at 400, thereby excluding 7 high-tax municipalities (in 1999: Gießen (420), Darmstadt (425), Maintal (430), Hanau (430), Offenbach (440), Wiesbaden (460) and Frankfurt (515)). Data source: *Statistisches Landesamt Hessen*, own calculations.

8 Group-specific time trends in local business tax multipliers (before matching)

8.1 FRM and non-FRM municipalities 1988-1996

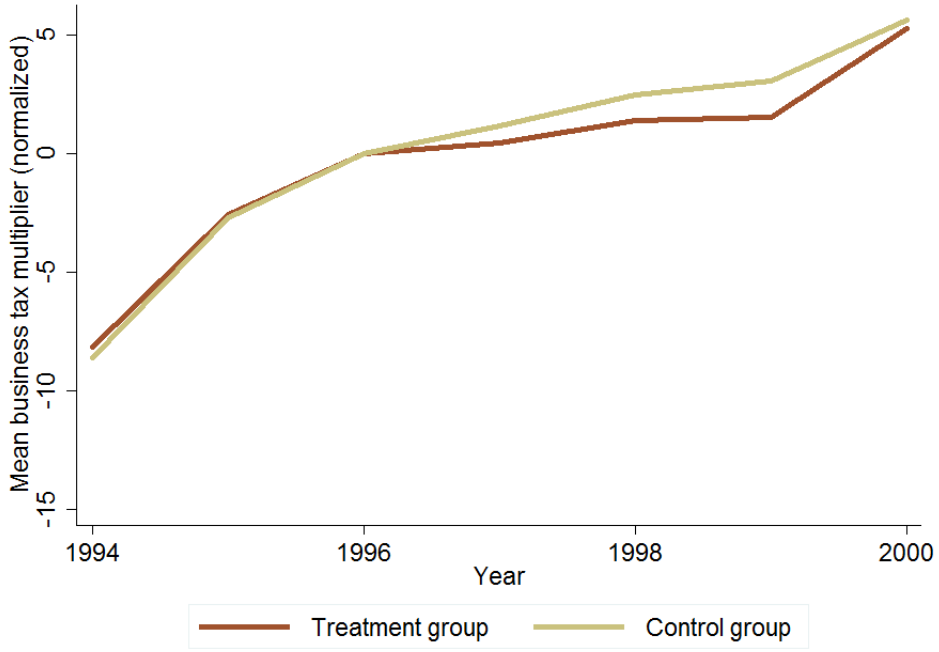
Figure A2: Local business tax multipliers of Rhineland-Palatine FRM and non-FRM municipalities from 1988 to 1996 (before matching)



Note: The graphs show the development of the average normalized business tax multiplier in Rhineland-Palatine metropolitan and interior municipalities. The normalization is conducted by subtracting from each municipality's business tax multiplier in each year the value of the tax multiplier in 1993, the pre-treatment year. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

8.2 FRM and non-FRM municipalities 1994-1999

Figure A3: Local business tax multipliers of Rhineland-Palatine FRM and non-FRM municipalities from 1994 to 1999 (before matching)



Note: The graphs show the development of the average normalized business tax multipliers in Rhineland-Palatine metropolitan and interior municipalities. The normalization is conducted by subtracting from each municipality's business tax multiplier in each year the value of the tax multiplier in 1996, the pre-treatment year. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

9 Propensity score matching

9.1 Baseline results reform 1994: propensity score matching FRM and non-FRM municipalities

Table A1: Average characteristics of FRM versus non-FRM Rhineland-Palatine municipalities in 1993[a]

	Full sample			Matched sample		
	Non-FRM (N=1,793)	FRM (N=137)	Signif. of diff.	Non-FRM (N=1,780)	FRM (N=126)	Signif. of diff.
Municipality taxes and budgets						
Business tax revenue per capita	0.139	0.098		0.090	0.0980	
Personal income tax revenue per capita	0.249	0.267		0.256	0.265	
Local business tax multiplier	324.18	330.29	***	327.7	328.37	
Property tax (B) multiplier	278.46	289.12	***	285.41	286.66	
Population and Demographics						
Population density	136.18	231.34	***	210.95	218.2	
Population share under age 20	0.227	0.229		0.230	0.230	
Population share 20 to 60	.551	.581	***	0.578	0.578	
Political majorities						
Share of votes CDU	0.132	0.176	**	0.163	0.180	
Share of votes SPD	0.137	0.326	***	0.317	0.316	
Share of votes Greens	0.003	0.010	***	0.008	0.008	
Share of votes FDP	0.008	0.029	***	0.025	0.024	
Share of votes voting communities	0.179	0.320	***	0.312	0.319	

[a]The table provides for the year 1993 the average characteristics of Rhineland-Palatine municipalities by their affiliation to the metropolitan area *Frankfurt/Rhein-Main* in the full sample and in the matched sample. Propensity score radius matching with caliper 0.01 was applied. Two Rhineland-Palatine counties neighboring Hesse but not being part of the metropolitan area *Frankfurt/Rhein-Main* are excluded. Significance of a t-test of the difference in characteristics: *<0.1, **<0.05, ***<0.01. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

9.2 Baseline results reform 1997-2000: propensity score matching FRM and non-FRM municipalities

Table A2: Average characteristics of FRM versus non-FRM Rhineland-Palatine municipalities in 1996[a]

	Full sample			Matched sample		
	Non-FRM (N=1,825)	FRM (N=135)	Signif. of diff.	Non-FRM (N=1,819)	FRM (N=121)	Signif. of diff.
Municipality taxes and budgets						
Business tax revenue per capita	0.099	0.081		0.081	0.083	
Personal income tax revenue per capita	0.195	0.233	***	0.232	0.231	
Cash effective revenue per capita	0.907	0.871		0.850	0.886	
Local business tax multiplier	335.46	337.71		335.11	337.45	
Property tax (B) multiplier	292.63	300.21	***	294.09	298.42	
Population and Demographics						
Population density	131.44	218.76	***	220.33	213.83	
Population share under age 20	0.230	0.234		0.237	0.234	
Population share 20 to 60	0.539	0.574	***	0.567	0.571	
Political majorities						
Share of votes CDU	0.124	0.163	**	0.156	0.169	
Share of votes SPD	0.126	0.301	***	0.308	0.292	
Share of votes Greens	0.004	0.011	***	0.010	0.010	
Share of votes FDP	0.006	0.024	***	0.017	0.0215	
Share of votes voting communities	0.176	0.320	***	0.327	0.306	

[a]The table provides for the year 1996 the average characteristics of Rhineland-Palatine municipalities by their affiliation to the metropolitan area *Frankfurt/Rhein-Main* in the full sample and in the matched sample. Propensity score radius matching with caliper 0.01 was applied. Two Rhineland-Palatine counties neighboring Hesse but not being part of the metropolitan area *Frankfurt/Rhein-Main* are excluded. Significance of a t-test of the difference in characteristics: *<0.1, **<0.05, ***<0.01. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

9.3 Robustness reform 1994: propensity score matching FRM and interior municipalities

Table A3: Average characteristics of FRM versus interior Rhineland-Palatine municipalities in 1993[a]

	Full sample			Matched sample		
	Interior (N=648)	FRM (N=137)	Signif. of diff.	Interior (N=615)	FRM (N=108)	Signif. of diff.
Municipality taxes and budgets						
Business tax revenue per capita	0.099	0.098		0.093	0.102	
Personal income tax revenue per capita	0.238	0.267		0.268	0.266	
Property tax (B) revenue	0.013	0.018	**	0.017	0.019	
Local business tax multiplier	324.32	330.29	***	327.96	328.66	
Property tax (B) multiplier	276.79	289.12	***	283.18	284.39	
Population and Demographics						
Population density	133.47	231.34	***	225.68	211.8	
Population share under age 20	0.227	0.229		0.228	0.228	
Population share 20 to 60	0.551	0.581	***	0.576	0.575	
Political majorities						
Share of votes CDU	0.123	0.176	***	0.181	0.171	
Share of votes SPD	0.138	0.326	***	0.307	0.304	
Share of votes Greens	0.003	0.010	***	0.006	0.005	
Share of votes FDP	0.009	0.029	***	0.023	0.019	
Share of votes voting communities	0.203	0.320	***	0.283	0.324	

[a]The table provides for the year 1993 the average characteristics of Rhineland-Palatine municipalities by their affiliation to the metropolitan area *Frankfurt/Rhein-Main* in the full sample and in the matched sample. Propensity score radius matching with caliper 0.01 was applied. Two Rhineland-Palatine counties neighboring Hesse but not being part of the metropolitan area *Frankfurt/Rhein-Main* are excluded. Further excluded are all non-FRM municipalities in border counties. Significance of a t-test of the difference in characteristics: *<0.1, **<0.05, ***<0.01. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

9.4 Robustness reform 1997-2000: propensity score matching FRM and interior municipalities

Table A4: Average characteristics of FRM versus interior Rhineland-Palatine municipalities in 1996[a]

	Full sample			Matched sample		
	Interior (N=664)	FRM (N=135)	Signif. of diff.	Interior (N=651)	FRM (N=116)	Signif. of diff.
Municipality taxes and budgets						
Business tax revenue per capita	0.086	0.081		0.079	0.080	
Personal income tax revenue per capita	0.203	0.233	***	0.229	0.229	
Cash effective revenue per capita	0.966	0.871	**	0.876	0.887	
Local business tax multiplier	334.92	337.71	*	337.58	337.06	
Property tax (B) multiplier	289.82	300.21	***	297.88	296.67	
Population and Demographics						
Population density	132.94	218.76	***	203.85	210.16	
Population share under age 20	0.229	0.234	*	0.235	0.235	
Population share 20 to 60	0.543	0.574	***	0.566	0.570	
Political majorities						
Share of votes CDU	0.113	0.163	***	0.167	0.162	
Share of votes SPD	0.125	0.301	***	0.305	0.286	
Share of votes Greens	0.005	0.011	***	0.009	0.009	
Share of votes FDP	0.007	0.024	***	0.024	0.019	
Share of votes voting communities	0.204	0.320	***	0.2923	0.317	

[a]The table provides for the year 1996 the average characteristics of all municipalities by their affiliation to the metropolitan area *Frankfurt/Rhein-Main* in the full sample and in the matched sample. Propensity score radius matching with caliper 0.01 was applied. Two Rhineland-Palatine counties neighboring Hesse but not being part of the metropolitan area *Frankfurt/Rhein-Main* are excluded. Further excluded are all non-FRM municipalities in border counties. Significance of a t-test of the difference in characteristics: *<0.1, **<0.05, ***<0.01. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

9.5 Extension reform 1994: propensity score matching FRM-border-county and non-FRM municipalities

Table A5: Average characteristics of FRM-border-county versus non-FRM Rhineland-Palatine municipalities in 1993[a]

	Full sample			Matched sample		
	Non-border county (N=1,793)	Border county (N=457)	Signif. of diff.	Non-border county (N=341)	Border county (N=457)	Signif. of diff.
Municipality taxes and budgets						
Business tax revenue per capita	0.139	0.113		0.098	0.113	
Personal income tax revenue per capita	0.249	0.242		0.252	0.242	
Property tax (B) revenue	0.011	0.009	*	0.011	0.009	
Local business tax multiplier	324.18	321.23	***	322.28	321.23	
Property tax (B) multiplier	278.46	264.05	***	264.42	264.05	
Population and Demographics						
Population density	136.18	182.58	***	189.55	182.58	
Population share under age 20	0.227	0.230	*	0.227	0.230	
Population share 20 to 60	0.551	0.565	***	0.568	0.565	
Political majorities						
Share of votes CDU	0.13	0.107	**	0.123	0.107	
Share of votes SPD	0.137	0.177	***	0.192	0.177	
Share of votes Greens	0.003	0.003		0.004	0.003	
Share of votes FDP	0.008	0.011		0.011	0.011	
Share of votes voting communities	0.179	0.262	***	0.250	0.262	

[a]The table provides for the year 1993 the average characteristics of all municipalities by whether they are located in a county bordering Hesse in the full sample and in the matched sample based on a propensity score nearest neighbor matching with caliper 0.1. Two Rhineland-Palatine counties neighboring Hesse but not being part of the metropolitan area *Frankfurt/Rhein-Main* are excluded. Further excluded are all 'interior' municipalities in border counties. Significance of a t-test of the difference in characteristics: *<0.1, **<0.05, ***<0.01. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

9.6 Extension reform 1997-2000: propensity score matching FRM-border-county and non-FRM county municipalities

Table A6: Average characteristics of FRM-border-county versus non-FRM Rhineland-Palatine municipalities in 1996[a]

	Full sample			Matched sample		
	Non-border county (N=1,825)	Border county (N=463)	Signif. of diff.	Non-border county (N=338)	Border county (N=463)	Signif. of diff.
Municipality taxes and budgets						
Business tax revenue per capita	0.099	0.096		0.094	0.096	
Personal income tax revenue per capita	0.195	0.212	***	0.215	0.212	
Cash effective revenue per capita	0.907	0.862	*	0.855	0.862	
Local business tax multiplier	335.46	328.16	***	328.32	328.16	
Property tax (B) multiplier	292.63	286.51	***	287.41	286.51	
Population and Demographics						
Population density	131.44	180.7	***	181.78	180.7	
Population share under age 20	0.230	0.235	***	0.234	0.235	
Population share 20 to 60	0.539	0.554	***	0.553	0.554	
Political majorities						
Share of votes CDU	0.124	0.096	***	0.100	0.096	
Share of votes SPD	0.126	0.159	***	0.169	0.159	
Share of votes Greens	0.004	0.004		0.004	0.004	
Share of votes FDP	0.006	0.008		0.007	0.008	
Share of votes voting communities	0.176	0.245	***	0.261	0.245	

[a]The table provides for the year 1996 the average characteristics of all municipalities by whether they are located in a county bordering Hesse in the full sample and in the matched sample based on a propensity score nearest neighbor matching with caliper 0.1. Two Rhineland-Palatine counties neighboring Hesse but not being part of the metropolitan area *Frankfurt/Rhein-Main* are excluded. Further excluded are all 'interior' municipalities in border counties. Significance of a t-test of the difference in characteristics: *<0.1, **<0.05, ***<0.01. Data source: *Statistisches Landesamt Rheinland-Pfalz*, own calculations.

10 Data sources and definitions

Data sources

Local data was provided by the statistical offices of the states of Hesse[22] and Rhineland-Palatinate[23]. It can either be accessed through their online download systems or via *Auskunftsdienst*.

Local business tax multipliers

Local governments set a tax multiplier, which multiplied with the federal base rate results in the local business tax rate. Between 1993 and 2000, the base rate was structured in the following way: earnings of partnerships were only taxed if above 12'000 Euro, then subject to a base rate of 1%. For every increment of 12'000 Euro in earnings, the base rate increased by another percentage point. The maximum rate was 5%, for earnings exceeding 48'000 Euro. For corporations the base rate was a uniform 5% starting with the first Euro in earnings. These two factors determine the statutory business tax rate. For instance, with a multiplier of 400 percent the resulting statutory business tax rate amounts to 0.20 or 20% ($= 400\% \times 0.05$). Local multipliers are fixed for a year. During our study period, there was no lower or upper bound for local multipliers.

Municipality taxes and budgets

Business tax revenue per capita: annual tax revenue of local business tax, before state and federal deductions (*Gewerbesteuerumlage*). Data expressed in thousand Euro.

Personal income tax: municipalities' share of federal income tax revenue. Data expressed in thousand Euro.

Cash effective revenue: actual annual cash revenue *(Kassenäßige Bruttoeinnahmen im Verwaltungs- und Vermögenshaushalt)*. Data expressed in thousand Euro.

Corporate business tax multiplier: local business tax multipliers are expressed in (percentage) points.

Property tax (B) multiplier: property tax B is applied for all sorts of housing and commercial property and expressed in (percentage) points.

Population and demographics

Population density: expressed as absolute number of people per square kilometer. Population data at year end (Dec. 31st).

Population share under 20: share of people aged under 20, expressed in percent of total population at year end (Dec. 31st).

Population share 20 to 60: share of people aged between 20 and 60, expressed in percent of total population at year end (Dec. 31st).

Political majorities

Election outcomes: local elections took place on June 18th, 1989, and June 12th, 1994. Results expressed in percent of total number of voters.

Share of votes CDU: share of votes Christian Democrats (CDU).

Share of votes SPD: share of votes Social Democrats (SPD).

Share of votes Greens: share of votes Green Party (Die Grünen).

Share of votes FDP: share of votes Liberal Party (FDP).

Share of votes voting communities: share of voting communities (Freie Wähler).

[22] Statistisches Landesamt Hessen, Rheinstrasse 35/37, 65175 Wiesbaden; www.statistik-hessen.de.

[23] Statistisches Landesamt Rheinland-Pfalz, Mainzer Strasse 14/16, 56130 Bad Ems; www.statistik.rlp.de.

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