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**TAX MIMICKING IN THE SHORT - AND
THE LONG - RUN:
EVIDENCE FROM GERMAN
REUNIFICATION**

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Tax mimicking in the short- and the long-run:

Evidence from German reunification

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Abstract

This paper uses the quasi-experiment of Germany's reunification to identify local tax mimicking by municipalities in Eastern-Germany. After reunification, East-German municipalities were allowed to independently set, for the first time in decades, local business and property tax rates. I explore whether the tax rates chosen by East-German border municipalities were influenced by the tax rates of adjacent West-German municipalities. To obtain causal estimates, I rely on instrumental variables regressions within the spatial lag framework, using West-German border municipalities' tax rates in 1989 as instruments for their post-reunification tax rates. The results suggest that East-German municipalities mimicked business tax rates immediately after reunification, but not in later years. I find no evidence of mimicking for property taxes. These results indicate that mimicking is not an important determinant of local tax policy.

Keywords: Tax mimicking, Business taxes, Property taxes, German reunification

JEL codes: H20, H71, H77

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1 Introduction

Even though many studies have explored whether local governments set tax rates in response to the tax rates chosen by their geographical neighbors, the empirical evidence on local tax mimicking remains ambiguous. Several studies find that local governments indeed engage in tax mimicking.¹ However, many of these studies have recently come under criticism as their identification strategies rely on questionable assumptions, notably selection on observables (Gibbons and Overman, 2012). In line with such concerns, a small number of quasi-experimental studies have emerged that exploit natural experiments to construct more credible identification strategies. The existing quasi-experimental evidence, however, is mixed. Lyytikäinen (2012) finds no evidence for local property tax mimicking in Finland, Isen (2014) finds no evidence for income, property, and sales tax mimicking in Ohio, and Baskaran (2014) finds no evidence for business and property tax competition in Germany. On the other hand, Eugster and Parchet (2011) and Parchet (2012) find strong evidence in favor of mimicking for personal income taxes in Switzerland, and Agrawal (2013) finds similar evidence for sales taxes in the US.

This paper adds to the quasi-experimental literature on local tax mimicking by exploiting a particularly interesting natural experiment: German reunification. The accession of the territories of the former German Democratic Republic (GDR) into the Federal Republic of Germany (FRG) is an interesting experiment because it provides a unique context to study whether local government's initial tax choices – i. e. when in effect a new country is formed – and subsequent adjustments are driven by tax mimicking. In particular, I explore whether the initial and the long-run tax policies of Eastern border municipalities are influenced by the tax rates in adjacent Western municipalities.

¹See for example Brueckner and Saavedra (2001), Sollé Ollé (2003), Feld and Reulier (2009), Schaltegger and Küttel (2002), Allers and Elhorst (2005), Leprince et al. (2007), Bordignon et al. (2003), Heyndels and Vuchelen (1998), Büttner (2001), Hauptmeier et al. (2012), and Cassete et al. (2012). See also Brueckner (2003) and Revelli (2005) for surveys of the literature.

Using a sample of 158 Eastern and 133 Western municipalities located along the 1400 kilometers long former border between West- and East-Germany, I obtain the following findings regarding business and property tax mimicking by East-German border municipalities. The business tax rates chosen by East German border municipalities in 1992, the first year for which comprehensive administrative data on local taxation in East-German municipalities is available, depends positively on the business tax rates of their West-German neighbors. In 1992, an one point higher average business tax rate in their West-German neighbors led a given East-German municipality to choose a tax rate that was about 0.3 points higher. The effect continues to be positive but is only half as large in 1993. From 1993 onwards until 2000 (the end of the sample period), I find no evidence for business tax mimicking. In contrast to these differentiated findings regarding the business tax, I find no evidence for meaningful tax mimicking for property tax rates, neither in 1992 nor later. Overall, these results suggest that when they face unfamiliar economic environments, municipalities resort to “social learning” to determine appropriate tax rates. Other potential reasons for tax mimicking, notably tax and yardstick competition or budget spillovers, do not seem to be relevant.

To obtain these results, I estimate standard spatial lag models that relate the average tax rate of Western neighbors to the tax rate chosen by a given Eastern municipality. As is well known, neighbors’ tax rates are endogenous variables in the spatial lag framework (Brueckner and Saavedra, 2001), but this endogeneity problem can be addressed through an instrumental variables approach. I use as instruments for the tax rates chosen by the West-German border municipalities in post-reunification years their tax rates in 1989. Conceptually, a strong relationship between the between-municipality variation in tax rates of Western municipalities in 1989 and the between-municipality variation in later years can be expected if (i) underlying economic or demographic characteristics primarily determine local tax rates in Western municipalities and (ii) if the between-municipality distribution

of these characteristics did not change too much over time. Empirically, I indeed find that the between-variation in West-German border municipalities' tax rates in 1989 strongly predicts the between-variation in their tax rates both in 1992 and in later post-reunification years, leading to strong first stage results in the IV regressions.²

Apart from a strong first stage, the instrument should be valid, i. e. it should fulfill the exclusion restriction and be unrelated to the error term. First, tax rates chosen by West-German border municipalities in 1989 should fulfill the exclusion restriction because East-German border municipalities will arguably react to current tax rates in West-German municipalities (i. e. tax rates chosen in a given post-unification year) but not directly to tax rates chosen in 1989.

Second, to be uncorrelated with the error term, the instrument should not be subject to reverse causality and omitted variables bias. Tax rates chosen by West-German municipalities in 1989 should be robust to reverse causality as reunification was unexpected at the beginning of 1989 (tax rates are always chosen from the beginning of a year). Thus, expected tax rates of East-German municipalities cannot reasonably have influenced tax rates chosen by West-German municipalities in 1989.

Omitted variables that affect tax rates of West-German municipalities in 1989 and tax rates of East-German municipalities in post-unification years similarly, notably common spatial or economic characteristics of Eastern and Western neighbors, are a more serious

²The persistence in the between-municipality distribution of tax rates also implicitly suggests that West-German municipalities have effectively ignored the tax rates chosen by their East-German neighbors after reunification. That is, while Western municipalities' tax policies may or may not have been affected by the shock of German reunification, Western municipalities arguably have not specifically reacted to the tax policies of their East-German neighbors. This interpretation is plausible at least for the first few years after reunification. Tax and yardstick competition with East-German municipalities was presumably not a relevant concern for West-German municipalities given the differences in economic conditions between the East and the West. Budget spillovers is also an implausible reasons for mimicking as public infrastructure was clearly worse in the East. Finally, social learning is unlikely to matter as well as Eastern municipalities were obviously not better informed than their Western neighbors about appropriate tax policies in a market economy.

concern, even if economic conditions were highly dissimilar in West- and East-Germany at the time of reunification given the different economic models in the two former countries.

As a first attempt to address potential omitted variables, I include county fixed effects in the spatial lag models and thus identify tax mimicking only through within-county variation. In addition, I specifically control for municipality-level characteristics. In particular, I use night light output per capita to proxy for economic conditions, average elevation and land area of a municipality to proxy for geographical features, and municipal population as proxy for demographic characteristics. Results are largely identical with and without control variables, indicating in the spirit of Altonji et al. (2005) that the estimates are robust to omitted variables.

The remainder of this paper is structured as follows. The next section describes the institutional context. Section 3 discusses the importance of tax mimicking along the German inner border. Section 4 introduces the empirical model and Section 5 describes the data. Section 6 collects the results. I conclude in Section 7.

2 Institutional context

2.1 Local taxation in Germany

Three important local taxes are available to German municipalities: the business tax (*Gewerbesteuer*), the property tax B (*Grundsteuer B*), and the property tax A (*Grundsteuer A*).³ Municipalities levy the business tax on incorporated and privately held firms. Total tax revenues in the federation in 2013 were around 43 billion Euro. The tax base is related to firm profits, but some adjustments are made to reported profits, for example to account for interest payments. These adjustments are based on federation-wide regula-

³Unlike in some states of the US and in Switzerland, municipalities are not allowed to set municipality-specific income tax rates.

tions, and hence the rules that determine the tax base for the business tax are the same for all municipalities in the federation. While the base is thus given from the perspective of municipalities, they can levy their own tax rates. More specifically, municipalities are allowed to choose a “multiplier” (*Hebesatz*), which determines the effective tax rate in a municipality. In the following, I therefore use “tax multiplier” and “tax rate” interchangeably.

The property tax B works similarly. This tax is levied by the municipalities on non-agricultural properties. The tax base is the assessed value of the property. As for the business tax, municipalities are allowed to set a multiplier that determines the effective tax rate. Total tax revenues in 2013 from the property tax B were around 12 billion Euros.

Finally, the property tax A is levied on agricultural profits. As for the other two local taxes, municipalities choose a multiplier on a base determined according to federal regulations. In terms of revenues, however, the property tax A is far less important than the business and property tax B. Total federation-wide revenues in 2013 were around 370 Million Euros.

2.2 German reunification and local taxation in East-German municipalities

This paper focuses on tax choices of municipalities located in the territory of the former GDR. The GDR was a highly unitary (and authoritarian) country that was divided into three main administrative tiers: the central government, 15 regional units (*Bezirke*) and some 7600 municipalities.⁴ Political authority was concentrated at the central level: the

⁴Compared to Western-Germany, the GDR had a very large number of municipalities when it disintegrated in 1990. The reason for this difference is that West-German municipalities underwent amalgamation reforms in the 1960s, which led to a significant decline in the number of municipalities. No similar reforms took place in the GDR, primarily because in the GDR’s unitary institutional framework, municipalities had no important administrative tasks.

regional units were mere administrative arms of the central government while municipalities did not even serve a meaningful administrative function.

While East-German municipalities levied business and property taxes⁵, uniform multipliers were set by the central government for the whole country. For the business tax, the uniform multiplier was 400 points. Proceeds from the business tax were small as state-owned companies (where most of the economic activity took place given the socialist economic model of the GDR) were exempted from business taxation.

As for the business tax, municipalities were forced to levy a uniform multiplier of 300 points for the property tax B and 200 points for the property tax A. Proceeds from the property taxes were small as well given exemptions and the absence of substantial private property in the socialist economic model.

With the accession to the (West-) German Federation, the GDR ceased to exist, and its former territories completely adopted the constitutional and legislative framework of the West. In particular, the 15 regions were abolished and replaced with five new states: Mecklenburg-Western Pomerania (MV), Saxony-Anhalt (ST), Saxony (SA), Thuringia (TH), and Brandenburg (BB). Municipalities continued to exist, but were now grouped into states rather than into regions.

Finally, reunification also required Eastern municipalities to adopt the model of local taxation employed in the West. This meant, in particular, that as of 1991, Eastern municipalities had to choose, for the first time in decades, municipality-specific multipliers for the business and property taxes. In the following, I explore whether the initial and later choices of East-German border municipalities did depend on the tax rates chosen by their West-German neighbors.

⁵The reason for this similarity between the GDR and FRG was that the business and property taxes have a long history in Germany – they were already used before World War II. Thus both German states inherited these types of taxes.

3 Tax mimicking along the inner-German border

3.1 Reasons for tax mimicking

Local governments may engage in tax mimicking for various reasons. An important reason is tax competition. According to standard tax competition models, local governments aim to lure mobile tax bases by offering them low tax rates (Wilson, 1986; Zodrow and Mieszkowski, 1986).⁶ Consequently, these models predict the emergence of strategic interactions in local taxation, leading to tax mimicking across localities. That is, when some other municipalities sets its tax rate at a particular value, a given municipality has an incentive to react to this choice and set its tax rate accordingly. The direction of the interactions is ambiguous, however. According to the underlying assumptions of a particular tax competition model, local taxes may be either strategic substitutes or complements.

Yardstick competition models provide a second explanation for why local governments may engage in tax mimicking (Salmon, 1987; Besley and Case, 1995). According to these models, voters decide whether to re-elect their local officials according to the tax and expenditure bundles offered by neighboring municipalities. If the domestic bundle is deemed worse than in comparable municipalities, citizens will vote their local officials out of office. Hence, local officials have an incentive to systematically react to the tax policies in other municipalities. In particular, yardstick competition models would predict that tax rates are strategic complements.

A third reason for the emergence of strategic interactions are budget spillovers (Case et al., 1993). The idea is that local public goods offered in a given jurisdiction have positive externalities in other municipalities. A given municipality, therefore, does not have to provide certain public goods itself, allowing it to levy lower tax rates. As a consequence,

⁶See also for more recent contributions Wilson (1991), Wildasin (1998), Keen and Kotsogiannis (2002), Wilson and Wildasin (2004), and Wilson and Janeba (2005). Wilson (1999) offers a survey.

there will be negative interactions in tax rates, i. e. tax rates are predicted to be strategic substitutes.

Yet another reason for mimicking, particularly in contexts where policy makers have limited information about the effects of various available policies, could be social learning and knowledge diffusion. Glick (2014) develops a general model where policy makers want to achieve certain goals but are unsure about how to achieve them.⁷ In such an environment, mimicking and learning from others jurisdictions' choices is shown to be an efficient strategy. Adapted to the context of local taxation, these arguments predict that municipalities would mimic neighbors whom they believe to be particularly well informed about appropriate tax rates.⁸

3.2 Relevance of explanations for East- German municipalities

Not all of the above explanations for tax mimicking are equally plausible descriptions of the tax policies of East-German municipalities, especially not in the first few years after reunification. Local tax competition with Western municipalities is unlikely to be a major concern of East-German municipalities immediately after reunification. It is unlikely that East-German municipalities expected to attract firms from their Western neighbors by adjusting their tax policies. After a few years, however, tax competition may be feasible as public infrastructure in the East had reached Western standards.

Yardstick competition is also unlikely to matter initially as municipalities in the East and West should have been too different for meaningful comparisons. Over time, however, yardstick competition may have become a reason for tax mimicking. Budget spillovers, in contrast, are possible both immediately after reunification and also over a longer time

⁷Previous contributions along similar lines include Gale (1996), Bala and Goyal (1998), Volden et al. (2008), and Callander (2011).

⁸Becker and Davies (2014) develop a formal model where interactions in tax policies emerge due to social learning. Tyran and Sausgruber (2005) show with laboratory experiments that subjects learn from the tax policies chosen by others.

horizon. If Western neighbors provide local public goods, Eastern municipalities have to provide fewer themselves, allowing them to lower their tax rates.

Finally, social learning is a plausible reason for tax mimicking in Eastern municipalities, especially in the first few years after reunification. Municipalities in the East had little information about appropriate tax rates. Thus, tax rates chosen by Western neighbors may have served as an important reference for Eastern policy makers. However, with increasing experience of Eastern policy makers within the institutional, political, and economic framework of the West, the social learning channel for tax mimicking may have become less relevant.

4 Empirical model

To establish whether municipalities located along the East German border set their tax rates in response to the tax rates chosen by their Western neighbors, I estimate a standard spatial lag model. Such a model can be specified as follows:

$$t_i^k = \beta \sum_j \omega_j t_j^k + \epsilon_i, \text{ with } i \neq j. \quad (1)$$

t_i^k is the tax rate in a given municipality i for tax $k =$ (business tax, property tax B, property tax A). $\sum_j \omega_j t_j^k$ is the weighted average tax rate of the other municipalities and ω_j are the weights. According to this specification, the tax rate in municipality i is assumed to react to the weighted average tax rate of all other municipalities included in the sample.⁹

As the correct weights are unknown, authors typically experiment with different weights. A popular weighting scheme is to give all contiguous neighboring municipalities the same positive weight and all other municipalities a weight of 0. The implicit assumption un-

⁹A more general version of this model would relate the tax rates of all other municipalities to the tax rate of municipality i . However, this model typically cannot be estimated due to insufficient degrees of freedom. Thus, the simplified version with weighted averages is generally estimated in the literature.

derlying this weighting scheme is that municipalities react primarily to their immediate neighbors. This assumption is plausible in the context studied in this paper, i. e. the most relevant Western municipalities for Eastern border municipalities should be their immediate neighbors. I hence use a weighting matrix that gives the same positive weight to all contiguous Western municipalities, and 0 to all other municipalities.

Estimating Equation 1 with OLS is problematic because of endogeneity. If there is tax mimicking and β is significantly different from 0, the error term ϵ_i and $\sum_j \omega_j t_j^k$ are by construction correlated. To address this endogeneity problem, one common strategy is to use an instrumental variables approach, i. e. to instrument neighbors average tax rate with one or several exogenous variables. Traditionally, authors have used neighbors' economic, demographic, or political characteristics as instruments for neighbors' tax rates (Brueckner and Saavedra, 2001). However, this approach has recently come under criticism as neighbors characteristics are not quasi-random but may endogenously depend on current and expected tax policies of both a given municipality i and all other municipalities (Gibbons and Overman, 2012). Following such concerns, a more recent literature uses natural experiments to construct more credible identification strategies. For example, Lyytikäinen (2012) uses a property tax reform in Finland and Baskaran (2014) uses geographical location of municipalities combined with a reform of local fiscal equalization in a German State to induce exogenous variation in neighbor's tax rates.

I follow this strand of the literature and exploit geographical location, namely location along the East-West German border, together with a natural experiment, i. e. German reunification, to develop a credible IV strategy. The idea is to use the tax rates of Western municipalities in 1989 as instruments for their tax rates in the post-reunification period. This instrument arguably fulfills the exclusion restriction as Eastern municipalities should react to current but not directly to past tax rates of their Western neighbors.

Instrument validity, on the other hand, is generally a problem with lagged variables, for example if there is reverse causality due to anticipation effects. However, anticipation effects are unlikely in the current context as Western municipalities were arguably completely unaware in early 1989, when they had to choose their the tax rates for that year, that the GDR would soon disintegrate.

Another reason why the instrument may be invalid are omitted variables that would lead municipalities to the east of the common border to chose the same tax rates as municipalities to the west had chosen in 1989. Such effects due to common omitted variables are – especially in the first few post-reunification years – unlikely to exist given the economic differences between Eastern and Western Germany. Nevertheless, to address possible omitted variables, I first control for county fixed effects and thus identify spatial interactions with within-county variation.¹⁰

In addition, I control in robustness tests for municipality-level variables. I focus on four covariates. First, following Henderson et al. (2012) I use night light output per capita, which is available from 1992 onwards, as a proxy for economic conditions. Second, I use average elevation in a municipality and its land area as proxies for geographical characteristics. Finally, I control for population to account for demographic factors. These four covariates should control for the most important municipality-level determinants of local tax rates.

¹⁰The average number of municipalities per county in the three Eastern states considered in this paper was about 50 at the end of the sample period. The ratio has changed in recent years due to comprehensive amalgamation reforms which led to a reduction in both the number of counties and municipalities. Note also that all three Eastern states changed county boundaries shortly after reunification, in particular by merging counties. The county fixed effects in the regressions therefore reflect the situation as of 2000, even if other county boundaries were relevant in the previous years.

5 Data

5.1 Data on local taxation

The sample consists of almost all municipalities that were adjacent to the west and the east of the common German border in 2000. I drop a few border municipalities because they underwent amalgamations during the 1991-2000 period and change their regional codes for this reason.¹¹ I also drop border municipalities from the two Eastern states that do not share a significant common border with Western states (see discussion below). Subfigure a of Figure 1 shows all municipalities along the common border that are included in the sample. Altogether, the sample includes 158 Eastern and 133 Western border municipalities.¹²

As noted above, I focus only on the three Eastern states, i. e. those with a reasonably long border with the West: Mecklenburg-Western Pomerania, Saxony-Anhalt, and Thuringia.¹³ I collect data on local tax rates in these three states from various sources. For Mecklenburg-Western Pomerania, the state statistical office offers an online database that provides data on local tax rates from 1992 onwards. 1992 is the earliest year for which data on local taxation is available as the laws that required the statistical offices to collect information on local taxes were introduced in Mecklenburg-Western Pomerania, as in most other Eastern states, only in 1991. For Thuringia, an online database of the state statistical office provides data from 1995 onwards. For the period 1992-1994, the data was collected by hand from

¹¹See Section A.1 in the Appendix for details on how I handle amalgamations. Municipalities have also changed regional codes due to county boundary reforms, but in these cases the new codes can be easily matched to the old ones.

¹²Of the 158 Eastern municipalities in the sample, some further municipalities are not used in the regressions because they are only contiguous to forest areas (which do not levy any taxes) in the West rather than proper municipalities. Some municipalities are also dropped because of missing values for the tax rates in the original sources.

¹³All five Eastern states have municipalities that border West-Germany. However, the number of border municipalities in Saxony was three and in Brandenburg four in 2000.

print publications of the statistical office. For Saxony-Anhalt, I collected the data on local taxes from 1992 to 2000 from print publications.

Administrative data on local taxation in the four Western states that border the former GDR (Schleswig-Holstein (SH), Lower-Saxony (LS), Hesse (HE), and Bavaria (BAY)) are available in electronic form starting from the early eighties onwards. Depending on the state, this data was either downloaded from online databases or acquired by request from the relevant state statistical office.

5.2 Other data

Geodata on municipal boundaries and location are obtained for the year 2000 from the *Federal Agency for Cartography and Geodesy* (FACG). I also use this data to calculate land area. Data on elevation is from the FACG as well.¹⁴ Data on night light output is from the US Air Force's Defense Meteorological Satellite Program's Operational Linescan System (DMSP-OLS) and is made available to the public by the National Oceanic and Atmospheric Agency' (NOAA).¹⁵ Data on population size was obtained from the state statistical offices.

6 Results

6.1 Graphical evidence

Figure 2 presents descriptive evidence on the correlation between local governments tax rates in Eastern border municipalities and their contiguous Western neighbors' average tax rate in in 1992. For the business tax, a positive relationship between neighbors' and own

¹⁴The actuality of the elevation data varies between states. I assume that the elevation of municipalities has not changed since 1992.

¹⁵Details on this data is available in Henderson et al. (2012).

tax rates can be observed. It is also interesting that already in 1992, there is substantial variation in the tax rates chosen by Eastern border municipalities.

For the property tax B and A, on the other hand, no significant link between the Western neighbors' and own tax rates are observable. There is also much less variation between Eastern municipalities for the property taxes than for the business tax. For the property tax B, most municipalities choose a multiplier of 300. For the property tax A, multipliers bunch at either 200 or 300. In contrast, there is substantial variation in the property tax rate B and A chosen by Western border municipalities.

Overall, this graphical evidence suggests that there was mimicking in local business taxation but no mimicking in property taxation in 1992. However, one concern with this descriptive evidence is endogeneity. In the following, I address this potential endogeneity problem through the IV approach described above.

6.2 Baseline results

Table 1 collects the baseline IV spatial lag regressions as specified in Equation 1 for each of the three taxes in 1992. The structure of the table is as follows. Column (I)-(II) report results with the business tax as dependent variable, Column (III)-(IV) report results with the property tax B as dependent variable, and columns (V)-(VI) report results with the property tax A as dependent variable.

As mentioned, I use as instruments for the average of the Western neighbors' tax rate in 1992 the average of their tax rates in 1989. Standard errors are robust to heteroscedasticity and clustered at the county level. I also control in all models for state or county dummies. It is likely that state-level policies, for example the extent to which certain administrative tasks have been decentralized to the local tier or regulations regarding the local equalization scheme, will lead to between-state variation in local tax rates. Thus, state dummies are important to reduce the variance of the estimates. Accordingly, Columns (I), (III), and

(IV) report models with state fixed effects.¹⁶ In Columns (II), (IV), and (VI), I control for county rather than only state dummies (each state encompasses several counties) to account for possible omitted variables that lead to spatial correlation in local tax rates.

The results suggests that the average local business tax in Western neighbors has a positive effect on Eastern municipalities own business tax rates in 1992. According to Column (I) of Table 1, a one point higher average tax multiplier in neighboring Western municipalities leads Eastern municipalities to choose a 0.3 points higher tax rate. The effect remains in the same ballpark in terms of magnitude and continues to be significant when state dummies are replaced by county dummies (Column II).

In contrast, there is no significant effect of Western neighbors' tax rates for the property tax B on the property tax B rates in Eastern border municipalities (Column III-IV). The magnitude of the coefficients is also very small, which together with the small standard errors suggest that the absence of an effect is not due to imprecise estimates. Similarly, there are no significant interactions for the property tax A.

The Kleibergen-Paap weak identification tests reported at the bottom of Table 1 show that the instrument is strong in all models. The first-stage coefficient estimates, which can be found in Table A.1 in the Appendix, confirm that the Western municipalities' tax rates in 1989 strongly predict their tax rates in 1992.

6.3 Control variables

County dummies may not sufficiently control for omitted variables that influence local tax rates to the West and the East of the common border. In Table 2, therefore, I replicate the baseline regressions after additionally controlling for night light output per capita, average elevation in a municipality, average population size, and land area. To account for

¹⁶Estimates without state dummies are similar in magnitude, but slightly less significant. These results are available from the author. See also the results reported in Table A.3 in the appendix.

outliers, all control variables are log transformed. I also include the control variables as cubic polynomials to account for possible non-linearities.

Controlling for the covariates does not substantially affect the estimates for the business and property taxes. As in the baseline regressions, Eastern local governments seem to set a tax multiplier that is slightly less than 0.3 points higher for each additional point of the average tax multiplier in the West.¹⁷ For the property tax A, the estimates are in the same ballpark as in the baseline regressions and again provide no evidence for tax mimicking. While the estimate for the property tax B is significant when only state fixed effects are included, its magnitude is small. Overall, this evidence continues to suggest that mimicking is unimportant for the property tax B either.

6.4 Long-run effects

In this section, I explore how tax mimicking evolves over time. Do Eastern local governments continue to mimic their Western neighbors' business tax rates several years after reunification? Or alternatively, do they start to mimic property tax rates after a few years, e. g. because they engage in yardstick competition once they have become sufficiently similar to their Western neighbors. To explore such questions, I estimate the spatial lag models discussed in the previous section for each year between 1993 and 2000. For the average tax rate of neighboring Western municipalities, I continue to use their tax rates in 1989 as instruments because they remain a strong first-stage predictor even up to ten years after reunification.¹⁸ All estimated models include county fixed effects.

¹⁷As argued by Altonji et al. (2005), selection on observables can be used to assess the extent of bias due to selection on unobservables. The idea is that if coefficient estimates in models with and without observable control variables are not too different, then unobservable control variables are unlikely to change the estimates either. I implement a variant of this test in Table A.3 in the Appendix for the business tax rate chosen by Eastern municipalities in 1992. This test suggests that the estimate of 0.3 is indeed causal.

¹⁸The first-stage results are available in Table A.2 in the appendix.

For brevity, I summarize the second stage results in a figure. Thus, Figure 3 reports for each of the three taxes the previously discussed spatial lag estimates for 1992 for comparison, and spatial lag estimates for each year between 1993 and 2000.

For the business tax, the results show that already in 1993, tax mimicking is much less pronounced than in 1992: the coefficient drops by about one half to 0.16, but it is still significant. From 1994 onwards, the coefficient oscillates around 0 and is almost never significant. The null effects are also precisely estimated, with the 90% confidence bands typically around -0.25 to 0.15. The only exception is 1998, where the coefficient is negative and significant. That the spatial lag coefficient declines over time indicates once more that it is not unobserved omitted variables that are responsible for the positive coefficient in 1992.

While the coefficient is consistently positive for the property tax B, its magnitude is very small. It oscillates around 0.02 and 0.06. Thus, there is no strong evidence for local tax mimicking with respect to the property tax B even in the long-run. The null effects are also precisely estimated, with the 90% confidence bands reaching from slightly below 0 to slightly above 0.1.

For the property tax A, the coefficient drops from 0.03 in 1992 to -0.13 in 1993, it increases again in 1994 to -0.07 and remains in this ballpark. The coefficients are not as precisely estimated as for the other taxes: the 90% confidence bands are fairly large for this tax rate and range from about -0.4 to 0.25. Nevertheless, the magnitude of the coefficient estimates is relatively small. There is thus no strong evidence for local tax mimicking with respect to the property tax A in the long-run.

6.5 Responses to maximum tax rates in western neighbors

Rather than reacting to the average tax rates in their Western neighbors, Eastern local government may instead react to the maximum tax rate of their Western neighbors. For

example, Eastern municipalities may have wanted to levy high tax rates, but may have been reluctant to set a tax rate higher than those of their adjacent Western neighbors. Thus, we may be more likely to observe mimicking in the long-run when the spatial lag model is specified such that the tax rate in a given Eastern border municipality is assumed to react to the maximum tax rate in neighboring Western municipalities.

I therefore re-estimate the previous models with the change that local governments are assumed to react to the maximum tax rates of their Western neighbors. As instruments for the neighbors' maximum tax rate in a given year, I use the maximum tax rate in 1989. The estimates are collected in Figure 4. All estimated models include county fixed effects. As is clear from both figures, conclusions are not different than in the baseline regressions. There is a significant spatial lag coefficient in 1992 for the business tax, but not for the other taxes. The evidence for spatial interactions in business tax rates is weaker in 1993 and disappears from 1994 onwards. These findings indicate that Eastern municipalities reacted to the maximum tax rates of their Western neighbors in a similar fashion as they reacted to their average tax rates.¹⁹

6.6 Discussion

The previous results indicate that East-German border municipalities set their business tax rates in response to the tax rates of their Western neighbors, but only in the first few years after reunification. In the long-run, mimicking seems to be irrelevant for the business tax. For property taxes, mimicking seems to be irrelevant even in the first post-reunification years.

These results are consistent with the interpretation that East-German municipalities engaged in social learning immediately after reunification to determine business tax rates.

¹⁹I also run regressions relating the tax rate of a given Eastern municipality to the minimum tax rate of its Western neighbors. The results are again not substantially different than the baseline results. They are collected in Figure A.5 in the appendix.

After a few years, however, the relevance of the information from the West became less important and mimicking consequently stopped. Thus, the reliance of policy makers on information provided by neighbors declines over time, presumably because they have acquired sufficient own experience in the new institutional environment.

Other explanations for the observed tax mimicking in 1992, notably tax competition and yardstick competition, seem implausible given the economic differences between East and West after reunification. Also, mimicking because of tax or yardstick competition, if it takes place at all, should have increased over time, but the results suggest the opposite, i. e. mimicking has at best declined over the years. Budget spillovers do not seem to be a reasonable explanation either as it would suggest a negative spatial lag coefficient. However, the coefficient in 1992 is positive, and while it turns negative later on, it is small in magnitude and generally insignificant.

That mimicking does not matter for property taxes, neither immediately nor a few year after reunification, suggests that for these taxes, not only tax and yardstick competition and budget spillovers, but also social learning is unimportant. A plausible explanation is that the information provided by the Western neighbors regarding business taxes was more relevant for Eastern municipalities than the information regarding property taxes. First, setting appropriate business taxes was a more difficult task given the inexperience of Eastern officials with a market economy. Second, business taxes raise around four times as much revenues as the property tax B and more than hundred times as much as the property tax A. Hence, Eastern officials may have found it relatively unimportant to adjust property tax rates. In addition, property taxes hikes are more sensitive politically as their incidence is felt more directly by voters than the incidence of the business tax.²⁰ Indeed, according to Figure 2, most Eastern municipalities seem to have continued to levy the same property tax B and A rates as imposed on them by the GDR central government before reunification.

²⁰The property tax B, for example, has to be paid by all owners of residential properties. In contrast, only a few large firms have to make significant business tax payments.

Overall, these results suggest that tax mimicking, if it takes place, does so for reasons of social learning. More traditional explanations for tax mimicking, notably tax and yardstick competition and budget spillovers, do not seem to be relevant in the East-German context. However, even the importance of social learning seems to be limited. Social learning seems to matter only in contexts where policy makers face severe information constraints, notably if they have to set tax rates for the first time within a new economic system. As time passes and local officials gain enough experience, the importance of social learning declines and tax mimicking consequently become less pronounced. In the long-run, the tax rates chosen by a given municipality are not causally related to tax rates chosen by their neighbors.

6.7 External validity

The previous results are obtained for border municipalities in East-Germany. One criticism that can be leveled regarding these results is that border municipalities may be special. That is, the results obtained for border municipalities may not carry over to other East-German municipalities, and even less to municipalities in West-Germany or other countries.

One way to evaluate whether border municipalities are substantially different than East-German interior municipalities is to observe the level and evolution over time of the tax rates in these two groups. Substantial differences either in the level or in the trend may limit the generalizability of the previous findings. Figure 5 shows that for all taxes, both the level and the trends in tax rates are similar between interior and border municipalities. Thus, it seems that both sets of municipalities are similar with respect to their tax setting behavior.

Second, I report t-tests in Table 3 on the difference in municipal characteristics between Eastern border and interior municipalities in 1992. Note first that consistent with Figure 5, there are no substantial differences in business and property tax B rates of border and interior municipalities. The exception is the property tax A, where the difference in average

tax rates is statistically significant. However, the magnitude of the difference is small. There are also no significant differences in night light output per capita and population size. However, border municipalities seem to have on average a higher elevation and a larger land area. The difference in land area is small in magnitude, however (about four square kilometers).²¹ Nevertheless, these geographical differences are unlikely to limit the generalizability of the estimates.

Overall, Eastern border municipalities do not seem to have been substantially different than interior municipalities in the first few post-reunification years. Consequently, it seems likely that a generic Eastern municipality, too, would have attempted to engage in social learning, at least to the extent that this was possible. For example, it may have attempted to learn from such neighbors that had useful information regarding the optimal tax policy because they had particularly competent officials. More importantly, that Eastern border and interior municipalities are reasonably similar also indicates that tax mimicking would not matter for a generic East-German municipality in the long-run.

The situation faced by East-German municipalities after reunification was unusual. However, municipalities in other Eastern-European countries faced similar challenges as East-German municipalities in the first few years after the demise of communism. Thus, the first set of results in this paper, namely that municipalities learn from neighbors about appropriate tax rates when they face unfamiliar environments, can arguably be generalized to municipalities in Eastern Europe. By the same token, the results would also suggest that West-German municipalities or municipalities in other countries with market economies would engage in social learning when they encounter unexpected developments and unfamiliar situations.

The second finding, i. e. that mimicking is unimportant in the long-run, has also relevance beyond East-German municipalities. As East-Germany completely adopted the

²¹The reason for the difference in average elevation is that several Eastern border municipalities are in the *Harz*, the highest mountain range in Northern Germany.

economic model of the West, it became over time, i.e. after initial difficulties had been overcome, just another market economy. Consequently, the long-run results – that tax mimicking is unimportant – can be generalized to other countries with market economies. Indeed, the long-run results are consistent with previous findings from West-Germany (Baskaran, 2014) as well as countries such as Finland (Lyytikäinen, 2012) and the US (Isen, 2014).

7 Conclusion

This paper exploits the natural experiment of German reunification to study tax mimicking by municipalities in East Germany. I find that tax mimicking matters only in the first two years after reunification and only for the business tax. Thereafter, business tax mimicking by East-German border municipalities ceases. For property taxes, the results suggest no mimicking, neither immediately after reunification nor in later years.

Overall, these results are consistent with the idea that local governments engage in social learning when they face unfamiliar economic environments. After reunification, Eastern municipalities had to choose for the first time local tax rates. Choosing the right business tax rate has seemingly been particularly difficult for Eastern officials given their inexperience with a market-based economy. In this context, mimicking their Western neighbors was a reasonable strategy. Once Eastern officials had gained some experience with the new economic realities, the relevance of social learning and the importance of information from their Western neighbors declined, and mimicking stopped correspondingly. *A fortiori*, these findings also suggest that the other prominent explanations for tax mimicking, notably tax and yardstick competition or budget spillovers, are not relevant in the East-German context.

These results are in line with recent quasi-experimental evidence from Germany and other developed countries. The relevant studies suggest that the importance of tax mimicking may have been overestimated by the traditional empirical literature on local taxation. With more credible identification strategies, the evidence for tax mimicking vanishes, and thus also the evidence for its underlying channels. An exception is the social learning channel, for which I find some evidence in the immediate aftermath of German reunification, but the importance of this channel diminishes over time as well.

While this paper adds one additional piece of evidence regarding the importance of local tax mimicking, the quasi-experimental literature on this question remains small. Further work based on alternative natural experiments is necessary before the evidence can be regarded as conclusive. Second, if mimicking behavior is not an important long-term determinant local tax rates, the question which factors ultimately determine equilibrium tax policies should be raised. Exploring such alternative determinants of local tax policies is another promising avenue for future work.

Acknowledgements

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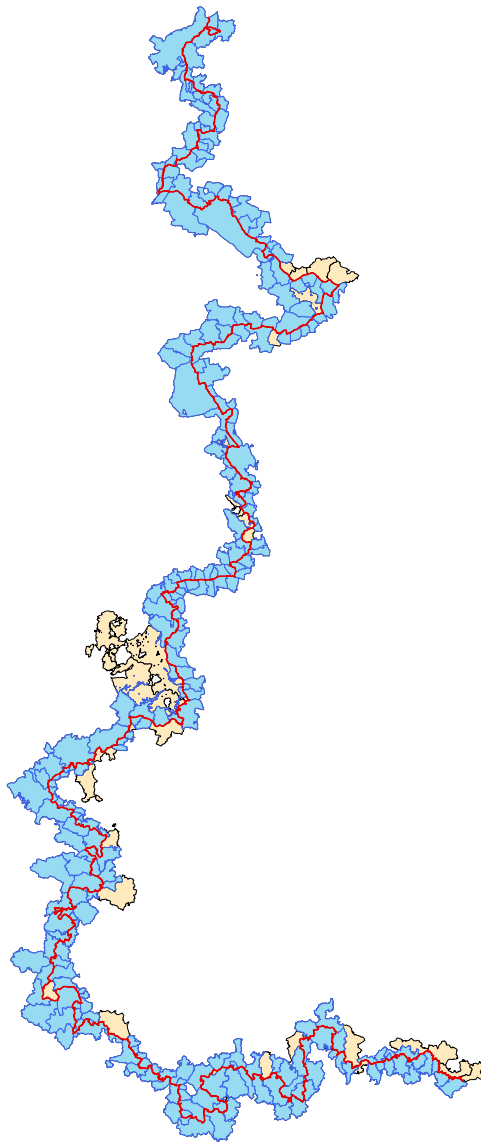
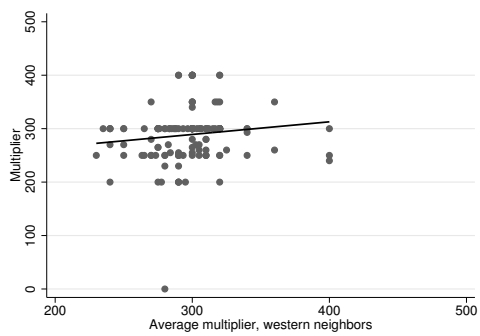
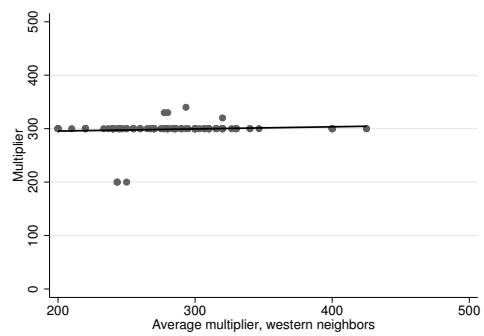


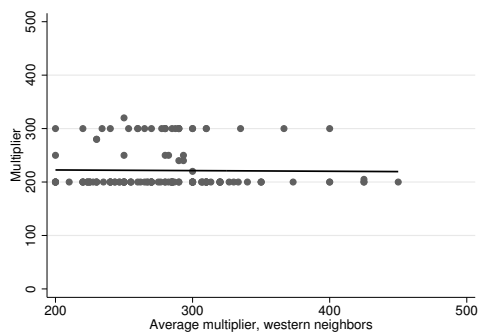
Figure 1: Municipalities in East and West-Germany at the common border. This figure shows the municipalities located to the east and the west of the border between West-Germany and the former GDR. Border municipalities included in the sample are colored in blue, border municipalities that were omitted are colored in yellow. Omitted municipalities are either forest areas or municipalities that changed their regional codes due to amalgamations and therefore cannot be traced over time.



(a) BUSINESS TAX

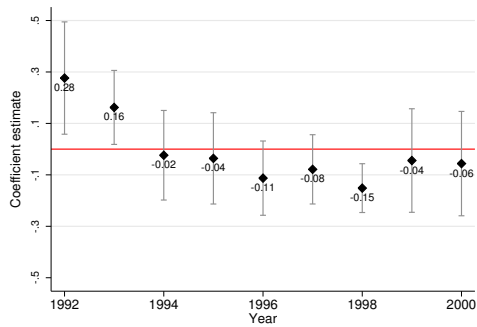


(b) PROPERTY TAX B

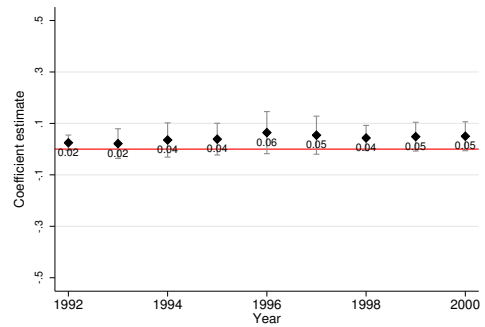


(c) PROPERTY TAX A

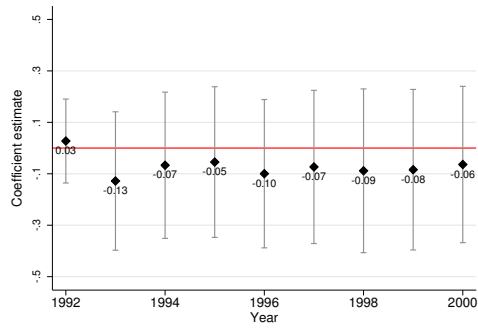
Figure 2: Business and property tax multipliers in East-German border municipalities and average multipliers in Western neighbors, 1992. This figure shows a scatterplot of the business (subfigure a), property tax B (subfigure b), and property tax A (subfigure c) multipliers in East-German border municipalities in 1992 against the average multipliers in West-German border municipalities in 1992. Each figure also includes also a linear fit.



(a) BUSINESS TAX

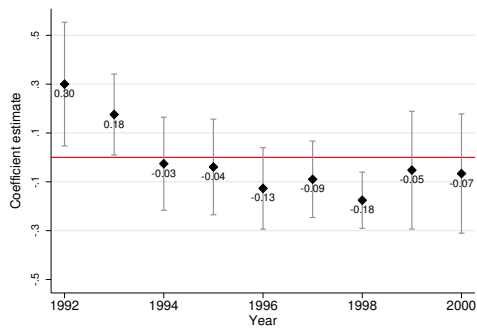


(b) PROPERTY TAX B

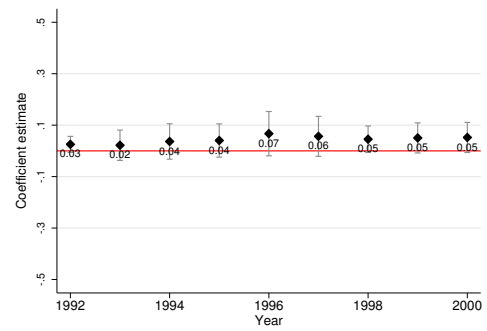


(c) PROPERTY TAX A

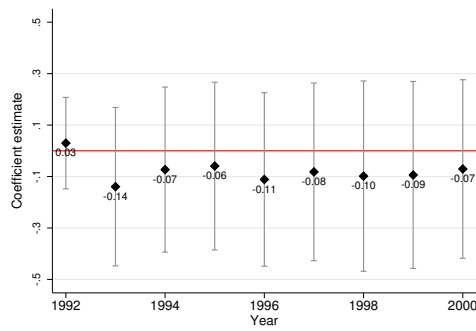
Figure 3: Tax mimicking over time, 1992-2000. This figure shows for each year the coefficient estimates and 90% confidence bands of the tax mimicking coefficient in Equation 1.



(a) BUSINESS TAX

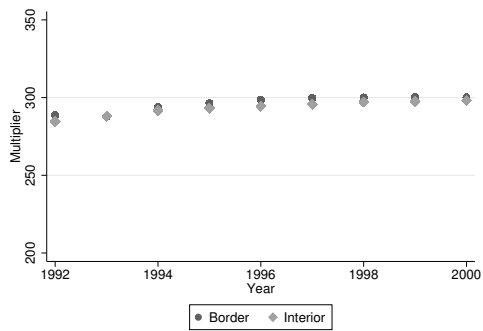


(b) PROPERTY TAX B

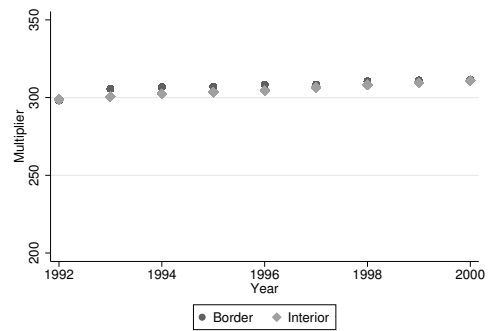


(c) PROPERTY TAX A

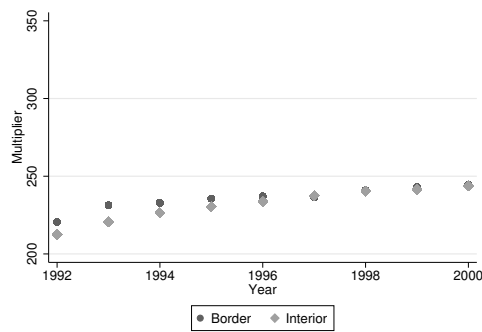
Figure 4: Tax mimicking over time, 1992-2000, maximum tax rates in Western neighbors. This figure shows for each year the coefficient estimates and 90% confidence bands of the tax mimicking coefficient in Equation 1 under the assumption that Eastern municipalities only react the Western with the highest tax rate.



(a) BUSINESS TAX



(b) PROPERTY TAX



(c) PROPERTY TAX

Figure 5: Business and property tax multipliers in border and interior Eastern municipalities, 1992-2000.

Table 1: TAX MIMICKING ALONG THE FORMER EAST- AND WEST-GERMAN BORDER, IV ESTIMATES FOR 1992

	Business tax		Property tax B		Property tax A	
	(I)	(II)	(III)	(IV)	(V)	(VI)
Neighbor tax rate	0.300*** (0.115)	0.276** (0.133)	0.027 (0.021)	0.025 (0.018)	0.013 (0.064)	0.027 (0.099)
FE Dummies	State	County	State	County	State	County
F	6.248	3.576	1.568	1.527	0.036	0.063
Kleibergen-Paap Wald F statistic	656.645	545.010	616.847	392.783	1.1e+04	4508.019
N	139	139	145	145	145	145

Notes Dependent variables: business tax rate (Columns I-II), property tax rate B (Columns III-IV), and property tax rate A (Columns V-VI). Neighbor tax rate denotes the average tax rate in West-German border municipalities that are contiguous to a given East-German border municipality. Standard errors (in parentheses) are heteroscedasticity robust and clustered at the county level. Stars indicate significance levels at 10%(*), 5%** and 1%***).

Table 2: TAX MIMICKING ALONG THE FORMER EAST- AND WEST-GERMAN BORDER, IV ESTIMATES FOR 1992, WITH CONTROL VARIABLES

	Business tax		Property tax B		Property tax A	
	(I)	(II)	(III)	(IV)	(V)	(VI)
Neighbor tax rate	0.288*** (0.110)	0.269* (0.152)	0.030* (0.018)	0.035 (0.023)	0.046 (0.075)	0.072 (0.097)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
FE Dummies	State	County	State	County	State	County
F	23.826	88.734	23.718	233.055	48.904	1.1e+04
Kleibergen-Paap Wald F statistic	758.476	393.950	958.696	466.117	1.0e+04	1633.563
N	136	136	142	142	142	142

^{Notes} Dependent variables: business tax rate (Columns I-II), property tax rate B (Columns III-IV), and property tax rate A (Columns V-VI). Neighbor tax rate denotes the average tax rate in West-German border municipalities that are contiguous to a given East-German border municipality. Standard errors (in parentheses) are heteroscedasticity robust and clustered at the county level. Stars indicate significance levels at 10%(*), 5%(**) and 1%(***). Control variables: cubic polynomial of log night light output per capita, log mean elevation, log population, and log area.

Table 3: DIFFERENCES IN MUNICIPAL CHARACTERISTICS BETWEEN INTERIOR AND BORDER MUNICIPALITIES IN EAST-GERMANY IN 1992

		Interior municipalities	Border municipalities	Difference		
Business tax	Mean	284.657	288.687	-4.030	t-statistic	-0.835
	SD	57.956	50.040		p-value	0.404
	N	2850	150			
Property tax B	Mean	298.670	298.217	0.454	t-statistic	0.327
	SD	16.944	16.660		p-value	0.743
	N	3001	157			
Property tax A	Mean	212.533	220.605	-8.072	t-statistic	-3.039
	Std. Error	32.072	38.950		p-value	0.002
	N	2998	157			
Light output	Mean	0.148	0.131	0.016	t-statistic	1.150
	SD	0.174	0.143		p-value	0.250
	N	2996	154			
Population	Mean	1920.597	1400.533	520.065	t-statistic	0.761
	SD	8448.467	2965.486		p-value	0.446
	N	2998	154			
Area	Mean	17.174	20.964	-3.791	t-statistic	-2.856
	SD	16.261	16.303		p-value	0.004
	N	3007	158			
Elevation	Mean	154.551	252.220	-97.669	t-statistic	-7.947
	SD	147.547	199.907		p-value	0.000
	N	3007	158			

This table compares the characteristics of East-German municipalities located at the border to West-Germany with those of interior municipalities in 1992. The data on elevation is for different years for the various states (elevation is assumed to be constant over time).

A.1 Dealing with amalgamations

One problem for the analysis are amalgamations. One form of amalgamation is a merger which results in a new municipality and a change in regional codes. As I use geodata and regional codes for municipalities as of 2000, I cannot define spatial relationships for these municipalities in the early sample period (in particular, it is difficult to identify Western neighbors of municipalities that were subject to amalgamations).²² However, only few new municipalities were formed during the sample period and the number of municipalities dropped for this reason is small (see Figure 1).

Amalgamations also took the form of annexations of smaller municipalities by some larger municipality. In these cases, the “new” municipality continues with the old regional codes and can therefore be traced over-time. Yet, one difficulty with annexations is that before the annexation (i. e. in the early part of the sample period), the larger partner, whose tax rates are related to the tax rates of Western municipalities, may have not bordered Western municipalities at all or may have had a smaller number of Western neighbors than indicated by the geodata for 2000. Thus, spatial relationships may not be completely accurate in the first few years after reunification.²³ This issue is not a severe problem, however. First, it is only relevant in the early part of the sample period. Second, only few border municipalities were subject to annexations. Third, even if the larger partner is not contiguous to (some) Western municipalities (while after the annexation the “new” municipality is), it is by definition very close. Thus, it is not unreasonable to assume that it is affected by the tax rates of the relevant Western municipalities.

To assess the incidence of amalgamations, Figures A.1, A.2, and A.3 show maps with municipal boundaries in the immediate post-unification period and those in 2000. While

²²Note that the earliest available geodata for all three states is from 1997. Thus, using older geodata does not solve this problem.

²³This issue may also lead to inaccuracies in the control variables that rely on the geodata, notably night light output, land area, and elevation.

I could obtain geodata for boundaries from the State Statistical Office of ST in 1990, only paper maps are available for MV (in 1992) and TH (in 1990). I overlay the old maps with the municipal boundaries as of 2000. Consistent with Figure 1, it is clear that most municipalities were not affected by amalgamations in MV and ST. In TH, a somewhat larger number municipalities merged into larger units, even though there remains a substantial number of municipalities that experienced no changes in boundaries.

As noted, those municipalities where regional codes changed because of the amalgamations have already been dropped from the sample. Yet, those where amalgamations took the form of an annexation are still included. To explore whether the results are robust to omitting these municipalities, I report in Figure A.4 results where all municipalities subject to any type of amalgamation are dropped. The results are in line with the findings in the main text.

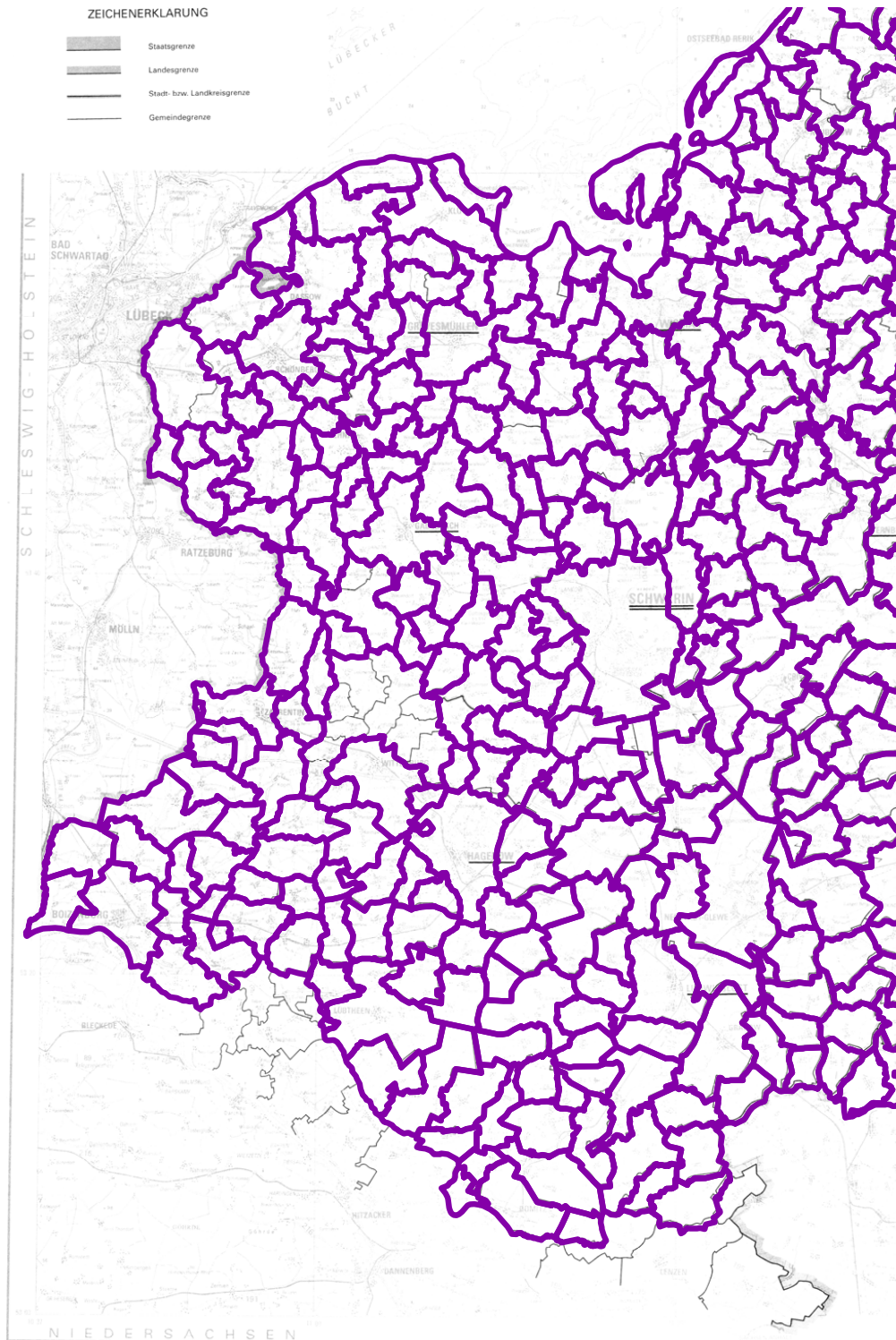


Figure A.1: Municipal boundaries in 1992 (in black) and in 2000 (in purple) in Mecklenburg-Western Pomerania. Municipalities that were subject to amalgamations have black lines inside the municipal boundaries of 2000.

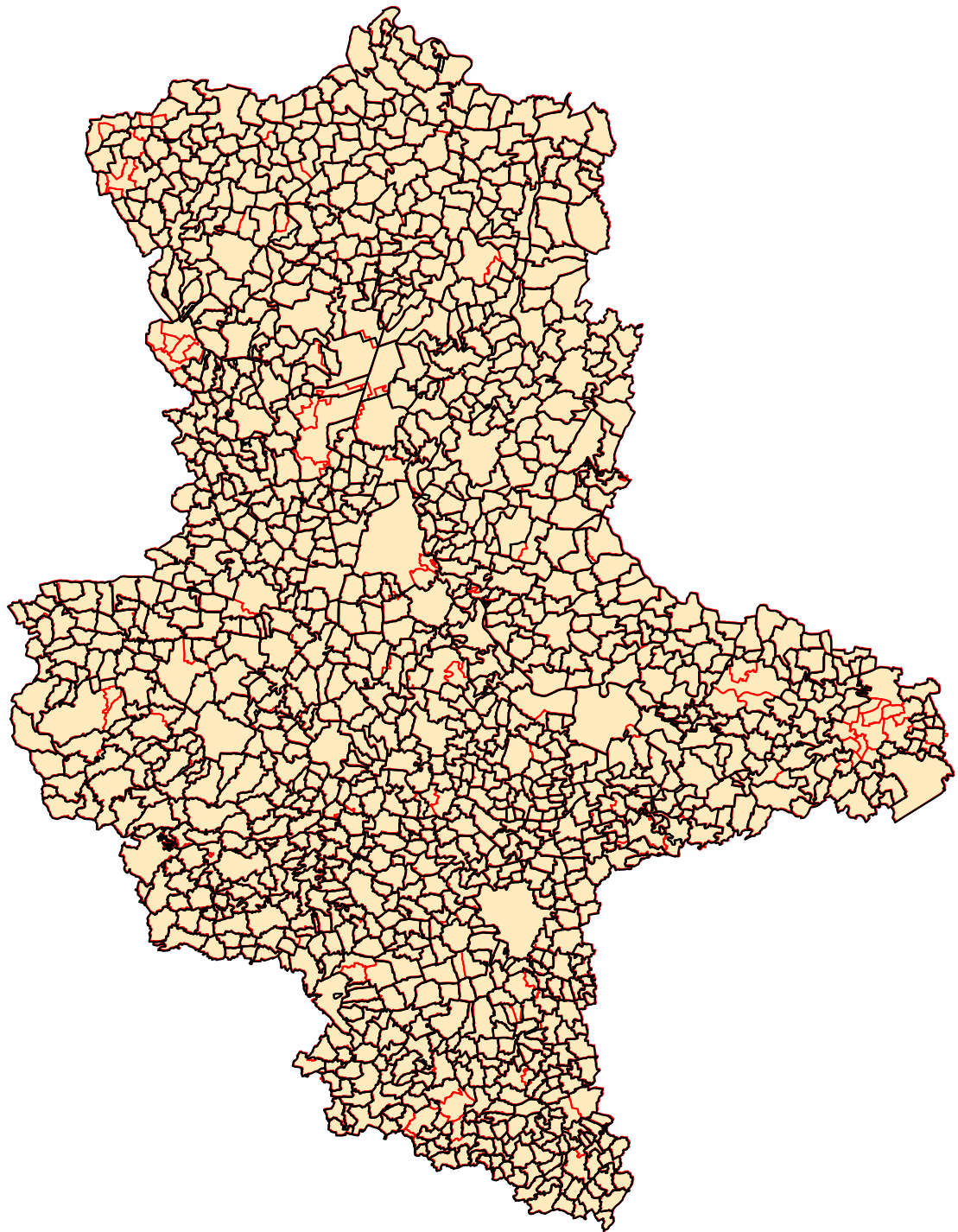


Figure A.2: Municipal boundaries in 1990 (in red) and in 2000 (in black) in Saxony-Anhalt. Municipalities that were subject to amalgamations have red lines inside the municipal boundaries of 2000.

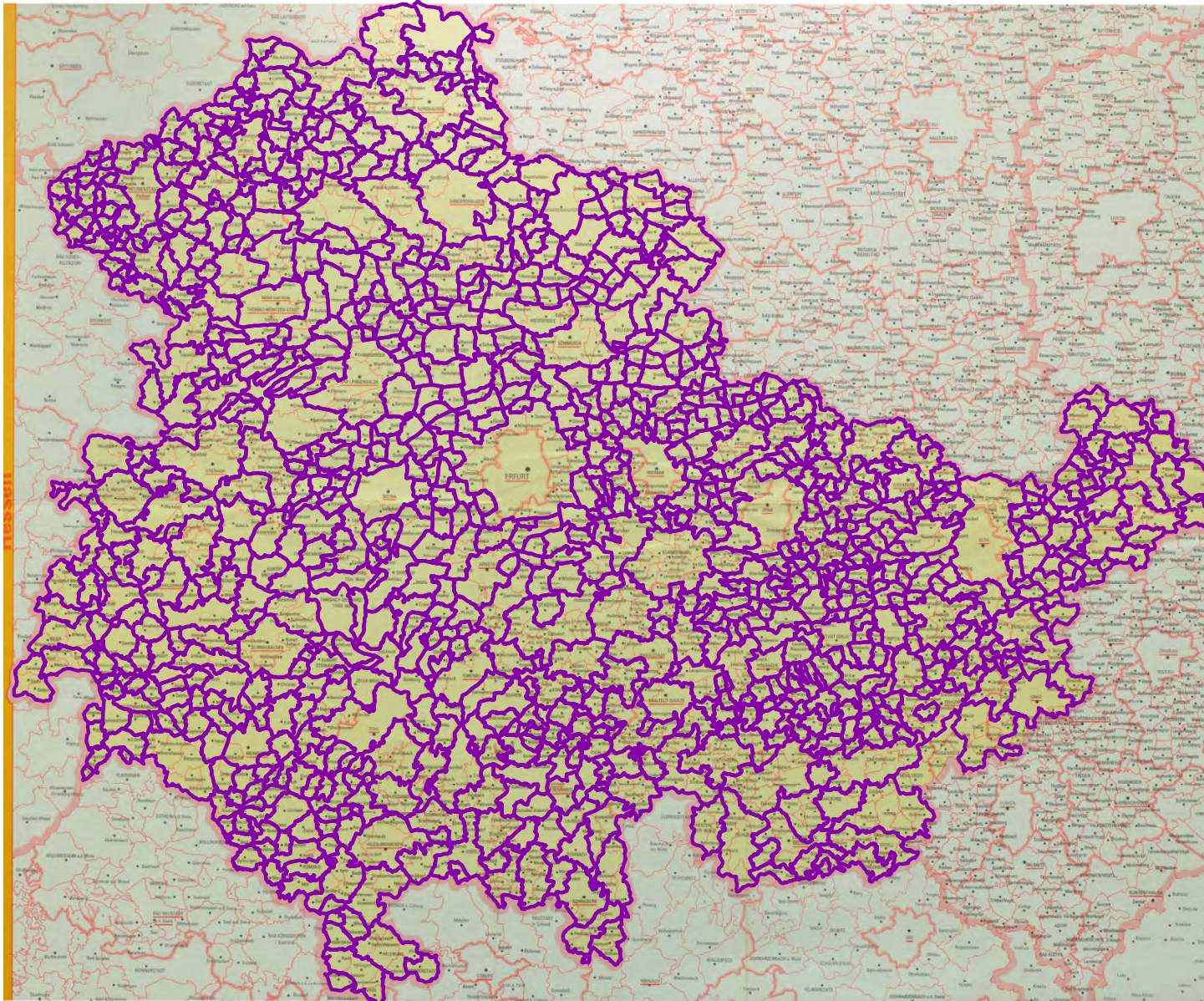
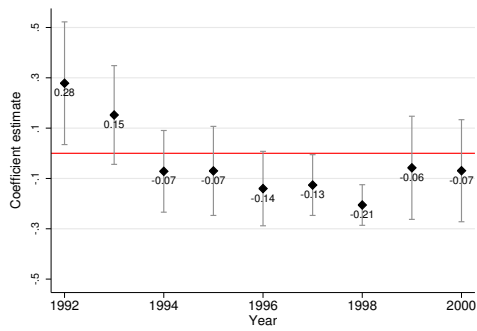
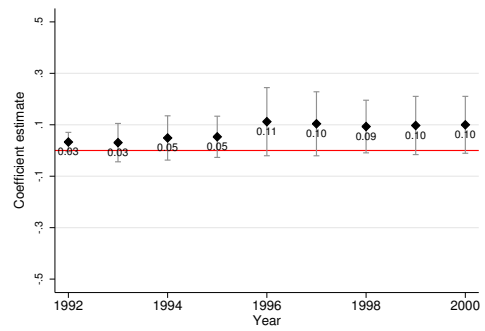


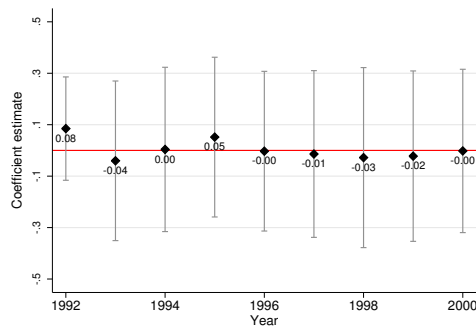
Figure A.3: Municipal boundaries in 1990 (in red) and in 2000 (in purple) in Thuringia. Municipalities that were subject to amalgamations have red lines inside the municipal boundaries of 2000.



(a) BUSINESS TAX



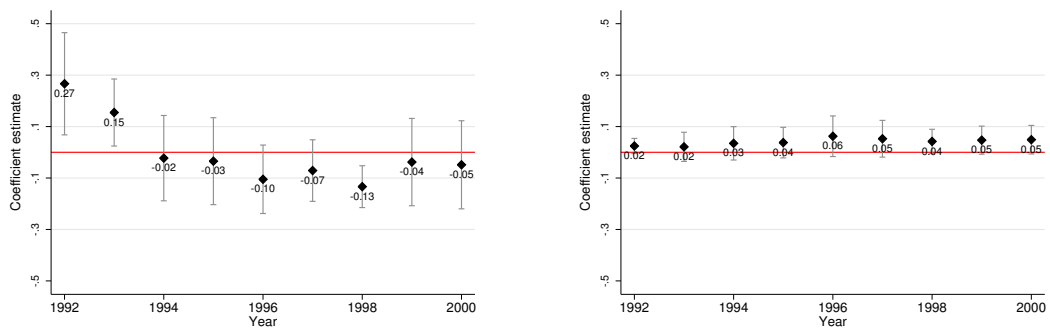
(b) PROPERTY TAX B



(c) PROPERTY TAX A

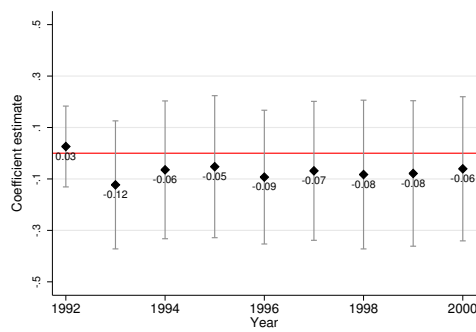
Figure A.4: Tax mimicking over time, 1992-2000, without municipalities subject to amalgamations. This figure shows for each year the coefficient estimates of the tax mimicking coefficient in Equation 1 after dropping all municipalities that were subject to amalgamations during the sample period. The sample shrinks by 34 municipalities for this reason.

A.2 Additional results



(a) BUSINESS TAX

(b) PROPERTY TAX B



(c) PROPERTY TAX A

Figure A.5: Tax mimicking over time, 1992-2000, minimum tax rates in Western neighbors. This figure shows for each year the coefficient estimates of the tax mimicking coefficient in Equation 1 under the assumption that Eastern municipalities only react their Western neighbor with the minimum tax rate.

Table A.1: TAX MIMICKING ALONG THE FORMER EAST- AND WEST-GERMAN BORDER, IV ESTIMATES FOR 1992, FIRST-STAGE RESULTS

	Business tax		Property tax B		Property tax A	
	(I)	(II)	(III)	(IV)	(V)	(VI)
Without control variables						
Neighbor tax rate, 1989	0.917*** (0.036)	0.910*** (0.039)	1.014*** (0.041)	1.020*** (0.051)	0.977*** (0.009)	0.978*** (0.015)
With control variables						
Neighbor tax rate, 1989	0.910*** (0.033)	0.906*** (0.046)	1.009*** (0.033)	1.009*** (0.047)	0.976*** (0.010)	0.971*** (0.024)

Notes This table collects the first-stage results for the estimates reported in Table 1 and Table 2. Dependent variables: Average of neighbors' business tax rate (Columns I-II), property tax rate B (Columns III-IV), and property tax rate A (Columns V-VI) in 1992. Neighbor tax rate 1989 denotes the average tax rate in West-German border municipalities that are contiguous to a given East-German border municipality in 1989. Standard errors (in parentheses) are heteroscedasticity robust and clustered at the county level. Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).

Table A.2: TAX MIMICKING ALONG THE FORMER EAST- AND WEST-GERMAN BORDER, FIRST-STAGE RESULTS OF IV ESTIMATES FOR 1992-2000

	1992	1992	1994	1995	1996	1997	1998	1999	2000
Business tax									
Neighbor tax rate, 1989	0.910*** (0.039)	0.942*** (0.039)	0.866*** (0.074)	0.757*** (0.104)	0.726*** (0.120)	0.793*** (0.184)	0.719*** (0.219)	0.707*** (0.225)	0.657** (0.250)
Kleibergen-Paap Wald F statistic	545.010	594.836	137.300	53.481	36.471	18.592	10.767	9.825	6.912
Property tax B									
Neighbor tax rate, 1989	1.020*** (0.051)	1.014*** (0.054)	0.948*** (0.082)	0.937*** (0.080)	0.989*** (0.129)	0.976*** (0.129)	0.958*** (0.134)	0.938*** (0.136)	0.943*** (0.135)
Kleibergen-Paap Wald F statistic	392.783	357.861	132.699	136.229	59.009	56.987	51.358	47.261	48.462
Property tax A									
Neighbor tax rate, 1989	0.978*** (0.015)	0.956*** (0.018)	0.825*** (0.117)	0.801*** (0.117)	0.811*** (0.116)	0.798*** (0.117)	0.783*** (0.115)	0.759*** (0.118)	0.750*** (0.090)
Kleibergen-Paap Wald F statistic	4508.019	2731.538	49.698	46.867	49.032	46.636	46.396	41.494	68.988

Notes This table collects the first-stage results and Kleibergen-Paap Wald F statistics for the estimates reported in Figure 3. Dependent variables: Average of neighbors' business tax rate (subfigure a), property tax rate B (subfigure b), and property tax rate A (subfigure c) in 1992-2000. Neighbor tax rate 1989 denotes the average tax rate in West-German border municipalities that are contiguous to a given East-German border municipality in 1989. Standard errors (in parentheses) are heteroscedasticity robust and clustered at the county level. Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).

Table A.3: POSSIBLE BIAS REGARDING BUSINESS TAX MIM-ICKING DUE TO SELECTION ON UNOBSERVABLES

	(I)	(II)	(III)	(IV)
β_f	0.269			
β_r		0.253	0.309	0.273
$\frac{\beta^f}{\beta^r - \beta^f}$		-17.839	6.661	59.609
Fixed effects	County	None	State	County
Control variables	Yes	No	No	No

Notes This tables collect results from a test to evaluate the size of bias due to selection on unobservables. This test is based on the insight by Altonji et al. (2005) that the extent of bias due to selection on unobservables can be assessed by exploring changes in coefficient estimates due to selection on observables. Following Nunn and Wantchekon (2011), I perform this test by calculating the ratio between β^f , i. e. the estimate of the spatial lag coefficient with the full set of co-variates (county dummies and cubic polynomials of night light output per capita, average elevation, population size, and area), and $\beta^r - \beta^f$, where β^r is the coefficient estimate with a restricted set of covariates (the variables included in each model are indicated by the rows at the bottom of the table). The ratio $\frac{\beta^f}{\beta^r - \beta^f}$ indicates how much more of the treatment effect would have to be explained by unobserved variables than by the observed covariates for the effect to be spurious. Negative values for this ratio imply that the effect with observable covariates is even larger than without covariates. The results suggest that the importance of unobserved variables must be at least six times larger than those of observed covariates.