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Constrained Tax Competition – Empirical Effects of the Minimum Tax Rate on the Tax Rate Distribution

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Constrained Tax Competition – Empirical Effects of the Minimum Tax Rate on the Tax Rate Distribution

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Abstract:

The paper explores the effect of a minimum tax rate on the tax policy of jurisdictions competing for investment and business location. The testing ground is the universe of local municipalities in the German federation which enjoy the autonomy to set the tax-rate of the local business tax. After experiencing problems with profit-shifting between jurisdictions, in 2004 a federal reform forced municipalities to charge a minimum tax rate on local business profits. As a consequence, low-tax municipalities, i.e. municipalities with tax rates below the minimum, had to adjust their tax policy. In the light of the theoretical literature on minimum tax rates in tax competition, we explore whether the reform has altered the tax-rate distribution beyond the effect on low-tax jurisdictions. More specifically, we test whether municipalities with tax rates above the minimum rate have reviewed their tax policy and decided to set higher tax rates. The empirical results point to significant effects in this regard. We show that the distribution has become more compressed in the bottom part after the reform. Moreover, our results provide quasi-experimental evidence on tax-competition effects in the sense that jurisdictions competing with low-tax jurisdictions have responded with setting higher tax-rates.

Keywords: Tax competition; Minimum tax rate; Local business taxation; Yardstick competition

JEL classification: H71, H23, H25

1 Introduction

Over the last decades a large literature in public economics has been concerned with income taxation under conditions of factor mobility. The theoretical literature has emphasized that if the set of available tax instruments is limited, and if governments act non-cooperatively, an inefficient tax competition equilibrium emerges. Local income tax decisions exert mobility effects and, as a consequence, the cost of raising funds for the individual government are higher than in a cooperative setting, where governments coordinate taxation (for an overview of the large theoretical literature see the surveys by Wilson and Wildasin (2004) or Wilson (1999)). But the literature has also emphasized that governments are often not able to commit to a cooperative solution (for a recent survey see Keen and Konrad (2014)). Therefore, the literature has considered various institutions that may help to establish a cooperative solution.

In a setting with an upper-level government or with supra-national institutions, harmonization of tax policy is one possible option (*e.g.*, Sinn (1990), Razin and Sadka (1991)). With heterogeneous jurisdictions, however, harmonization may be difficult to establish since not all governments will equally benefit – some governments might even be harmed (Kanbur and Keen, 1993). Another institutional type of coordination that has received much attention in the theoretical literature is a minimum tax rate (see Konrad (2009), Kiss (2012), and Keen and Konrad (2014)). Given tax policy interdependence the minimum tax is not just a truncation of the tax-rate distribution but may exert effects on the tax policy of jurisdictions which have set their tax rate above the minimum rate. As a minimum tax rate defines a floor to the tax competition game it is not binding in the sense that in the initial equilibrium all jurisdictions set higher tax rates (Konrad (2009)).

In practice, however, minimum tax rates have mainly been applied to sales taxes. This includes general sales taxes as the value-added tax in Europe as well as specific sales taxes such as the minimum tax on diesel fuels. Although governments are increasingly aware of international corporate tax competition as a problem, cooperation is limited. Measures in specific areas are discussed in order to combat what is

referred to as harmful tax competition (see OECD (1998), Devereux et al. (2007) and the more recent BEPS report). However, minimum tax rates in corporate income taxation or other income taxes are largely absent.

Against this background, this paper takes advantage of a recent reform of business taxation in the German federation, where a minimum tax rate has been implemented as an instrument to limit tax competition among lower level governments. An interesting feature of the German federation is that the more than 10,000 municipalities experience autonomy in setting the local business tax rate. As the same (federal) tax law holds for all municipalities and since tax administration is done by the state governments, tax competition between German municipalities focuses on the choice of the business tax rate. The tax-rate distribution shows marked variation (see Buettner and von Schwerin (2015)). Yet after experiencing problems with profit-shifting between municipalities, in 2004 municipalities were forced by a reform of the federal tax law to charge a minimum tax rate on local businesses. As a consequence, municipalities with tax rates below the minimum including those that had zero tax rates imposed, had to adjust their tax policy. In the light of the theoretical literature, the reform may have altered the tax-rate distribution also through *secondary* effects, as municipalities with tax rates above the minimum rate might have reviewed their tax policy.

Our paper thus exploits a reform to consider the effects of the minimum tax-rate on tax policy. More specifically, we provide quasi-experimental evidence for the interdependence in municipalities' tax-policy decisions, which allows us to predict the effects of the minimum tax-rate on the equilibrium tax-rate distribution.

Our paper follows the literature on empirical tax competition which has explored tax policy at the sub-national level under various institutions. This includes fiscal equalization (e.g., Egger and Koethenbueger (2010), Buettner (2006), Baskaran (2014), Holzmann and von Schwerin (2015)), co-occupation of a tax base by different tiers of government (e.g., Esteller-More and Sole-Olle (2001)), and formula

apportionment (e.g., Buettner et al. (2011)). To the best of our knowledge, minimum tax rates have so far not been under empirical test.

Our results show that the minimum rate tax rate has significant effects on the tax-rate distribution. Not only are some jurisdictions required to adjust their tax-rates, but competing jurisdictions are found to respond as well and to raise their tax rates. We measure competition along several dimensions. First, we consider how municipalities with a tax rate above, but close to the minimum rate did react to the reform and in what way. Moreover, we explore whether tax competition effects are found with regard to neighboring jurisdictions defined in various ways, including geographic proximity, employment structure and size.

The rest of this paper is structured as follows. Section 2 gives an overview of the relevant institutions and provides a short summary of the federal reforms between 2002 and 2004. We then turn to the data in section 4, before we test distributional and spatial effects of the minimum rate. Section 5 concludes.

2 Institutional Background

The local business tax contributes substantially to the revenues of German municipalities. Its aggregate revenue in 2005 around the introduction of the minimum tax rate amounts to approx. 17% of total revenues.¹ Since the tax law is the same for all jurisdictions and since tax administration is done by the state governments, autonomy in business taxation is confined to the choice of the statutory tax rate.² To define the statutory tax rate the local government of municipality i chooses a multiplier m_i , which is applied to a uniform base rate. Formally, the statutory local business tax rate, τ_i^{stat} , is:

$$\tau_i^{stat} = b * m_i, \tag{1}$$

¹ Source: figure is based on net revenue in 2005 for all German municipalities. Source: Federal Ministry of Finance (online), *Eckdaten zur Entwicklung und Struktur der Kommunal финанzen 2005 bis 2014*, September 2015.

² Local discretion is also enjoyed with regard to the land tax, which constitutes another part of local tax revenue, albeit with a significantly smaller revenue share of 7% t in 2005.

Table 1: Measures of Location for the Business Tax-Rate Distribution

Year	Munic.	Observations	Mean	Median	Min	Max	P1	P99
1998	14,308	10,876	322.7	320	0	900	235	420
1999	14,197	11,098	322.7	320	0	900	225	420
2000	13,854	11,099	323.8	320	0	900	225	420
2001	13,837	11,099	325.8	327	0	900	240	420
2002	13,416	11,069	327.2	330	0	900	245	428
2003	13,148	10,991	329.2	330	0	900	250	430
2004	12,629	11,036	330.7	330	200	900	250	430
2005	12,430	11,051	332.7	330	200	900	250	435
2006	12,340	11,057	333.8	330	200	900	250	435
2007	12,312	11,073	334.4	330	200	900	250	440
2008	12,263	11,080	335.1	330	200	900	250	440

Table 1: Summary statistics of local business tax multipliers of all German municipalities 1998-2008. Some municipalities did not adjust tax multiplier in 2004. By federal law, in these municipalities a multiplier of 200 was applied. Source: German Statistical Bureau, *Hebesätze der Realsteuern*. Own calculations.

where m_i stands for the local tax multiplier, and b denotes the base rate, which is set by the federal government. Table 1 shows the development of business tax multipliers from 1998-2012 for all German municipalities.³

In 2005, the median multiplier was at 330 percentage points, which (using the federal base rate of 5.0%⁴) constitutes a median statutory business tax rate of 16.5%. The distribution then lies within the following range: 98% of municipalities in 2005 choose a multiplier between 250 and 435, which produces a tax rate differential of over 9% (from 12.5% to just over 21.5%).

Since the local business tax rate is a key indicator for private investment and firm locations (Egger et al., 2013), the choice of the local business rate is an important instrument for raising the attractiveness of a municipalities for investment. It is therefore not surprising that the tax rate distribution shows a clear east-west divide, where municipalities in Eastern Germany tend to set much lower rates. Table 2 reports

³ The local business tax is a major part of the total effective tax rate for corporations. Formally, up to 2008 the latter is defined as

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

where base rate b is equal to 5% and t_c is the firm's effective federal corporate income tax rate on retained earnings. In 2004 t_c is 26.4% (25% corporate tax rate plus solidarity surcharge (5.5% on top)).

⁴ Before 2008, 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.

Table 2: Measures of Location: East and West

Year	Western States							New States						
	Obs.	Mean	P1	P10	P50	P90	P99	Obs.	Mean	P1	P10	P50	P90	P99
1998	8,436	327.0	250	300	320	360	430	2,441	307.6	200	250	300	365	400
1999	8,436	327.7	250	300	325	360	430	2,664	307.0	200	250	300	370	400
2000	8,436	328.9	260	300	330	360	430	2,665	307.8	200	250	300	370	400
2001	8,436	330.9	260	300	330	360	430	2,665	309.6	200	250	300	373	400
2002	8,436	332.4	270	300	330	365	430	2,635	310.4	200	250	300	375	400
2003	8,436	334.5	275	300	330	370	440	2,557	311.5	200	250	300	380	400
2004	8,436	336.3	275	300	330	370	440	2,602	312.6	200	250	300	380	405
2005	8,436	338.4	280	300	335	370	440	2,617	314.1	200	250	300	380	410
2006	8,436	339.5	280	300	340	375	440	2,623	315.5	200	270	300	380	410
2007	8,436	339.9	280	300	340	375	440	2,639	316.8	200	275	300	380	410
2008	8,436	340.6	280	300	340	380	440	2,646	317.3	200	275	300	380	419

Table 2: Summary statistics of local business tax multipliers of all German municipalities 1998-2008. Sample split by states. New states are: Mecklenburg-West Pomerania, Brandenburg, Saxony-Anhalt, Saxony, Thuringia and Berlin. Western states are the rest of Germany. Source: German Statistical Bureau, *Hebesätze der Realsteuern*. Own calculations.

the distribution for west and east, separately. Accordingly, the local business tax rates tends to be higher in the west than in the east. An interesting difference is observed with regard to the shape of the tax-rate distributions. While in the West, the 10% (1%)-percentile is at 300 (260) percentage points in 2002, it is at 250 (200) in the East. This indicates that a low-tax strategy is more prevalent among municipalities in the east.

In 2003 a tax reform was enacted,⁵ that included various steps to close loopholes within the tax code. This package provided an implicit minimum tax rate to address so-called tax havens within Germany. This reflected public concern that individual municipalities with extremely low business tax rates offer interesting tax planning opportunities within Germany. Box 1 focuses on the debate around a small village in the northern part of Germany which became popular through this debate. The relevant passage in the law essentially states that if a company has a branch or subsidiary in a municipality with a multiplier below 200% the resulting savings in taxes would not be granted.⁶ This can be seen as the introduction of a minimum tax rate “through the backdoor”, as most of the business done within the low tax mu-

⁵ The *Steuervergünstigungsabbaugesetz* (law to abate tax exemptions) was officially decided on the 16. 03. 2003, Bundesgesetzblatt 2003 Teil I Nr. 19, 20.05.2003.

⁶ The important changes are: Artikel 1, Änderungen des Einkommensteuergesetzes 2002 (§35 Abs. 1), Absatz (5); Artikel 4, Änderungen des Gewerbesteuergesetzes 2002 (§8a), Absatz (2).

municipalities took place through branches and subsidiaries.⁷ A further decision later in the same year⁸ went a step further and introduced a uniform minimum wage for all municipalities. Article 2(5) of the tax law was amended to state that the tax multiplier is 200 percentage points, if not set higher by the municipality. While most of the affected municipalities complied with the new rules, two municipalities in Brandenburg actually initiated a lawsuit which went on, until on 27.01.2010 the *Bundesverfassungsgericht* (federal constitutional court) ruled that the reform had been lawful and would not mean a conflict with the constitution and the tax autonomy of municipalities in Germany. Since then, no further changes to the minimum tax multiplier of 200 percentage points have been made.

⁷ Source: IWW Institut für Wissen und Wirtschaft (iww.de, viewed 30.01.2016): *Die Änderungen durch das Steuervergünstigungsabbaugesetz*, Hans Günter Christoffel, Gestaltende Steuerberatung 05/2003.

⁸ *Gesetz zur Änderung des Gewerbesteuergesetzes und andere Gesetze* ("law to change the local business tax law and other laws") The law was officially passed on the 23. 12. 2003, Bundesgesetzblatt 2003 Teil I Nr. 66, 29.12.2003.

Box 1: A German Village as Tax Haven^a

Norderfriedrichskoog is a small village at the shore of the North Sea, some 200 kilometers north of Hamburg. Despite the fact that it consisted of less than 20 houses and hosts no more than 50 inhabitants in 2003, it gained widespread recognition as a (local business) tax haven for foreign and domestic enterprises. Since 1978 the local business tax rate was officially set to zero, but it took until the early 1990s for firms to realize the tax planning potential that could be realized here.

First, some real estate firms and smaller financial service providers opened up branches to make use of a loophole in the German tax code. With a subsidiary here, profits could be re-routed and would not be subject to the local business tax, which elsewhere would amount to 12%-20% of profits. When a few years later major corporations like Lufthansa, Deutsche Bank, Unilever or E.ON followed the example and established local subsidiaries, the German Federal Court of Auditors (*Bundesrechnungshof*) investigated the matter and criticized the massive loss of tax revenue. *Norderfriedrichskoog* was in the spotlight, which - at first - only increased the attraction of firms. Maintenance of the minimal local infrastructure (two streets and the fire brigade) produced almost zero cost, which is why *Norderfriedrich-*



Picture 1: The mayor of *Norderfriedrichskoog* next to company nameplates.

skoog could easily pass on the tax revenue and profit instead from the other side effects of the boom. Farmers could sublet houses and barns for companies, others opened up office management companies to provide for the up to 500 foreign firms. Also the surrounding municipalities' economy could benefit from the increased demand for hotels and restaurants.

However, with the changes in federal legislation in 2003 onwards (see section 2), *Norderfriedrichskoog* was ultimately forced to impose the minimum local business tax multiplier (200 percentage points) in 2004. As expected, this strongly reduced the number of firms and put a sudden stop to the upswing of the previous years. On the other hand however, it produced immense tax revenue from the remaining firms. At times, an estimated 1 million Euro per inhabitant (over 40 million Euro in total) accrued in annual business tax revenue. What seems like a blessing, actually created a major problem. As states and counties operate capacious systems of revenue-sharing, *Norderfriedrichskoog* now had to hand over most of the tax revenue as intergovernmental payments. As these payments are capacity-based, they were projected to exceed the actual revenue in 2012, which would have created losses in the local budget. In 2011 the municipality therefore increased the tax multiplier to 310 which is the reference rate used to calculate the fiscal capacity. Since then, *Norderfriedrichskoog* has a tax rate which is somewhere around the state average.

^a Sources:

Deutsche Welle (dw.com, viewed 30.01.2016): *Is the Party Over for Germany's Little Monaco?*, 9.11.2003.

Die Welt (welt.de, viewed 30.01.2016): *Steuern sparen zwischen Kühen und Deich*, 15.05.2008.

Hamburger Abendblatt (abendblatt.de, viewed 30.01.2016): *Nordfriesisches Steuerparadies vor der Pleite*, 30.06.2011.

3 Data and Descriptive Analysis

The empirical analysis utilizes the business tax-rate multiplier for all German municipalities for the years from 1998 to 2008. Note that the business tax rate is set only on a year-to-year basis. The data is publicly available from the German Statistical Offices (*Hebesätze der Realsteuern*). However, for several reasons, our dataset is restricted to municipalities which still existed in 2013. Since some of new states in the East showed ongoing efforts to reform the administrative structure, this approach excludes some municipalities.

The introduction of a minimum tax rate has potentially multiple effects on the tax rate distribution. As has been described in section 2, the minimum rate requirement actually became effective in 2004. However, there were indications for such a measure already before that year, particularly in 2003. Also, after 2004, some of the affected municipalities filed a lawsuit and refused to adjust local policy during its course.⁹ Figure 1 shows two relevant developments over time. The left panel gives the absolute number of municipalities with a tax multiplier below 200. One can see that the number changes over time. Clearly, in 2003 and later years, we observe less municipalities with a tax multiplier of 200. We also see that after 2004 there are some resistant municipalities, which do not formally adjust their tax policy to comply with the new institutions (but are effectively forced to do so).

After the reform, interestingly, we do not find that the minimum tax rate is chosen by many jurisdictions. Actually, the panel on the right hand side of Figure 1 shows that there is only a temporary peak at a rate of 200 in 2004. Afterwards there is trend away from the minimum tax rate. As can already seen in table 2, in the *New States* there is some upward movement at the lower end of the distribution after 2005.

⁹ Note that even though the data has them on file with a sub-200 tax rate, they actually were forced to charge the minimum rate since 2004.

Figure 1: Municipalities with a Tax rate below and equal to the Minimum Rate (1998-2012)

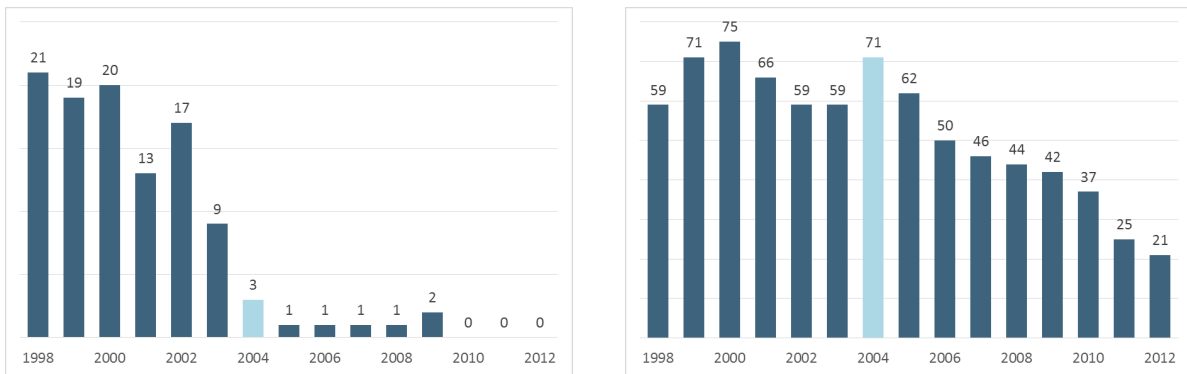


Figure 1: Left Panel: Number of municipalities with a local business tax multiplier below 200. Right Panel: Number of municipalities with a local business tax multiplier at 200. Reform year 2004 colored in light blue. 1998-2012. Source: Own calculations.

4 Empirical Analysis

4.1 Differential Trends along the Tax-Rate Distribution

As we have noted above, the introduction of the minimum tax rate has primary effects on municipalities with tax-rate below the minimum tax rate, which are forced to alter their tax policy. It may also have secondary effects on other municipalities tax policies if the tax-competition equilibrium is changed. To explore the secondary effects on the distribution, we start with an analysis of the impact of the reform on the lower end of the tax rate distribution. Since the tax rate distribution differs substantially, we split the sample into *Western States* and *New States*. As the general level of local business tax multipliers in the western states is higher (some 30 percentage points in the median) the distributional effects are perhaps stronger in the new states. One indication, as mentioned earlier, is the fact that the 10%-percentile of the tax rate distribution has shifted from 250 to 275 after 2005. In the western states, it has remained unchanged at 300.

Figure 2 shows density plots of the lowest 10% in terms of the respective tax rate. For both graphs, the light blue line represents the pre-reform distribution of the 10%-percentile, while the dark blue line represents the situation in 2007. The distribution in the west is monotonous with a maximum density at

Figure 2: Kernel Densities of the 10%-Percentiles

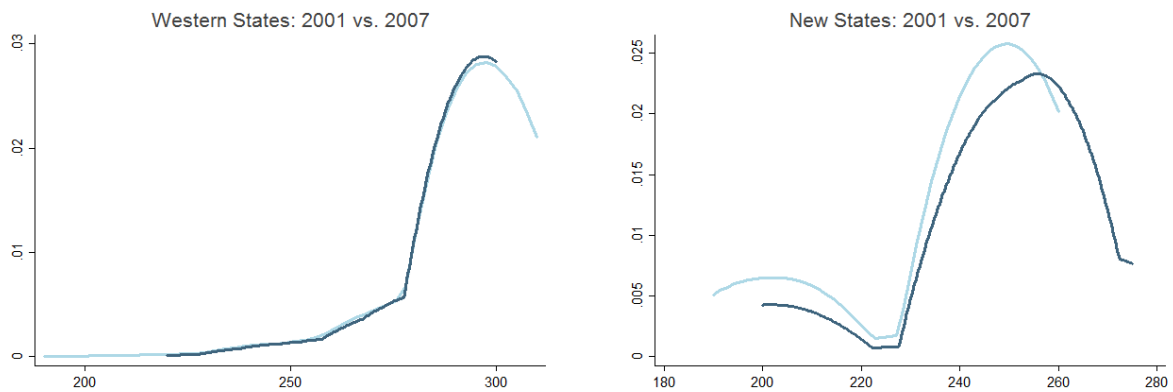


Figure 2: Left Panel: kernel density plot of the 10%-percentile of the tax multiplier distribution in the western states. The light blue line shows the year 2001 (cut-off value 300), the dark blue line shows the year 2007 (cut-off value 300). Right Panel: kernel density plot of the 10%-percentile of the tax multiplier distribution in the new states. The light blue line shows the year 2001 (cut-off value 250), the dark blue line shows the year 2007 (cut-off value 275). Source: Own calculations.

300. The distribution in the east shows a peak at a lower level and, in addition, a local maximum around 200. This suggests that “tax-havens” in the pre-reform distribution are mostly located in the East. With regard to the reform, in the western states no effect is visible. A shift of the low tax municipalities can be seen in the new states. This results in a compression of the lower half of the tax-rate distribution. This is consistent with table 2, which shows that in the western states, the median has moved away from the 10%-percentile and in the new states, the 10%-Percentile has moved towards the median. Interestingly, however, after the reform, there is no bunching at the minimum rate of 200. Rather, jurisdictions seem to have given up a low-tax strategy and, consequently, the distribution has shifted to higher tax rates.

To obtain more precise measures of the effects, we utilize regression analysis. More specifically, we use regressions that include a dummy variable which indicates whether the municipality had chosen a tax rate in the 10%-percentile before the reform (2002) - excluding municipalities with tax-rates below the

minimum rate.

$$m_{it} = \alpha_i + \gamma_t + u_{it} \quad t = 2001, \dots, 2007 \quad (2)$$

$$m_{it} = \alpha_i + \beta_1 (d_{(t \geq 2004)} * low_{10}^{2002}) + \gamma_t + u_{it} \quad t = 2001, \dots, 2007 \quad (3)$$

$$m_{it} = \alpha_i + \beta_1 (d_{(t=2002 \dots 2007)} * low_{10}^{2002}) + \gamma_t + u_{it} \quad t = 2001, \dots, 2007 \quad (4)$$

We combine this indicator with two kinds of treatment dummies. In equations (2) and (3), the interaction term is one in 2004 and beyond (otherwise zero), and in equation (4) we use a fully flexible specification, where the treatment effect is measured for each year separately. All estimations are run for the split samples of western states and new states.

Table 3 has the results. They show that in both samples, municipalities with tax rate in the 10% percentile display significant trends towards higher tax rates. As of 2007, the municipalities in the part of the tax-rate distribution have increased their tax rate by 17 points more than other municipalities in the East. In the western part this effect is much less pronounced.

Table 3: Trends across the Tax-Rate Distribution

	Municipalities in the West			Municipalities in the New States		
	(1)	(2)	(3)	(4)	(5)	(6)
Reform		4.152 *** (0.166)			11.719 *** (0.452)	
t02			-1.801 *** (0.308)			-1.440 * (0.824)
t03			-0.485 (0.308)			0.718 (0.832)
t04			2.481 *** (0.308)			3.652 *** (0.827)
t05			3.160 *** (0.308)			10.374 *** (0.827)
t06			3.851 *** (0.308)			14.756 *** (0.826)
t07			4.069 *** (0.308)			17.049 *** (0.825)
y2002	1.545 *** (0.118)	1.545 *** (0.117)	1.859 *** (0.129)	0.435 (0.270)	0.435 * (0.264)	0.600 ** (0.278)
y2003	3.644 *** (0.118)	3.644 *** (0.117)	3.729 *** (0.129)	1.529 *** (0.273)	1.522 *** (0.267)	1.443 *** (0.281)
y2004	5.363 *** (0.118)	4.639 *** (0.120)	4.930 *** (0.129)	2.894 *** (0.272)	1.547 *** (0.271)	2.477 *** (0.280)
y2005	7.495 *** (0.118)	6.772 *** (0.120)	6.944 *** (0.129)	4.479 *** (0.272)	3.132 *** (0.271)	3.287 *** (0.280)
y2006	8.622 *** (0.118)	7.898 *** (0.120)	7.951 *** (0.129)	5.712 *** (0.271)	4.364 *** (0.271)	4.016 *** (0.280)
y2007	9.009 *** (0.118)	8.285 *** (0.120)	8.300 *** (0.129)	6.688 *** (0.271)	5.347 *** (0.270)	4.740 *** (0.279)
cons	330.958*** (0.083)	330.958*** (0.083)	330.958*** (0.083)	311.139*** (0.191)	311.142*** (0.187)	311.141*** (0.185)
R^2	0.175	0.185	0.186	0.067	0.106	0.124
Number of obs.	59,023	59,023	59,023	18,091	18,091	18,091
Number of groups	8,434	8,434	8,434	2,648	2,648	2,648

Table 3: Dependent variable: local tax multiplier. Estimations include year dummies (as indicated) and fixed effects. Standard errors are given in parentheses. * denotes significant at 10%; ** significant at 5%; *** at 1%. (1)-(3) refer to West Germany, (4)-(6) refer to Eastern Germany

4.2 Neighborhood Effects in Local Tax Competition

As noted above, competition between jurisdictions has many possible dimensions. The literature on yardstick competition emphasized that tax competition is particularly strong between geographic neighbors (Besley and Case (1995), Bordignon et al. (2003), Bordignon et al. (2004), see also Janeba and Osterloh (2013)). To test whether spatial tax competition effects have been triggered by the minimum tax, we compare the tax policy of municipalities in regions, where the reform exerted some primary effect. This means that there are municipalities which were forced to set a higher tax-rate in order to comply with the new regulation. More specifically, we construct a spatial indicator of treatment effects: for each municipality with a pre-reform tax rate above the minimum tax we compute an indicator of whether a primary tax-rate adjustment was induced by the reform in any of the neighboring municipalities.

To define neighboring municipalities, various measures of spatial distance have been suggested in the literature Anselin (1988). A simple spatial pattern is contiguity, i.e. direct neighborhood. Figure 3 show a map of Germany (small shape) and a zoom-in of those states, which host one or more of the municipalities, which were directly affected by the minimum rate (dark blue). It also highlights the neighbors based on contiguity (queen) in a light blue color.

To estimate the spatial treatment effect we utilize a diff-in-diff analysis which uses municipalities in regions without a low-tax municipality as control groups. Formally

$$m_{it} = \alpha_i + \gamma_t + u_{it} \quad t = 2002, \dots, 2007 \quad (5)$$

$$m_{it} = \alpha_i + \beta_1 (d_t^{2005} * neighbor_i) + u_{it} \quad t = 2002, \dots, 2007 \quad (6)$$

$$m_{it} = \alpha_i + \beta_1 (d_t^{2005} * neighbor_i) + \gamma_t + u_{it} \quad t = 2002, \dots, 2007, \quad (7)$$

where γ_t denotes fixed time-effects and α_i is a fixed effect that controls for the pre-reform tax rate.

Figure 3: Map of Municipalities affected by the Minimum Tax Rate and their Neighbors

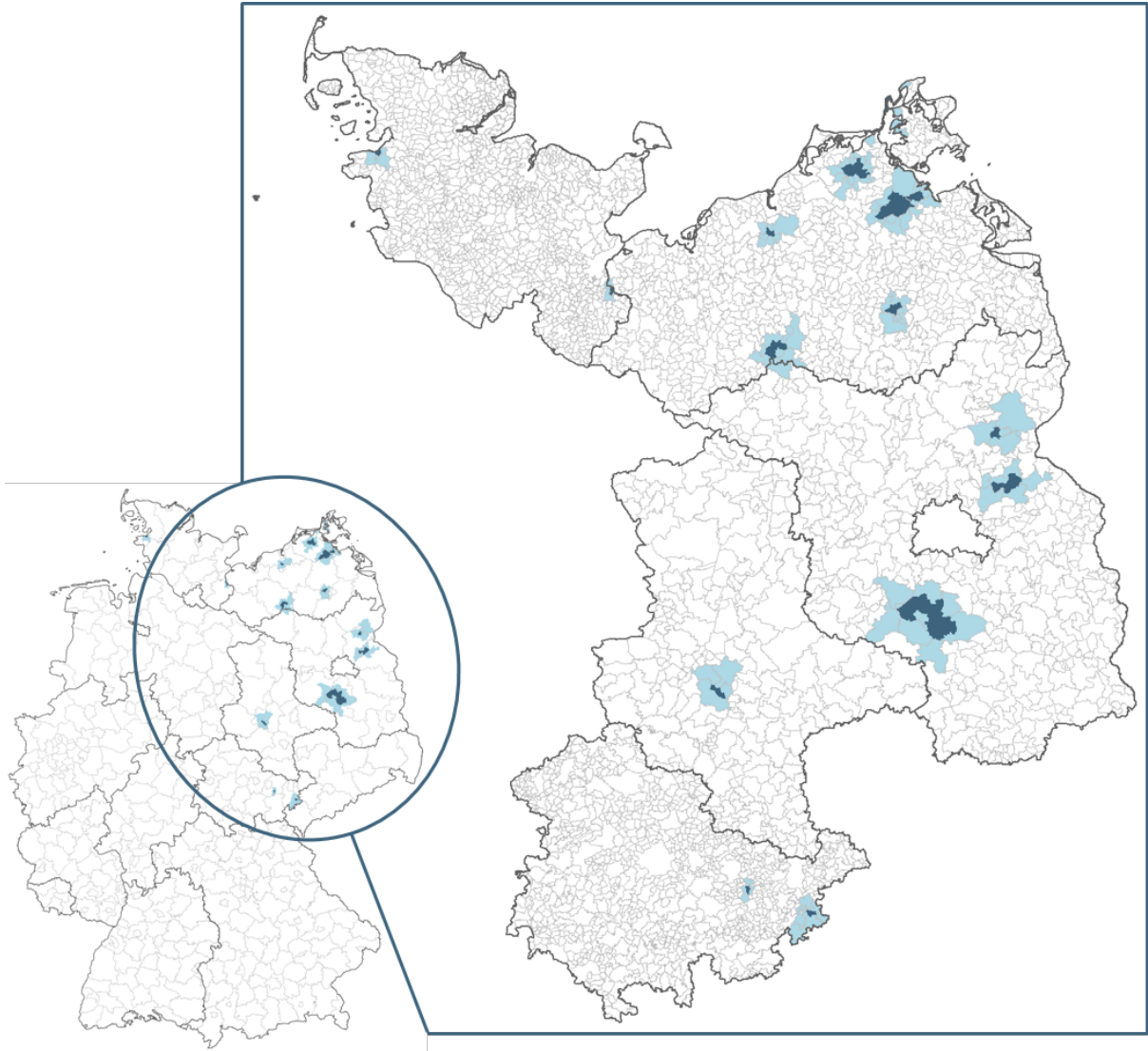


Figure 3: Overview of all German states and zoom-in on states hosting municipalities with a tax multiplier below 200 in 2002. From North to South: Schleswig-Holstein, Mecklenburg-West Pomerania, Brandenburg, Saxony-Anhalt and Thuringia. Municipalities with a tax multiplier below 200 in 2002 are colored dark blue, neighbors are colored light blue. State borders are marked in a dark grey color, county borders (overview map) and municipality borders (zoom-in map) are marked in a light grey color. Source: Own design.

Figure 4: Mean Business Tax Multipliers of Municipalities affected by the Reform and their Neighbors (2002-2009)

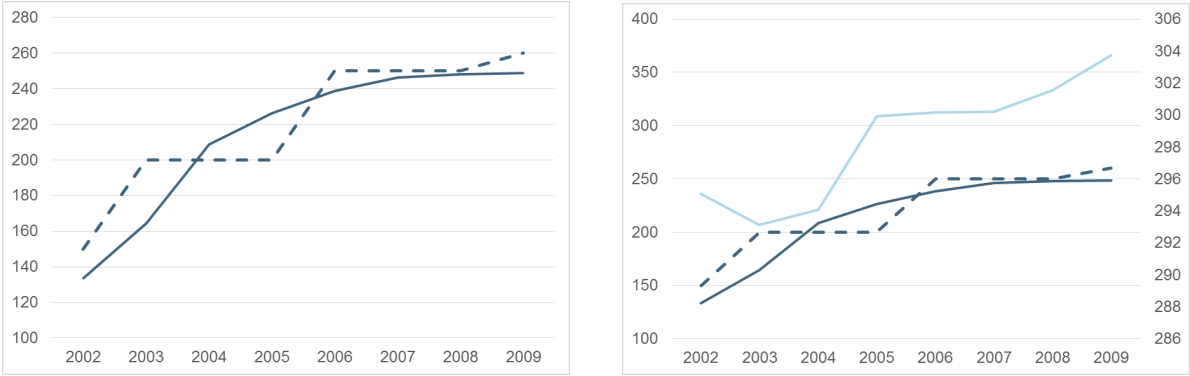


Figure 4: Left Panel: Mean (solid line) and median (dashed line) local business tax multipliers of municipalities affected by the reform. Right Panel: Mean (solid line) and median (dashed line) local business tax multipliers of municipalities affected by the reform in dark blue. Mean local business tax multipliers of neighboring municipalities colored in light blue. Primary and secondary axis have different scaling. 2002-2009. Source: Own design.

In the estimations we use alternative definitions of the control group. The first set takes all municipalities in the same state without primary effects in the neighborhood as controls. To focus on the same state is useful, as each state runs a separate fiscal equalization system, which exerts common shocks to all municipalities in the state. The second approach more narrowly focuses on counties and considers all municipalities as controls that are situated in the same county without primary effects in the neighborhood as controls. Although this may help to take account of common shocks at the county level, revenue sharing institutions might result in a transmission of income effects on the control group. The third definition of control group follows the first definition but excludes all municipalities in the same county. Descriptive statistics for the treatment and the various control groups are provided in the appendix (see Tables A-1, A-2, A-3 and A-4).

The estimation results are provided in Table 4. The table reports robust standard errors that take account of spatial effects at the county level. Throughout specifications, there is significant treatment effect. It suggests, that municipalities have adjusted their tax rate upwards if at least one of the adjacent municipalities has been forced by the 2003/2004 reform to raise their tax rate to the level of the minimum tax rate. The magnitude of effects is, however, limited. The preferred estimation with jurisdictions in the same state but located in other counties suggests that the multiplier was increased by about 3 points.

Figure 5: Mean Business Tax Multiplier of Treatment and Control Groups (2003-2007)

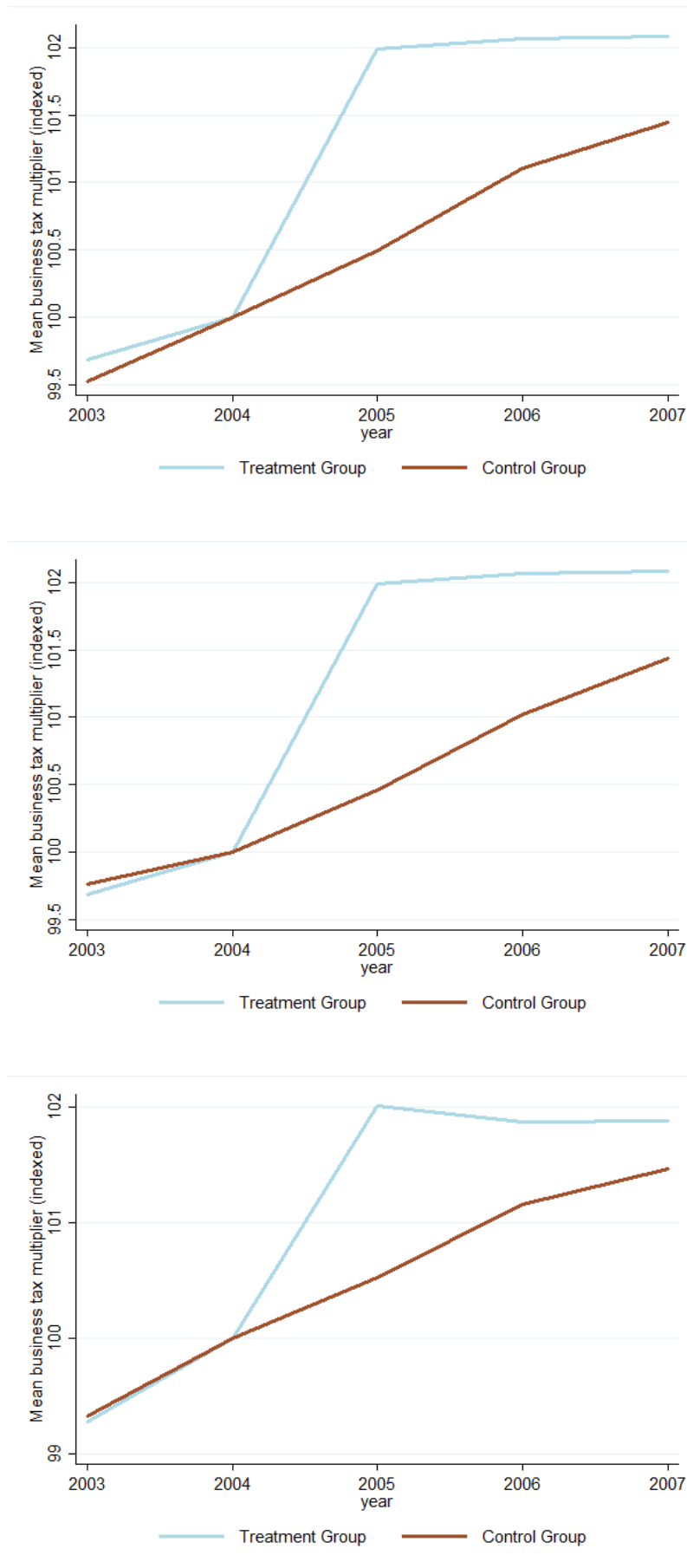


Figure 5: Mean business tax multipliers are indexed to 100 in 2004. Treatment group is shown in light blue color, control groups are shown in red color. Control group specifications 1 (upper panel), 2 (middle panel) and 3 (lower panel). 2003-2007. Source: Own calculations.

Table 4: Difference-in-Differences Estimation

	(1)	(2)	(3)	(4)	(5)
Reform		2.931 ** (1.375)	2.883 ** (1.374)	2.869 * (1.385)	2.892 ** (1.407)
y2004	1.690 *** (0.286)		1.690 *** (0.286)	1.219 *** (0.386)	1.977 *** (0.359)
y2005	3.367 *** (0.400)		3.299 *** (0.394)	2.860 *** (0.639)	3.597 *** (0.480)
y2006	5.137 *** (0.585)		5.138 *** (0.585)	4.497 *** (0.952)	5.605 *** (0.714)
y2007	5.969 *** (0.617)		5.969 *** (0.617)	5.295 *** (0.970)	6.426 *** (0.781)
cons	302.834*** (0.353)	306.067*** (0.007)	302.834*** (0.354)	295.757*** (0.560)	307.100*** (0.436)
R^2	0.079	0.001	0.079	0.056	0.099
Number of obs.	16,222	16,222	16,222	6,502	10,106
Number of groups	3,292	3,292	3,292	1,326	2,046

Table 4: Dependent variable: local tax multiplier. Estimations include year dummies (as indicated) and fixed effects. Robust standard errors are given in parentheses, estimations clustered on county level. * denotes significant at 10%; ** significant at 5%; *** at 1%. (1): Specification (5), (2): Specification (6), (3) - (5): Specification (7). Control group for (1)-(3) are all municipalities in states hosting a treated municipality. Control group for (4) are all municipalities in counties hosting a treated municipality. Control group for (5) are all municipalities in the same state but in different counties hosting a treated municipality.

5 Conclusions

The minimum tax rate as a form of limited tax-policy coordination has received much attention in the theoretical literature. While the literature has discussed minimum tax rates mainly in the context of income tax competition for mobile factors, in practice, minimum tax rates have been applied predominantly to sales taxes. Therefore, empirical evidence on the effects of minimum tax rates is lacking. Against this background, this paper has taken advantage of a recent reform in business taxation in the German federation, where a minimum tax rate has been implemented as an instrument to limit tax competition among lower level governments.

As a consequence of the reform, municipalities with rates below the minimum tax rate including those that had zero tax rates imposed, had to adjust their tax policy. However, in light of the theoretical literature, the reform may have altered the tax-rate distribution also through secondary effects, as munic-

ipalities with tax rates above the minimum rate may have reviewed their tax policy. Our empirical results support the existence of such secondary effects and point to significant effects on the tax-rate distribution. In particular, we find that the tax-rate distribution is compressed in the bottom part of the distribution after the reform. We provide quasi-experimental evidence on tax-competition effects in the sense that jurisdictions competing with low-tax jurisdictions have responded with setting higher tax-rates. While the effects are statistically significant, the size of the effects is modest.

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Table A-1: Treatment Group for Table 10

Year	Observations	Mean	Median	Min	Max	P1	P99
1998	71	290.4	300	200	350	200	350
1999	84	291.3	300	200	360	200	360
2000	84	290.6	300	100	360	100	360
2001	84	294.5	300	200	375	200	375
2002	80	295.1	300	200	375	200	375
2003	76	293.1	300	200	400	200	400
2004	78	294.1	300	200	400	200	400
2005	80	299.9	300	200	395	200	395
2006	80	300.1	300	200	395	200	395
2007	81	300.2	300	200	395	200	395
2008	82	301.5	300	200	395	200	395

Table A-1: Summary statistics of local business tax multipliers of the treatment group 1998-2014. Source: German Statistical Bureau, *Hebesätze der Realsteuern*. Own calculations.

Table A-2: Control Group 1 for Table 10 (Host States)

Year	Observations	Mean	Median	Min	Max	P1	P99
1998	3,032	296.9	300	0	430	200	400
1999	3,238	297.2	300	100	430	200	400
2000	3,239	297.7	300	100	430	200	400
2001	3,239	300.1	300	166	450	200	400
2002	3,213	301.5	300	200	450	200	400
2003	3,140	302.7	300	200	450	200	400
2004	3,182	304.2	300	200	450	200	400
2005	3,195	305.7	300	200	450	200	400
2006	3,201	307.5	300	200	450	200	400
2007	3,216	308.6	300	200	450	200	400
2008	3,222	309.4	300	200	450	200	400

Table A-2: Summary statistics of local business tax multipliers of control group 1: All municipalities in states hosting a treated municipality. 1998-2014. Source: German Statistical Bureau, *Hebesätze der Realsteuern*. Own calculations.

Table A-3: Control Group 2 for Table 10 (Host Counties)

Year	Observations	Mean	Median	Min	Max	P1	P99
1998	1,163	292.1	300	0	400	200	400
1999	1,257	291.4	300	100	400	200	400
2000	1,258	291.4	300	100	400	200	400
2001	1,258	293.5	300	166	400	200	400
2002	1,244	294.8	300	200	400	200	400
2003	1,220	295.2	300	200	400	200	400
2004	1,237	295.9	300	200	400	200	400
2005	1,242	297.3	300	200	400	200	400
2006	1,246	299.0	300	200	400	200	400
2007	1,251	300.2	300	200	400	200	400
2008	1,254	301.6	300	200	420	200	400

Table A-3: Summary statistics of local business tax multipliers of control group 2: All municipalities in counties hosting a treated municipality. 1998-2014. Source: German Statistical Bureau, *Hebesätze der Realsteuern*. Own calculations.

Table A-4: Control Group 3 for Table 10 (Host States without Host Counties)

Year	Observations	Mean	Median	Min	Max	P1	P99
1998	1,830	301.7	300	0	430	200	400
1999	1,946	301.8	300	200	430	200	400
2000	1,959	302.3	300	200	430	200	400
2001	1,974	304.5	300	200	450	200	400
2002	1,969	305.8	300	200	450	200	400
2003	1,920	307.5	300	200	450	225	400
2004	1,941	309.6	300	200	450	240	400
2005	1,948	311.2	310	200	450	250	400
2006	1,951	313.1	310	200	450	250	400
2007	1,960	314.1	310	200	450	250	400
2008	1,963	314.6	310	200	450	250	400

Table A-4: Summary statistics of local business tax multipliers of control group 3: All municipalities in states hosting a treated municipality, without the counties hosting a treated municipality. 1998-2014. Source: German Statistical Bureau, *Hebesätze der Realsteuern*. Own calculations.