NBER WORKING PAPER SERIES

NORDERFRIEDRICHSKOOG! TAX HAVENS, TAX COMPETITION AND THE INTRODUCTION OF A MINIMUM TAX RATE

William C. Boning
Drahomir Klimsa
Joel Slemrod
Robert Ullmann

Working Paper 31225
http://www.nber.org/papers/w31225

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2023

Boning acknowledges support by the National Science Foundation Graduate Research Fellowship Program under Grant No. DGE 1256260. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Norderfriedrichskoog! Tax Havens, Tax Competition and the Introduction of a Minimum Tax Rate

William C. Boning, Drahomir Klimsa, Joel Slemrod, and Robert Ullmann

NBER Working Paper No. 31225
May 2023
JEL No. H25,H26,H71

ABSTRACT

German municipalities levy local business taxes by choosing a tax rate to apply to local business income, where the tax base is defined uniformly at the national level. Before the federal government's imposition of a minimum tax rate in 2004, some municipalities such as the tiny North Sea town of Norderfriedrichskoog chose to act as tax havens by setting a zero tax rate. We combine administrative microdata from firm tax returns with municipality-level information to study the choice to become a tax haven; the (reported and real) income tax havens attracted from other municipalities before and after the introduction of the minimum tax rate; and how the introduction of the minimum tax rate affected tax competition between municipalities. We find that income was shifted to tax haven municipalities both before and after the introduction of the minimum tax rate. The mandated increase in tax havens' tax rates did not lead to rate increases (or decreases) among municipalities in general, or among tax haven municipalities' geographical neighbors. Our results suggest that tax havens largely did not affect the business tax rates set by non-havens.

William C. Boning
Office of Tax Analysis
Department of the Treasury
1500 Pennsylvania Avenue, NW
Washington, DC 20220
William.Boning@treasury.gov

Joel Slemrod
University of Michigan
701 Tappan Street
Room R5396
Ann Arbor, MI 48109-1234
and NBER
jslemrod@umich.edu

Drahomir Klimsa
European University Viadrina
Große Scharrnstraße 59
Frankfurt D-15230
Germany
Klimsa@europa-uni.de

Robert Ullmann
University of Augsburg
Universitaetsstr. 16
Augsburg 86159
Germany
robert.ullmann@wiwi.uni-augsburg.de

1. Introduction

Tax havens, which have long been a key component of tax planning by corporations, have drawn increased attention from policymakers and academics in recent years. One policy approach to concerns about the effects of tax havens is to impose a minimum tax rate in all jurisdictions. This was proposed in 1992 by an expert committee of the European Commission (Ruding, 1992), which advocated a legally binding minimum corporation tax rate (of 30%). Recently, in July 2021, 130 countries joined the proposal of the OECD/G20 Inclusive Framework on BEPS that reallocates taxing rights on the profits of large multi-national corporations (MNCs) to market jurisdictions under Pillar One and establishes a global minimum tax rate of 15% under Pillar Two.

An extensive literature, reviewed below, is available on international tax havens. In this study, we examine a similar but distinct setting featuring tax havens in German municipalities, which can set an individual tax rate for all businesses operating within their borders. Before 2004, some German municipalities functioned as domestic tax havens, levying zero or very low tax rates to attract taxable income and boost economic activity. Concerned about the revenue loss resulting from such practices, the German federal government drastically reduced the attractiveness of tax havens by imposing a minimum tax rate in 2004.

Studying tax havens and the consequences of imposing a minimum tax rate in the German context has several distinct advantages. Germany has a single federally administered tax system with a fixed definition of the business income tax base. Differences in the quality of governance, which is critical to the success of international tax havens (Dharmapala and Hines, 2009; Slemrod, 2008), are not significant in Germany, nor is the fact that the institutional features of some international tax havens are suited to particular home countries, such as the Isle of Man for British MNCs and the Cayman Islands for American MNCs. Within Germany, MNCs cannot exploit the different definitions of organizational form across locations. Moreover, the tax rate is completely transparent. Finally, administrative data from firms' tax returns are available and comparable across jurisdictions. Perhaps most importantly, the effects of the establishment of a minimum tax rate of 9.1% in 2004 provide insights into the role played by tax differentials in profit-shifting decisions, and into whether profit shifting intensifies or abates tax competition. We note that tax competition depends on the institutional setting and that sub-national contexts may differ greatly from one another and from the international context.

Our research addresses a series of empirical questions: Which kinds of municipalities became tax havens? What was the nature and volume of economic activity tax havens attracted? What were the effects of imposing a minimum tax rate on tax havens and non-havens?

We find that German municipal tax havens resemble the "dot" havens described by Dharmapala and Hines (2009)—although they are mostly landlocked and relatively poor compared with non-havens—with minimal physical investment but substantial (relative to the number of employees or number of inhabitants) relocation of paper profits, both before and after the minimum tax rate was imposed. We estimate that before the introduction of the minimum tax rate, only between 0.022% and 0.046% of the national local business tax (LBT) base, or €227 million to €470 million, was located in municipal tax havens, which is considerably less than what has been estimated by the literature on international tax havens. Strikingly, in the three years after the minimum tax rate was introduced, the LBT base in tax havens declined only slightly. Across all municipalities, we find that the LBT base responded similarly to the LBT rate before and after the minimum tax was imposed. We also find that German municipal tax havens had no discernible effect on the tax rates of non-havens either via the paper transactions profit-shifting channel or via the production location channel. Using the changes forced by the minimum tax rate to instrument for changes in tax havens' tax rates in spatial auto-regressions, we find that other municipalities, even tax havens' nearest neighbors, did not react to an exogenously imposed increase in the tax rates set by tax havens.

The remainder of the paper proceeds as follows. Section 2 summarizes the related literature, Section 3 discusses the relevant German tax institutions. Section 4 describes the data used for our analyses. Section 5 reports the results of our research and discusses the implications of these findings for policy debates about international tax havens. The final section concludes.

2. Related Literature

This inquiry connects with several studies that examine the effects of tax systems on firms' investment, location, and profit-reporting behavior; interdependence between governments when setting their potentially multidimensional tax policies; corporate tax havens; and how the interaction between firms' choices and governments' choices generates an equilibrium. As each of these literatures is large, we select a few key contributions that emphasize the link between this study and existing

work on the theory and empirical measurement of the effects of tax havens and minimum tax rates.

2.1. Related Theoretical Literature

The theoretical literature on tax competition does not speak with one voice on whether tax havens reduce tax rates elsewhere or how a minimum tax rate alters rates in jurisdictions in which the tax rate lies above the minimum rate. Nor is there consensus on the welfare effects of tax havens and minimum tax rates, although models in which tax havens reduce global welfare often also predict that tax havens lead other jurisdictions to reduce their tax rates. This pattern is consistent with models that assume a benevolent (local, not global) social planner, where competition depresses rates below the optimum, whereas it is at odds with models in which tax competition constrains a Leviathan government that would otherwise set tax rates above the social optimum.

The canonical model of tax competition (Zodrow and Mieszkowski, 1986; Wilson, 1986) features competition for real activity, but not shifted profits, among symmetric governments. This model, in its simplest form, predicts strategic complementarity in tax rates, so that when one municipality raises rates, others follow suit.

The notion of tax havens immediately suggests asymmetry among jurisdictions, even a qualitative differentiation. Allowing asymmetric jurisdictions or a Stackelberg leader rather than simultaneous rate setting alters the canonical model's predictions. For example, Wang (1999) shows that imposing a minimum tax rate, limiting other municipalities possibilities to undercut the Stackelberg leader's choice, can induce the leader to reduce its tax rate. Slemrod and Wilson (2009) emphasize the role of country size in the decision to become a tax haven: the cost of forgone revenue is low relative to the potential gains from attracting income from other countries.

A comparatively small body of the literature explicitly considers how profit shifting affects tax competition, offering diverse predictions about the effect of a minimum tax rate on the tax rates of jurisdictions not directly affected as well as the welfare effects of this minimum rate. Kanbur and Keen (1993) provide a model of profit shifting and the resulting tax competition, taking firm location decisions as fixed. They show that in their model the jurisdiction with a smaller production tax base sets a lower tax rate. Imposing a minimum tax rate that lies between the two tax rates increases both rates in equilibrium as well as welfare in both locations, because the larger jurisdiction's response leaves sufficient border-crossing that the smaller jurisdiction is better off.

Hong and Smart (2010) propose that tax havens raise equilibrium tax rates of non-havens by enabling countries to discriminate between the mobile part of the corporate tax base, which allows firms to use tax havens to lower the effective tax rate, and the immobile part. When tax havens exist, countries can raise tax rates on relatively immobile capital without losing the mobile proportion of the tax base. To the extent that raising the minimum tax rate eliminates tax havens, it would now reduce tax rates.

Johannesen (2010) adds that, because there is a congestion cost of an MNC shifting too much profit into a single jurisdiction, firms spread shifted profits across jurisdictions. Tax havens attract shifted profits that would otherwise arrive in low-tax, but non-haven, jurisdictions. Without shifted profits, jurisdictions have less incentive to set low tax rates. Eliminating tax havens by raising the minimum tax rate then provides opportunities for non-haven countries to attract shifted profits by reducing their tax rates to close to the new minimum, and can even reduce some countries' revenues.

Including tax enforcement in a model of tax competition can change the effects of a minimum tax rate. Slemrod and Wilson (2009) propose a model in which tax havens exert downward pressure on non-haven countries' tax rates and cause welfare losses due to the additional enforcement resources countries expend to limit the use of tax havens to shift profits. According to Cremer and Gahvari (1997, 2000), enforcement policy can be relaxed to attract shifted profits, and tax harmonization without enforcement harmonization can cause intensified competition for shifted profits.

That tax rate differentials affect the locations of both where real activity occurs and where taxable profits are reported is central to explaining tax havens. This is modeled by Hines and Rice (1994), who introduce a convex cost of moving a proportion of profits from local production either into or out of a jurisdiction. Grubert and Slemrod (1998) adopt a similar assumption and develop a structural model of the decision of U.S. firms to locate profits and production in Puerto Rico, given a tax provision that reduces the cost of shifting profits into Puerto Rico by locating real operating capital there. In both these models, the private cost of shifting income depends on the deviation of reported profit from real activity in the low-tax jurisdiction; therefore, earning more real income in a jurisdiction reduces the cost of shifting a given amount of income, thus providing an implicit subsidy to conduct some real activity in the tax haven.

Recent theoretical literature considers the welfare effects of the introduction of a global minimum tax rate. Johannesen (2022) shows that a minimum tax rate below the tax rates set by non-havens

has an ambiguous effect on welfare in non-havens. Whereas a minimum tax rate increases welfare in non-havens by curbing profit shifting and thus increasing government revenue, it also reduces welfare via a reduction of private consumption by increasing firms' foreign tax costs. Hence, only a global minimum tax at a sufficiently high rate, i.e., one that ends profit shifting to tax havens, has an unambiguously positive effect on welfare in non-havens. Hines (2022) argues that an efficient minimum tax rate has to equate the benefits to all countries of a higher global average tax rate with the costs imposed on countries whose tax rates are constrained by the minimum tax rate. Applying the second order approximation to his model, he finds that an efficient minimum tax rate equals the average tax rate of constrained countries plus the average effect of tax competition on the average global tax rate. The observed distribution of corporate tax rates in 2020 indicates that if tax competition depresses average global tax rates by 4% or more, a minimum tax rate of at least 27% would be necessary to increase welfare.

2.2. Related Empirical Literature

One strand of the empirical literature focuses on describing tax havens and their activities. Dharmapala and Hines (2009) show that international tax havens tend to be small, well-governed, and often coastal or island states. Slemrod (2008) adds that they tend to also participate in other kinds of "commercialization of state sovereignty" such as money laundering and postage stamp issuance pandering, in part because they have a relatively meager endowment of traditional resources.

Another strand of the literature estimates the volume of economic activity located in tax havens and responsiveness of profit and production location to tax differentials. Grubert and Slemrod (1998) perform simulations based on empirical analysis that suggests that most U.S. firms operating in Puerto Rico would not do so in the absence of tax incentives. Hines and Rice (1994) study macro-level data and find that the locations of foreign production and profits of U.S. multinationals are both highly responsive to tax rates. Dharmapala (2014) surveys recent empirical evidence on this question. The meta-analysis by Heckemeyer and Overesch (2017) shows that, when averaging recent estimates using more reliable firm-level data, the semi-elasticity of reported income with respect to the cross-country difference in tax rates is 0.8; that is, reducing the difference in tax rates by 10 percentage points would reduce the income reported in tax havens by 8%. (Barrios and d'Andria, 2020) report that recent studies using panel data (e.g., Becker and Riedel (2012); Beer and Loeprick (2015); Blouin et al. (2018)) find semi-elasticities between -0.4 and -0.5.

Studies using newer methods, however, remain divided on the impact of tax havens. Dharmapala and Riedel (2013) study the pass-through effects of macroeconomic shocks in non-haven foreign countries on profits in tax havens, and estimate that 2% of the shock to the parent's income is shifted to low-tax affiliates. The country-level descriptive statistics from the Bureau of Economic Analysis reported by Dharmapala (2014) and international statistics, including those of tax havens in Tørsløv et al. (2018), suggest that multinationals report around 40% of their profits and 10% of corporate tax revenue in low-tax affiliates. Dharmapala (2014), however, emphasizes that these reported profits need not be reflective of the taxable income, with an estimated proportion of 14.5% of value added in tax havens.

A third strand of the literature studies tax competition between jurisdictions and how tax havens affect the tax rates set by non-havens. Devereux et al. (2008) provide an empirical analysis of international tax competition for both capital location and profit. They estimate reaction functions in a two-dimensional policy space in which countries compete by setting both the effective marginal tax rate on investment and the statutory tax rate. The variation in tax rates they use is largely driven by rate changes in non-haven countries. They find evidence of competition in both rates, with a one percentage point fall in the weighted average statutory rate in other countries corresponding to a 0.7 percentage point reduction in the home country tax rate. The magnitude of the interaction between the two rates (i.e., between competition for capital and profits) is very small. Brueckner (2006) summarizes the empirical research on tax competition and stresses the need to adopt the instrumental variable method to obtain consistent estimates of responsiveness to other jurisdictions' rates in the spatial lag models common in this body of the literature.[1] Lyytikäinen (2012) demonstrates, in the context of property taxes, that using changes in the minimum tax rate as an instrument leads to smaller estimates of tax competition than using neighbors' demographics as instruments.

A much smaller body of literature considers these issues in the German municipality context. Fossen and Steiner (2018) estimate that a 1% increase in the LBT rate decreases the LBT base by 0.45%. However, they claim that the common practice of using tax revenue data, which reflects prepayments, instead of tax return data, which reflects realized tax liability, biases estimates of this elasticity away from zero. Tax rate increases lead firms to exaggerate the reduction in their

1 Besley and Case (1995) estimate spatial lag models for a variety of taxes, including U.S. state corporate income taxes.

expected tax base in order to reduce prepayments. We rely on tax return data, avoiding this bias. Fossen and Steiner (2018) also argue that the German federal fiscal equalization scheme largely compensates municipalities that raise their LBT rates for any resulting loss in the LBT base, limiting tax competition.

A study closely related to one piece of our research, Schwerin and Buettner (2016), uses a difference-in-difference strategy to examine the effect of raising the minimum tax rate on the tax rates of tax havens' geographic neighbors and on other low-tax municipalities regardless of location, which they operationalize by focusing on the tenth percentile of the tax rate distribution. They find that both low-tax municipalities in general and tax havens' geographic neighbors raised tax rates more than other municipalities. We note that the identifying assumption for their results for the tenth percentile of the distribution, that time trends across the distribution would be similar absent the minimum tax, is at odds with the negative, statistically significant coefficient in 2002, before the introduction of the minimum tax. We can replicate their results for geographic neighbors using the 17 tax havens they identify, but the results are not robust when including additional eight tax havens they do not include that merged with other municipalities in 2008 or later, after the period under study. We believe that using all of the tax havens provides a more complete picture of tax competition.

In contrast, studying the effects of substantial tax rate reductions in the German municipality of Monheim, Ilchmann et al. (2015) find that tax rate reductions did not trigger tax rate cuts in other municipalities in the same federal state but that municipalities closer to the municipality that lowered its rates were less likely to increase their rates. In a recent study, Langenmayr and Simmler (2021) show that municipalities set higher tax rates if immobile firms such as wind power plants constitute a larger proportion of the municipality's tax base.

3. The German Local Business Tax and its Tax Havens

3.1. Institutions

3.1.1. Overview

Most German firms are liable for the LBT levied by municipalities.[2] In addition, federal taxes, either corporate tax or personal income tax, are levied depending on the legal form. The computation of the tax base is similar across these three types of tax. Tax laws for all three are uniformly defined at the national level, with no differences across municipalities. Any variation across municipalities in the LBT regime derives solely from differences in LBT rates. From 2001 to 2006, the federal share of the overall tax burden was about 50%. LBT rates ranged from a minimum of 0% to 15.79% at the 90th percentile, 18.03% at the 99th percentile, and 31.03% at the maximum.

Non-tax laws (including labor laws) are also set at the national level and, therefore, do not vary across municipalities. Moreover, federal courts guarantee a homogeneous application of the law. General institutional factors such as the stability of the government (central and local), functionality of public authorities, infrastructure, availability of finance, unemployment support, and antitrust regulations are also similar throughout Germany. Finally, because of Germany's shared culture and relatively small geographical dimensions (886 km from north to south and 636 km from east to west), any unobservable variables such as tax-paying mentality are arguably more uniform than in cross-border studies (Klassen and Laplante, 2012) or even within large countries such as the United States (Gupta and Mills, 2002).

Mainly because of EU regulations, the rules for profit shifting within Germany are largely similar to the rules for cross-border profit shifting. Hence, profit shifting between firms in a firm group within Germany is largely limited by the arm's-length principle. The operational rules of the arm's-length principle resemble the international context, including the regulations governing transfer prices, royalties, and interest expenses. Moreover, the German thin capitalization rule has applied to domestic and cross-border transactions alike since 2003. One contrast is that the German-controlled foreign corporation regime does not apply to merely domestic transactions.

2 Exceptions are limited to farming firms as well as certain professional categories including lawyers, tax consultants, and medical doctors, who are not incorporated.

3.1.2. Local Business Tax

The Federal Republic of Germany had 16 states containing 472 districts in 2006. Each district is subdivided into municipalities, totalling 12,387 in 2006. The LBT is a major source of German municipalities' revenue. A flat "LBT collection rate" applies to nearly all corporate income, with full exemptions for certain unincorporated businesses such as medical practitioners, engineers, architects, lawyers, and auditors. The LBT collection rate, which in our sample period ranges from 0% to 900% with a mean (median) of 333% (350%), maps to an effective tax rate via a simple formula.[3] Unincorporated firms have an exemption amount of €24,500. Moreover, they can use an LBT credit against their income taxes; however, this arguably does not impact our results because the tax credit is, interestingly, independent of the actual LBT paid. It depends only on local business profits and is then computed based on a hypothetical average tax rate (i.e., it is the same regardless of whether the income is earned in a low-tax or high-tax jurisdiction).

Every municipality sets its LBT rate independently, and may only collect taxes from permanent establishments within its borders. Consequently, tax rate competition exists among municipal governments to encourage firms to establish facilities in their municipalities (for a detailed discussion of the tax rate competition among German municipalities, see Janeba and Osterloh (2013)). Figure 1 shows the spatial distributions of LBT rates at the beginning of our sample period in 2001 and Figure 2 shows the distribution at the end of our sample period in 2006.

[Insert Figure 1 about here]

[Insert Figure 2 about here]

Tax rates vary substantially from place to place and over time. Large cities such as Munich and Cologne generally have higher LBT rates (often above 17.5%) than small municipalities located in

3 Technically speaking, municipalities set an LBT collection rate. However, in the following, we refer to the LBT rate, which is the LBT collection rate divided by (LBT collection rate + 2,000 %). This computation correctly considers the marginal statutory multiplier of 5% in our sample period (see paragraph 11 of Section 2 of the LBT code) and the fact that the LBT is deductible from its own tax base (known as the circularity problem of the LBT). The computation of the LBT rate from the LBT collection rate was changed structurally in 2008, that is, after our sample period, to LBT rate = LBT collection rate * 0.035 and without the deductibility of by a statutory multiplier, where the vast majority of firms are subject to the marginal statutory multiplier of 5%. For small unincorporated businesses with profits below €48,000 in our sample period, the statutory multiplier ranged from 1% to 4%. This does not hold for incorporated businesses for which the multiplier is always 5%, which is also the marginal multiplier for unincorporated firms with profits above €48,000.

rural areas. We also observe that the denser and more affluent municipalities in the south and west levy higher LBTs than municipalities in the northeast.

Until 2003, municipalities set their LBT rates without any legal constraints. During this period, a handful of municipalities set tax rates of 0% and several others set LBT rates between 0% and 9.1% (i.e., the tax rate that would become the minimum rate in 2004). The evidence we present in Section 5.2 demonstrates that these municipalities functioned as tax havens, attracting shifted profits from higher-tax municipalities.

In 2004, the German federal government passed legislation explicitly intended to shut down municipal tax havens by disallowing LBT rates below 9.1%[4]. As early as 2003, the government attempted to force tax havens to abolish their practices by allocating tax haven income to a firm's direct parent company if the parent company was also located in Germany, using an unexpected change of the law published on March 16, 2003.[5] Given the specific design of this law change, double taxation might have occurred because the tax base was ultimately taxed in the tax haven as well as in the municipality of the parent company. Hence, this legislation specifically impacted the least aggressive tax havens, that is, those that did not have a tax rate of 0%, but were still below the threshold used to define a tax haven. Immediately after the law change, firms in the town of Norderfriedrichskoog appealed to the fiscal courts regarding the 2003 tax rate change. However, the Federal Fiscal Court, which is Germany's highest court in tax and fiscal matters, ruled on July 4, 2010 that the tax would have to be paid, ruling that the law was brought in existence according to formal constitutional regulations (leaving the more important question of material constitutionality unanswered). Similarly, Beiersdorf-Freudenberg, another tax haven at that time (zero tax rate in 2003, 0.99% tax rate in 2002), directly appealed to the Federal Constitutional Court, which is Germany's supreme court, regarding the 2004 law change and refused to collect the LBT from its resident businesses. Beiersdorf-Freudenberg was allowed to temporarily defer tax collections until the court ruled, on January 25, 2005, that the LBT would have to be collected for both 2003 and 2004. For various reasons, particularly the aforementioned unintended targeting of the least aggressive tax havens, relatively straightforward strategies to circumvent the new law (i.e., by establishing foreign

4 The minimum required LBT collection rate is 200%, corresponding to a tax rate of about 9.1% = 200% / (200% + 2,000%), as discussed in footnote 3.

5 Bundesgesetzblatt 2003 Teil I Nr. 19, 20.05.2003. At that time, municipalities could only increase their LBT collection rate until June 30 in a given year, while they could decrease it until December 31.

direct parents for tax haven subsidiaries), the retroactive introduction, and a widespread belief that the entire law could be unconstitutional, the 2003 law change was abolished again on December 23, 2003 and a minimum tax rate of 9.1% (relevant for taxation in 2004 and thereafter) was introduced.

In 2001 (2006), the beginning (end) of our period of investigation, the average LBT collection per municipality in our data was €2.03 million (€3.13 million), amounting to about 13.7% (21.3%) of average municipality revenue (including fees, fines, interest income, and rent income). Municipalities also collect taxes on real estate, for which they independently set tax rates.

3.1.3. Fiscal Equalization Scheme

Germany maintains a multi-layered fiscal equalization scheme intended primarily to smooth volatility in LBT receipts. During the study period, this scheme included income tax, value-added tax (VAT), and the LBT. Income tax and VAT are first collected by the federal government and then partially redistributed to the municipalities (sometimes indirectly by redistribution among the states). Depending on the exact state redistribution scheme, municipalities receive 12-18% of the income tax collected from their residents, which aims to compensate them for differences between where people live and work. Municipalities also receive about 2% of total VAT revenue, where the exact amount depends on various parameters including the municipality's LBT revenue.

In exchange, the collected LBT is partially forwarded to the federal government and state governments. Forwarding toward the federal and state governments follows a rule that depends on the LBT rate (with some variation in the parameters each year and between states). As a general rule, the lower the LBT rate, the higher the proportion of LBT collected that is redistributed to other municipalities (with a maximum of 100%, which typically only binds after a municipality sharply decreases the LBT rate). Each state also redistributes across municipalities and between municipalities and the state government. Redistribution by states varies across states and years, but usually depends on the number of inhabitants, LBT revenue, number of students in school, and the number of low-income families.

Overall, the fiscal equalization scheme reduces but does not eliminate tax competition between municipalities (for more details, see Fossen and Steiner (2018)).

3.2. Norderfriedrichskoog: An Illustrative Example

According to news reports, in 2000 the German North Sea village of Norderfriedrichskoog consisted of only 13 farmhouses and fewer than 50 inhabitants. Until 2003, it was the poster child for municipal tax havens and was at least the nominal home of subsidiaries of companies such as Deutsche Bank, Lufthansa, and power and gas giant E.ON, apparently because the local authority did not levy any LBT.

In fact, Norderfriedrichskoog was founded in 1696, when a local duke issued a tax exemption in return for building a dike to keep the North Sea out (Oberteis, 2002). Given the low need for revenue in the absence of extensive public facilities, the municipality had always set the LBT rate at 0%. However, companies began locating to Norderfriedrichskoog on a large scale only after 1995, when the Federal Court of Auditors criticized the municipality for levying no LBT, which drew widespread attention.

Because of a Federal Tax Office ruling that some aspects of communications and core management operations must be based in a municipality for a company to qualify for its low tax rate, companies needed to open offices in Norderfriedrichskoog to be able to shift profits to the tax haven. According to newspaper accounts (Schmidt, 2008), a local farmer established an office service and rented out rooms in her farmhouse—19 firms had their headquarters there at one point—and "managed" several of those firms. It was claimed that as many as 130 jobs were created in and around Norderfriedrichskoog between 1992 and 2003, a substantial number considering that only 45 people lived in the village in 2003.

Norderfriedrichskoog was not the only German municipality tax haven, but was by far the most prominent of the small number of municipalities setting such low business tax rates; media reports mention other zero-tax municipalities (Clorius, 2008). After the minimum tax rate was instituted, Norderfriedrichskoog imposed exactly the minimum tax rate of 9.1%. Eventually, in 2011 however, it was forced to raise tax rates further due to the state-level fiscal equalization scheme, which included a de facto minimum tax rate above the federal minimum (Clorius, 2008).

4. Data

We merge confidential administrative firm-level data from VAT returns for 2001 to 2006 from the Research Data Center (RDC) of the Federal Statistical Office and Statistical Offices of the Federal

States with publicly available municipality-level macroeconomic data from the Federal Statistical Office and with geographic data from the German Federal Agency for Cartography and Geodesy. The LBT system was reformed in 2008, substantially altering LBT rates by abolishing the deductibility of the LBT and changing the collection rates, which seriously impedes comparisons beyond the period under study.

The VAT return data cover the full population of German firms above the VAT threshold of €17,500 in annual sales. Although firm-level LBT return data are also available from the RDC, the VAT return data have the advantage that they are available annually, while the LBT returns available for research only cover every third year.

The main limitation of the VAT return data, which would also apply to the LBT return data, is that the firm group's tax returns cannot be linked across establishments in different municipalities. Thus, the unit of observation in our data is a single establishment-year. The VAT return data include information from the company registry that provides the number of employees, a field completed for about 70% of observations; we add one to the listed number of employees (to notionally represent the owner) to account for sole proprietorships. We also have information on sales subject to tax at the normal 16% VAT rate and the reduced 7% VAT rate, as well as tax-exempt sales. Moreover, we have nearly-complete information on input costs (excluding labor costs), with the data derived directly from the VAT return forms. We do not have information on capital stocks or investments.

The Federal Statistical Office's municipality-level macroeconomic data include information on the number of inhabitants, surface area and land use, number and use of buildings, migration, election results, and tourist visits, in addition to information about tax rates and the municipality revenue structure. Where municipality-level variables are unavailable (i.e., for certain years or certain municipalities), we use the corresponding district-level data, as districts are the smallest geographic division above municipalities. Finally, we add data from the German Federal Agency for Cartography and Geodesy, which include mapping information on each municipality as well as the location of borders and geographical municipality midpoints.We merge these data sources using

municipality identifiers[6].

We estimate firm-level profit based on sales and input costs, which are available in our VAT return data. A discussion of our proxy for the LBT base can be found in the online appendix. When we aggregate estimated LBT base to the municipality level and compare to the observed LBT base reported in the municipality-level macroeconomic data, the correlation coefficient is 0.82, indicating that the proxy is a good approximation.

We note that the aggregated sales and correspondingly the (proxy for the) LBT base located in tax havens show extremely high values in 2002 compared with the other years. This is consistent with newspaper articles in which the mayor of Norderfriedrichskoog describes 2002 as a high point in terms of the LBT base in this tax haven due to one-time accounting effects from a single firm. RDC confidentiality requirements do not permit us to remove just one firm from the data, so we instead remove the three firms with the highest increases in the LBT base between 2001 and 2002 from the sample. In doing so, we reduce the sensitivity of our results to outliers at the cost of underestimating the total profits shifted to tax havens in 2002.

5. Empirical Analysis

5.1. What Kinds of Municipalities Became Tax Havens?

We first study which kinds of municipalities became tax havens. Recall that Dharmapala and Hines (2009) note that international tax havens are typically small (population below one million), more affluent than other countries on average, and relatively well governed; they also tend to be islands, closer to financial centers, and possess fewer natural resources than non-havens. For our analysis, we define tax havens as those municipalities that set an LBT rate below 9.1% in 2002, one

6 Our matched sample includes 12,239 (98.81%) of Germany's 12,387 municipalities (in 2006). Non-merges are caused, for instance, by territory reforms during the sample period, particularly in Brandenburg, which make it impossible to merge the VAT return data to the municipality-level macroeconomic data. However, the merge ratio is also driven downward by so-called non-municipality-related areas (usually bare mountains, lakes, and extensive woodlands). Because such municipalities rarely host firms, the respective non-merges are often based on actual circumstances (i.e., the absence of firms) rather than missing data. We leave such non-municipality-related areas in the raw data-set of publicly available data before merging it with the tax return data because it is impossible to clearly identify these using the publicly available data we have. Moreover, a few non-municipality-related areas do host firms. For these, the LBT rate is usually set by the district in which the non-municipality-related area is located. When the data are merged, municipalities for which the VAT return data could not be matched for at least one firm in at least one year are dropped from the sample. The merge ratio is slightly lower in earlier years (e.g., 89.55% in 2001), as the fiscal authorities improved data quality significantly around the beginning of our sample period.

year before the public debate leading up to the implementation of the minimum tax rate. Under this definition, there are 25 tax havens, including Norderfriedrichskoog.

Table 1 compares German municipal tax havens as defined above (Panel A) with non-haven municipalities (Panel B) during the pre-minimum-tax period 2001-2003. For each municipality, we average the LBT rate and various demographic and economic characteristics from 2001-2003.

[Insert Table 1 about here]

During the pre-minimum-tax period, the average (median) non-haven municipality in Germany set an LBT rate of 14.00% (14.04%). It had 6,732 (1,512) inhabitants, gained 13.36 (0) new residents per year, and had a population density of 179.69 (92.91) inhabitants per km^2. The surface area was 27.88 (16.94) km^2. Whereas 57.92% (59.16%) of the surface area was used for farming, only 0.76% (0.31%) was used for business. The price of one m^2 of land was €74.61 (€50.24). Finally, the unemployment rate was 5.07% (3.65%) and nominal GDP per capita was €20,240 (€20,159).

The average (median) tax haven set an LBT rate of 6.60% (7.52%). All the tax havens, except the largest (Nuthe-Urstromtal, 7,271 inhabitants in 2002), had fewer inhabitants than the non-haven average, with a mean (median)[7] of 1,069 (624) inhabitants across all tax havens.[8] In contrast to non-havens, tax havens also suffered from depopulation, with a mean (median) of -3.70 (-4.00) residents per year. With 46.98 (30.97) inhabitants per km^2 and a surface area of 36.35 (15.03) km^2, tax havens also tended to be larger in area and less densely populated than non-havens. Consistent with the international setting, German tax haven municipalities had smaller populations than non-havens. They have large surface areas and tend to be located in rural regions. At 55.90% (68.04%), farming used a similar fraction of the surface area of tax havens and non-havens; however, at 0.31% (0.07%), businesses used much less of the surface area of tax havens than non-havens. The price of a m^2 of land was lower in tax havens, amounting to only €24.00 (€22.81). In contrast to the international setting, tax havens in Germany were poorer than non-havens: unemployment was higher in tax havens, at 8.64% (9.20%), and nominal GDP per capita was lower, at €16,944 (€14,544).

Next, we analyze the spatial distribution of tax havens. Figure 3 maps the geographical location

7 The mean in the tax haven sample is particularly subject to influence by outliers because there are only 25 tax havens.

8 Two of the zero-tax havens (Buchholz b. Wahlstedt and Barnstorf-Warle) were non-municipality-related areas, with no inhabitants but at least one firm.

of the 25 tax havens in Germany (orange areas) and the districts to which they belong (yellow areas).

[Insert Figure 3 about here]

This map shows that most of Germany's tax havens are located in states that were historically part of East Germany, and that the East remains economically underdeveloped compared with the more affluent states that were historically part of West Germany. One noteworthy exception is Norderfriedrichskoog, which is located in the far north near the Danish border on the German coast of the North Sea.

In summary, Germany's domestic tax havens exhibited only some of the characteristics typical of international tax havens. While they shared the nationwide good governance and rule of law and tended to have small populations, they were poorer and farther from Germany's economic centers in the west and south, mostly in the low-income eastern part of the country.

5.2. What Was the Nature of the Economic Activity Drawn to Tax Havens?

5.2.1. Paper Transactions vs. Production

As Firms can move profits into tax havens either by relocating physical production and service provision or through accounting transactions on paper, we next investigate what kinds of economic activity took place in tax havens. We first consider whether indicators of paper transactions, such as unusual ratios of employees, LBT base, and sales per inhabitant or per firm are related to municipalities' LBT rates.

We present a series of scatter plots highlighting the lowest-tax havens. Confidentiality rules require us to bin at least three firms or municipalities into each dot on the scatter plots. We combine the lowest-tax havens, which set a 2002 LBT rate of zero, into the red dot. The municipalities with the next-lowest 2002 tax rates are combined into the blue dot[9]. In Figures 4 to 8 the size of the dots indicates the number of municipalities included in the bin. The dots are centered on the simple

9 For each variable of interest, i.e. separately for each Figure 4 to 8, we then loop through all the years of our sample period 2001-2006 to ensure that we have at least three observations in each bin in each year. If at least one year has less than three observations, we add the municipalities with the next higher 2002 LBT rate to that bin and repeat the procedure until the requirement is met. We then use the next highest 2002 LBT rate as the starting point for the next bin and repeat the procedure until all municipalities are allocated to a bin. Hence, bins are not exactly the same across all Figures 4 to 8, but are very similar, and, more importantly, each bin in a given figure remains constant throughout the sample period, enabling us to gain insights into the relative development of tax havens and non-havens over time.

averages of the municipality-year-level values within the bin. The gray vertical line indicates the minimum tax rate of 9.1%, which applies from 2004.

[Insert Figure 4 about here]

[Insert Figure 5 about here]

Figure 4 shows that lowest-tax havens (red dot) had by far the largest number of employees per inhabitant of any municipality bin from 2001 to 2006. In some years, these lowest-tax havens contain more employees than inhabitants—even including children and the elderly. This implies either extreme commuting patterns or inhabitants with more than one (part-time) job, and coincides with higher unemployment rates in tax havens (Table 1). Figure 5 shows that some non-haven municipalities have employees per firm similar to tax havens, although tax havens lie at the lower end of the distribution. This indicates that activities of firms in tax havens do not require many employees, and as such are less likely to be physical production or service provision.

[Insert Figure 6 about here]

[Insert Figure 7 about here]

Figure 6 shows that the lowest-tax havens featured remarkably high amounts of estimated tax base per inhabitant. Their LBT bases per inhabitant were orders of magnitude higher than in any other municipality bin. After the introduction of a minimum tax rate in 2004, the LBT base per inhabitant in these tax havens did not fall but instead rose in 2004 before returning to roughly the 2001 level in 2005 and 2006. A similar pattern holds for sales per inhabitant, as shown in Figure 7. Remarkably, substantial sales volume is shifted into the lowest-tax havens in 2002-2004 relative to 2001, and sales volumes per inhabitant stay high through 2006. Figures 4 to 7 collectively show that the activity in tax havens was concentrated in the lowest-tax havens (red dot) and did not extend to other tax havens (blue dot). This activity appears to be income shifting rather than the relocation of real activity (i.e., physical production and service provision), as the lowest-tax havens have an unusually low number of employees per firm and extraordinarily high LBT bases and sales per inhabitant.

[Insert Figure 8 about here]

The impression from Figure 6 and Figure 7 is confirmed in Figure 8, which shows LBT collected per inhabitant from the public municipality-level data. As one would expect, the lowest-tax havens collected almost no LBT until 2003, as most of them apply a zero tax rate to their tax base (Figure 6 shows estimated LBT base per inhabitant). However, beginning in 2004, the lowest-tax havens collected vastly more LBT per inhabitant than other municipalities—in the hundreds of thousands of euros per inhabitant rather than low single digits. This massive LBT base per inhabitant remained after the introduction of the minimum tax rate and in fact grew between 2004 and 2006. Figures 6 and 8 together show that the LBT base did not substantially relocate out of tax havens following the imposition of the minimum tax rate.

Finally, Table 2 reports differences between all tax havens and similar non-havens (Panel B) and all non-havens (Panel C) during the pre-minimum tax rate period. Similar non-havens were constructed by 3-nearest neighbor propensity score matching on 2002 demographic and geographic characteristics. The characteristics used for this matching are the surface area and proportions of the surface area in use overall, for settlement and streets, and for farming; the total population and proportion of the population that is female; and births, deaths, youth population and elderly population per capita.

[Insert Table 2 about here]

The results confirm the impressions formed by Figures 4 to 8 above. On average, tax havens host more firms per inhabitant as well as have higher LBT bases and higher sales per inhabitant, per employee, and per firm than non-havens. Havens have fewer employees per firm than similar non-havens (Panel B) and all non-havens (Panel C).

Notably, the differences between tax havens and non-havens vanish when we consider medians instead of means. This indicates that economic activity in tax havens is concentrated to a few municipalities (i.e., the most aggressive tax havens), as already suggested by the graphical evidence above (see the lowest-tax havens in Figures 4-8). For instance, the mean LBT base per inhabitant is €175,765 in tax havens during the pre-minimum tax rate period and only (€2,944) €6,058 in all (similar) non-havens. However, the median LBT base per inhabitant is similar or even lower, with €2,407 in tax havens and (€2,199) €3,992 in (similar) non-havens.

5.2.2. Industry Breakdown

To further investigate the nature of the economic activity attracted to tax havens, we next compare the industry breakdown of firms in tax havens and similar non-havens (using 3-nearest neighbor propensity score matching in terms of the municipality demographics, as described in Section 5.2.1) between 2001 and 2006. Figure 9 shows the percentage of firms in specific industries in tax havens (orange circles) and in similar non-havens (black squares). Analogously, Figure 10 reports the percentage of the total LBT base in specific industries in tax havens and in similar non-havens, and Figure 11 reports the percentage of total employment in specific industries in tax havens and in similar non-havens.

[Insert Figure 9 about here]

[Insert Figure 10 about here]

[Insert Figure 11 about here]

Compared to similar non-havens, tax havens' industry mixes are more concentrated in rural extractive industries and in paper-transaction-heavy financial industries. Figure 9 shows that the percentage of firms operating in agriculture, forestry & mining (industry 1) is higher in tax havens than in similar non-havens, consistent with tax havens' rural locations and low average incomes. There are relatively few construction (industry 9), wholesale & retail (industry 10), and traffic & communication (industry 12) firms in tax havens. A high percentage of firms in tax havens operate in real estate, renting of movable property & services for enterprises (industry 14). Intra-group credit and leasing contracts are particularly suited to profit shifting via paper transactions, as is known from international tax havens. A similar pattern holds for the percentage of the total LBT base in specific industries in Figure 10. One difference from Figure 9 is that wood processing, glass & ceramics (industry 4) and metal production & mechanical engineering (industry 6) are slightly over-represented in tax havens in most years. The industry employment mix in Figure 11 is broadly similar, though employment in real estate, renting of movable property & services for enterprises (industry 14) is below what one would expect from Figure 10. The mix of industries and employment in tax havens suggests that the activity drawn to tax havens by low tax rates is mostly shifted there via paper transactions rather than by relocation of production or service provision.

On the whole, the evidence in Sections 5.2.1 and 5.2.2 suggests on-paper profit shifting into tax havens.

5.3. What Was the Volume of the Economic Activity Drawn by and Tax Base Shifted to Tax Havens?

Next we turn to quantifying the economic activity drawn by tax havens. In the international setting, prior literature suggests that a substantial portion of MNC profits is located in tax havens, with some estimates as high as 40% (Tørsløv et al., 2018).[10] Table 3 reports the aggregated LBT base (Panel A) and aggregated sales (Panel B) of German municipal tax havens and compares these with the respective aggregated amounts of all German municipalities for 2001-2006.

[Insert Table 3 about here]

The LBT base reported in tax havens over the sample period ranges between €226.53 million (2006) and €469.62 million (2001), with a mean of €331.67 million. The overall LBT base of all German municipalities is relatively constant over the sample period, with a mean of €1,008,849 million. Only 0.022-0.046% of the German LBT base is located in tax havens in each year, with a mean of 0.031%. Similarly, sales of firms located in tax havens range between 0.027% (2002) and 0.034% (2006) of the total sales of all firms in Germany, with a mean of 0.032%. This estimate may understate the LBT base located in tax havens to the extent that some categories of financial income are not reflected in the VAT sales measures we use to proxy for the LBT base (see Section 4). While the German LBT base and revenue in tax havens are large on a per-inhabitant basis(Table 2), German tax havens attract a much smaller fraction of the tax base than tax havens attract in the international setting. One argument for the creation of the minimum tax rate was that though the level of activity in tax havens was small, rapid growth in activity in Norderfriedrichskoog and its like in the years leading up to 2001 presaged larger issues unless legal changes were made.

Using the LBT base located in tax havens from Panel A and the tax rate differential between tax havens and non-havens obtained from Table 1, we can calculate a back-of-the-envelope approximation of the tax loss resulting from the existence of tax havens for the three years before the minimum tax rate was introduced. If the mean tax base located in tax havens between 2001 and 2003 of €336.78 million was taxed at 14.01%, which is the mean LBT rate for non-havens during the pre-minimum

10 For details of how the graphs are constructed, see Section 5.2.1.

tax rate period, instead of 6.75%, which is the mean LBT rate for tax havens, total revenue would be €24.45 million higher per annum on average. As the incentive to relocate profits to tax havens is the strongest in the highest rate municipalities, one might expect shifted profits to originate in higher-tax municipalities. Moreover, in the absence of tax havens, the average LBT rate in non-havens might also be higher, leading to more tax revenue by itself. Hence, our back-of-the-envelope calculation could underestimate the tax loss. On the other hand, higher LBT rates resulting from the absence of tax havens within Germany could also lead to firm tax avoidance by other means (e.g. shifting to other countries) or by reductions in economic activity, which would lead to our back-of-the-envelope calculation overestimating the tax loss.

5.4. What Were the Effects of the Minimum Tax Rate on Activity in Tax Havens?

Whereas the LBT base located in tax havens declined only slightly in the three years after the minimum tax rate was introduced, sales remained almost unchanged, as shown in Panel A and Panel B of Table 3. If tax rates elsewhere did not react substantially to the minimum tax rate (as shown in Section 5.6), these time series are consistent with a relatively inelastic response of the tax base previously located in tax havens to changes in tax rate differentials, as the tax rates of the lowest-rate tax havens rose by 9.1 percentage points.

The panel nature of our data enables us to study whether the steady volume of activity in tax havens after the minimum tax rate stems from a lack of exits among firms already located in tax havens or from new firms locating in tax havens. We return to the binned scatter plots from Section 5.2.1, this time showing the number of Figure 12 shows the number of new firms per inhabitant and Figure 13 reports the number of lost (exiting) firms per inhabitant from 2001 to 2006[11].

[Insert Figure 12 about here]

[Insert Figure 13 about here]

Firm turnover per inhabitant is far higher in the lowest-tax havens (red dot) than elsewhere, with entries falling and exits rising in these tax havens following the introduction of the minimum

11 We cannot observe new firms in the first year of our panel and lost firms in the last year of our panel.

tax. The lowest-tax havens have about 0.4 firm entries per inhabitant in 2002 and 2003, while nearly all other municipalities have just under 0.2 new firms per inhabitant in each year. The high rate of firm entry in tax havens falls to just above the average in 2004 and then to around the average in 2005 and 2006. Havens also lose more firms to exit in each year than non-havens. In 2002, 2003, and 2005 tax haven exits per inhabitant are around 0.15, with higher levels in 2001 (over 0.2 exits per inhabitant) and 2004 (about 0.3 exits per inhabitant). The contrast between the decline in firms locating in tax havens and the steady volume of activity in tax havens following 2003 suggests that the bulk of tax haven activity is concentrated in firms that did not relocate out of tax havens.

5.5. Did the Minimum Tax Rate Change How Business Activity Responds to Tax Rates?

To analyze the effects of the minimum tax rate on the relationship between tax rates and business activity, we estimate a model relating total business activity at the municipality level to business tax rates. We include terms to capture both the general relationship between the LBT rate and activity and the effects of tax haven status before and after the minimum tax rate was introduced. We split tax havens into zero-tax havens and non-zero-tax havens because businesses may choose to locate some activity in the places with the lowest possible tax rates. We interact indicators for these two categories of tax havens and the level of the LBT rate (in percentage points) with indicators for the pre- and post-minimum tax rate periods to capture whether activity in tax havens and the general responsiveness of activity to tax rates changed after the minimum tax rate was introduced. The resulting regression equation is:

$$\begin{aligned} log(y_{it}) = \alpha + \beta_1 \tau_{it} * Pre_t + \beta_2 \tau_{it} * Post_t + \beta_3 ZeroHaven_i * Pre_t + \beta_4 ZeroHaven_i * Post_t \\ + \beta_5 OtherHaven_i * Pre_t + \beta_6 OtherHaven_i * Post_t + \gamma X_{it} + \mu_{st} + \varepsilon_{it}, \end{aligned} \tag{1}$$

where y_{it} is either the LBT base, sales, input costs or the number of firms in municipality i in year t, τ_{it} is the LBT rate of municipality i in year t, X_{it} is a vector of municipality demographics, μ_{st} is a state-by-year fixed effect, and ε_{it} is an error term. The state-by-year fixed effects account for year-by-year changes in states' fiscal equalization schemes. The municipality demographics include the natural logarithm of the surface area, proportions of the surface area in use overall, for settlement and streets, and for farming; the natural logarithm of total population, proportion of the population that is female; and births, deaths, youth population and elderly population per capita. $ZeroHaven_i$ ($OtherHaven_i$) is an indicator variable that takes the value of 1 if municipality i is a (non-)zero-tax

haven and Pre_t ($Post_t$) is an indicator variable that takes the value of 1 if year t is before (after) the introduction of the minimum tax rate. The coefficients of interest are β_1 and β_2, the semi-elasticity of the municipality-level LBT base, sales, input costs, and number of firms with respect to the tax rate in the pre-minimum tax and the post-minimum tax rate periods, and the coefficients of the interaction terms β_3 to β_6 that indicate the municipality-level LBT base, sales, input costs, and number of firms in zero-tax and non-zero-tax havens in the pre-minimum tax rate and post-minimum tax rate periods.

The results are reported in Table 4. Column (1) shows results for the LBT base, Column (3) for sales, Column (5) for input costs and Column (7) for the number of firms. The even-numbered columns (Columns (2), (4), (6), and (8)) report the results of a specification that replaces the municipality demographics X_{it} with municipality fixed effects (which absorb the tax haven indicators), limiting the variation to within-municipality changes in tax rates over time. Italics indicate that the difference between the coefficients for the pre-minimum tax rate and post-minimum tax rate periods is statistically significant at conventional confidence levels.

[Insert Table 4 about here]

The estimated responsiveness of the municipal tax base depends greatly on the presence of municipality fixed effects. The estimated semi-elasticity of the LBT base with respect to the LBT rate is -6.025 (-6.570) in the pre-minimum (post-minimum) tax rate period in the specification without municipality fixed effects, indicating that a 1% increase in the LBT rate in a municipality reduces the LBT base in that municipality by 6.025% (6.570%) (Column (1)). However, when municipality fixed effects are included, the semi-elasticity of the LBT base becomes statistically insignificant with a value of -0.956 (-1.169) (Column (2)), indicating that across municipalities higher LBT rates are associated with smaller LBT bases but changes in LBT rates within a municipality over time are not related with a significant decrease in LBT base. A similar pattern can be observed for sales (Columns (3) and (4)), input costs (Columns (5) and (6)) and the number of firms (Columns (7) and (8)). The within-municipality semi-elasticities we estimate are, given standard errors, comparable to the -0.45 Fossen and Steiner (2018) estimate in the German setting, and also comparable to semi-elasticity estimates from studies using panel data on countries, which are between -0.4 and -0.5 for pre-tax profits (Becker and Riedel, 2012; Beer and Loeprick, 2015; Blouin et al., 2018).

For both specifications, the semi-elasticity of the LBT base in the post-minimum tax rate period is not statistically different from the semi-elasticity in the pre-minimum tax rate period (Columns (1) and (2)). While both sales (Columns (3) and (4)) and input costs (Columns (5) and (6)) become more responsive to tax rates, the two cancel out. This is consistent with the notion that the introduction of the minimum tax rate did not alter the responsiveness of the tax base to tax rates in Germany. The number of firms in a municipality becomes slightly more responsive to LBT rates in the post-minimum tax rate period (Columns (3) and (4)).

Conditional on the LBT rate and controls, zero-tax havens have significantly higher LBT bases (Column (1)), sales (Column (3)), input costs (Column (5)), and numbers of firms (Column (7)) both before and after the minimum tax rate was introduced. The regression results for tax havens are consistent with the statistics for aggregated LBT base and sales located in tax havens presented in Table 3. Over the three years we can observe following the substantial reduction in rate differences between tax havens and non-havens, substantially diminished tax incentives reduced the activity in zero-tax havens only somewhat. Non-zero-tax havens do not have higher activity than one would otherwise expect in the pre-minimum tax rate period but do in the post-minimum tax rate period, albeit not nearly as much as zero-tax havens, suggesting that by bringing non-zero-tax havens into the set of places tied for the lowest tax rate the minimum tax rate drove more activity to them.

5.6. What Were the Effects of Imposing a Minimum Tax Rate on the Tax Rates Set by Non-Havens?

5.6.1. Overview

Tax havens can affect the tax rates that non-havens set through two channels, which we examine separately. First, firms' ability to shift profits to tax havens via paper transactions may cause non-havens' tax bases to be more or less responsive to the tax rates set by non-havens, changing their revenue-maximizing and welfare-maximizing LBT rates. Second, tax havens may also compete with non-havens for the location of production activity, again altering the responsiveness of non-havens' LBT bases.

The cost of paper transactions does not rise sharply with distance, especially within Germany, so the effects of profit-shifting to tax havens are unlikely to vary with distance. The 2004 introduction of the minimum tax rate of 9.1% enables us to study the profit-shifting effects of tax havens by inspecting the patterns of the LBT rate changes in 2004 and in the other years. We test the predictions made using the Keen and Konrad (2013) and Slemrod and Wilson (2009) models (i.e.,

non-haven tax rates will rise) against the prediction by Hong and Smart (2010) that non-haven tax rates will fall, as well as Johannesen (2010)'s prediction that non-haven tax rates may fall for some municipalities that had set rates above the minimum. Directly inspecting the LBT rate changes allows us to separately examine subcategories of the rate changes, distinguishing increases from decreases and subdividing by the domain over which rates changed.

In contrast, competition for physical production is arguably more intense between nearer neighbors due to the distance-dependent costs of relocating production. Hence, we use a spatial autoregressive model with a variety of weights that capture functions of distance to assess the effects of the minimum tax rate imposed on tax havens on the tax rates of non-haven municipalities. To ensure that our model captures only the effects of the exogenously imposed changes in tax rates, we adopt a two-stage least squares (2SLS) specification using the increases in tax rates required to comply with the minimum tax rate as instruments for the geographical neighbor's changes in tax rates. This approach mirrors that adopted by Lyytikäinen (2012) in the context of property tax competition. Geographical differences in treatment intensity allow us to identify the effect of the 2004 change independent of the time-series shocks that affected all municipalities similarly.

5.6.2. Paper Transactions Profit-Shifting Channel

We compare the changes in the LBT rates set by non-havens before and after the minimum tax rate became binding in 2004. We expect each year to capture a Nash equilibrium in the tax rates set by municipalities because adjustments are frequent – 8% of municipalities adjusted their rates in 2002. A year-by-year Nash equilibrium implies that only 2004 is treated, so we adopt 2004 as our main definition of the treated period. As a robustness check we also consider the entire 2004-2006 period as treated, allowing for adjustments that take more than one year. As noted before, a major reform to the LBT system in 2008 seriously impedes comparisons beyond the period under study.

[Insert Table 5 about here]

Imposing a minimum tax rate of 9.1% in 2004 appears to have had little, if any, effect on the number or extent of non-haven tax rate changes. Excluding the 20 municipalities that increased their tax rates in 2004 to the required minimum, 7.56% of municipalities raised rates in 2002, 8.89% raised rates in 2003, 7.97% raised rates in 2004 and on average from 2004-2006 8.56% raised rates (although 2005 is unusually high at 10.37%, both 2004 and 2006 are below 8%). The difference between the

2002-2003 and 2004-2006 periods is 0.38%, which is only marginally statistically significant at the 10% level and small relative to the year-to-year variation in excess of 1 percentage point. The number of municipalities lowering rates remained at around 0.7% in each year from 2002-2005, then rose very slightly to 0.86% in 2006. Among municipalities raising tax rates, the average size of a rate increase was similar from 2002-2006, while the average decrease conditional on a decrease shrank slightly from 2002-2006. Finally, there is almost no change in the number of non-havens that adjusted their LBT rates downward to the minimum tax rate from 2002-2006, in contrast to the prediction of Johannesen (2010). In 2002, nine municipalities reduced their tax rates to the minimum tax rate, and in each year from 2003-2006 between four and ten municipalities made such a change. Accordingly, non-havens do not appear to reduce rates substantially to obtain a share of the additional shifted profits associated with having a tax rate tied with the lowest rate. We conclude that the introduction of the minimum tax rate of 9.1% in 2004 did not substantially alter the tax rate distribution, neither raising rates as Slemrod and Wilson (2009) predict nor reducing them as Hong and Smart (2010) predict.

While we find that the imposition of the minimum tax rate did not substantially alter the overall distribution of tax rate changes, suggesting that incentives for profit shifting do not drive overall rate-setting behavior, localized competition for physical production may still have led tax havens' neighbors to change their rates in response to the minimum tax rate.

5.6.3. Production Location Profit-Shifting Channel

We assess the effects of the minimum tax rate on the tax rates of neighbors, which we argue reflects competition for the location of production, using a spatial autoregression, as is common in the tax competition literature (Brueckner, 2006). Specifically, we weight neighboring municipalities' changes in tax rates using measures of distance and interpret the results in which competition is more intense between closer jurisdictions as evidence of competition for production location.[12] To ensure that our model captures only the effects of the exogenously imposed changes in tax rates, we rely on a 2SLS specification that uses the required increase in LBT rates from 2002 to 2004 (i.e., the increase necessary to comply with the minimum tax rate) as an instrument for neighbors' changes

12 Using a specification in tax rate changes rather than in levels, in contrast to most prior studies, has the advantage that differencing removes the time-invariant factors affecting municipalities' tax rates.

in tax rates, as proposed by Lyytikäinen (2012).

The regression equation for the tax rate reaction function we specify is

$$\tau_{i2004} - \tau_{i2002} = \alpha + \beta \sum_{j \neq i} w_{ij} \widehat{(\tau_{j2004} - \tau_{j2002})} + \gamma(X_{i2004} - X_{i2002}) + \mu_s + \varepsilon_i, \tag{2}$$

where the coefficient of interest is β, the slope of the reaction function, $\tau_{i(j)t}$ is the LBT rate of municipality $i(j)$ in year 2004 or 2002, the spatial weights w_{ij} are calculated as described below, X_{it} is a vector of municipality demographics, including the surface area and proportions of the surface area in use overall, for settlement and streets, and for farming; the total population and proportion of the population that is female; and births, deaths, youth population and elderly population per capita, μ_s is a state-fixed effect, and ε_i is an error term. The state-fixed effects account for differences in states' fiscal equalization schemes. The instrument for $(\tau_{j2004} - \tau_{j2002})$ is $max(\tau_{min} - \tau_{j2002}, 0)$, where τ_{min} is the minimum tax rate of 9.1%. The weights capture several functions of the distance between municipalities. Letting $f(d_{ij})$ denote the function of distance (and, in some cases, population), each set of weights is

$$w_{ij} = \frac{f(d_{ij})}{\sum_j f(d_{ij})}. \tag{3}$$

Three alternative sets of weights capture the most extreme gradients by distance: one set assigns equal weight to the three nearest neighbors by midpoint distance; another to the five nearest neighbors by midpoint distance; and a third to all municipalities in the same district. The sets of weights also include inverse distance, inverse distance squared, population-weighted inverse distance, and population-weighted inverse distance squared. A final set of weights counts the population-weighted inverse distance squared only to the 10 largest cities by population. Weighting by population captures the economic importance of municipality j, as we might expect that tax rates are especially responsive to the rates of the most populous places. The regression results are shown in Table 6.

[Insert Table 6 about here]

As shown in Table 6, there is no statistical evidence that neighbors respond to tax havens' changes in LBT rates. The effects are precisely estimated around zero using weights of 1/distance squared, the three or five closest municipalities, and other municipalities in the same district, ruling out substantial reactions by those municipalities most likely to be affected by the change in tax

havens' competitiveness for real production location. The effects are estimated imprecisely for the population-weighted measures, as we would expect given that the tiny populations of tax havens result in little variation in the population-weighted average tax rate. The results weighting by 1/distance are also imprecisely estimated, perhaps again because of lack of variation in the instrument.

To summarize the empirical results of the effects of the imposition of the minimum tax rate on tax havens' geographic neighbors, we find that in response to a substantial (up to) 9.1 percentage point increase in tax havens' tax rates, the closest non-havens did not substantially change their tax rates. This result suggests that tax havens' low tax rates did not lead to competition for the location of productive activity.

The results also have important implications for the tax competition between jurisdictions in our setting. Consistent with the results of Lyytikäinen (2012), who uses the variation from a minimum tax rate to instrument for Finnish property tax rates, we find no statistical evidence of spatial competition in business tax rates between German municipalities.

Our results contrast with Schwerin and Buettner (2016), who find a small (0.15 percentage points in 2005) yet statistically significant increase in the tax rates of tax havens' neighbors compared to a control group of non-neighbors in the same states. When we attempt to replicate their results using their method, we find no such increase in 2005 or 2006. This difference may arise because they identify 17 municipalities affected by the minimum, while we identify 25 such municipalities, of which 8 merged with other municipalities after 2008.

Our finding that there is no evidence of competition in business tax rates using the minimum tax rate instrument contrast with much of the literature, which finds evidence of competition using demographic instruments (Brueckner, 2006). Ordinary least squares regressions of tax competition face the criticism that unobserved factors may cause the tax rates in neighboring jurisdictions to move in sync for reasons other than tax competition, biasing the estimates upward. This concern is often addressed by instrumenting for neighbors' tax rates with neighbors' demographic characteristics. As Lyytikäinen (2012) highlights in the property tax competition context, neighbors' demographics may suffer from the same problems that ordinary least squares does. Neighbors' demographics may be correlated with the jurisdiction's own demographics, for example. Neighbors' demographics like education levels and the fraction of the population that is working-age may also directly attract businesses to the neighbors by providing a useful workforce. When we use neighbors' demographics

as instruments instead of the minimum tax rate (in results reported in the online appendix), we find evidence of tax competition similar to that in much of the literature[13]. While the minimum rate binds in only 20 of over 12,000 municipalities and so identifies a different local average treatment effect than do demographic instruments, our finding that there is not competition in business tax rates using a more plausibly exogenous instrument sounds a note of caution for studies using demographic instruments to identify business tax competition.

6. Conclusion

This study assesses the role played by tax havens as low-tax hosts for business profits, leveraging data on the LBT levied by German municipalities, with exogenous variation provided by the introduction of a minimum tax rate of 9.1% in 2004. This minimum tax rate policy in 2004 enables us to estimate how firms and non-haven municipalities respond to LBT rate changes in tax havens. Specifically, we study how reducing the incentive to shift profits and production to tax havens affects LBT rates in non-haven municipalities. Spatial autoregression allows us to assess whether the changes in tax havens' LBT rates have especially strong effects on the LBT rates set by their nearest neighbors, which could reflect competition for real economic activity, such as the location of physical production.

We first document that German municipal tax havens such as Norderfriedrichskoog have small populations, like international "dot" tax havens, but are landlocked and relatively poor compared with non-havens. They host significantly more sales, firms, and employees (likely part-time due to a management location requirement for access to their low tax rates) per capita than non-havens.

The evidence on the activity in tax havens suggests income shifting via paper transactions rather than relocation of real economic activity, as we observe relatively few employees per firm but extraordinarily high LBT bases and sales per inhabitant in tax havens compared with non-havens. Moreover, a high percentage of firms in tax havens operate in real estate, renting of movable property, and services for enterprises, consistent with the evidence from the international setting that renting and leasing contracts are common areas where paper transactions can shift profits.

13 The estimated tax competition in those results is similar before and after 2004, consistent with our results in Table 6.

We also observe that firms' response to the changes in tax rate differentials induced in tax havens by the minimum tax rate is somewhat inelastic, at least in the short run. In the three years after the minimum tax rate was introduced, the LBT base in tax havens did not decline significantly, although fewer firms entered and more firms exited tax havens. At the same time, we find that the overall elasticity of the tax base with respect to the LBT rate in Germany was not affected by the introduction of the minimum tax rate.

Finally, we find that German municipal tax havens had no substantial short-term effect on the overall distribution of LBT rates or on the LBT rates of their neighbors, from which we conclude that neither the incentives for profit shifting via paper transactions nor for relocation of real economic activity affected other municipalities' LBT rates. Using a spatial autoregression with the changes forced by the minimum tax rate as an instrument for the changes in neighbors' LBT rates, we also cannot reject the null hypothesis that municipalities do not compete in LBT rates.

We conclude that, within Germany, the volume of established profit shifting did not immediately decrease when rate differentials closed, pointing to the short-term stickiness of shifted profits. However, reductions in rate differentials did stop excess entry of firms into tax havens, suggesting that in the long run limiting haven tax rates may have larger effects on profit shifting. Furthermore, we find that German municipal tax havens largely did not affect the business tax rates set by non-havens. Institutional differences, in particular state-level schemes that reduce the benefits of lowering rates and the small fraction of profits shifted to German tax havens, limit the extent to which Norderfriedrichskoog and its like can be informative about the role of profit shifting to tax havens in international tax competition. Nonetheless, our results suggest that in some settings forcing tax havens to raise their tax rates does not substantially alter the nature of tax competition among non-havens.

References

Barrios, S. and d'Andria, D. (2020). Profit Shifting and Industrial Heterogeneity. *CESifo Economic Studies*, 66(2):134–156.

Becker, J. and Riedel, N. (2012). Cross-Border Tax Effects on Affiliate Investment - Evidence from European Multinationals. *European Economic Review*, 56(3):436–450.

Beer, S. and Loeprick, J. (2015). Profit Shifting: Drivers of Transfer (Mis)pricing and the Potential of Countermeasures. *International Tax and Public Finance*, 22(3):426–451.

Besley, T. and Case, A. (1995). Incumbent Behavior: Vote Seeking, Tax Setting and Yardstick Competition. *American Economic Review*, 85(1):25–45.

Blouin, J. L., Robinson, L. A., and Seidman, J. K. (2018). Conflicting Transfer Pricing Incentives and the Role of Coordination. *Contemporary Accounting Research*, 35(1):87–116.

Brueckner, J. K. (2006). Strategic Interaction among Governments. In Arnott, R. J. and McMillen Daniel P., editors, *A Companion to Urban Economics*, pages 332–347.

Clorius, S. (2008). Thirteen Courtyards, Five Hundred Companies (Dreizehn Höfe, fünfhundert Firmen). *Die Zeit*.

Cremer, H. and Gahvari, F. (1997). Tax Competition and Tax Evasion. *Nordic Journal of Political Economy*, 24(2):89.

Cremer, H. and Gahvari, F. (2000). Tax Evasion, Fiscal Competition and Economic Integration. *European Economic Review*, 44(9):1633–1657.

Devereux, M. P., Lockwood, B., and Redoano, M. (2008). Do Countries Compete over Corporate Tax Rates? *Journal of Public Economics*, 92(5):1210–1235.

Dharmapala, D. (2014). What Do We Know about Base Erosion and Profit Shifting? A Review of the Empirical Literature. *Fiscal Studies*, 35(4):421–448.

Dharmapala, D. and Hines, J. R. (2009). Which Countries Become Tax Havens? *Journal of Public Economics*, 93(9):1058–1068.

Dharmapala, D. and Riedel, N. (2013). Earnings Shocks and Tax-Motivated Income-Shifting: Evidence from European Multinationals. *Journal of Public Economics*, 97:95–107.

Fossen, F. M. and Steiner, V. (2018). The Tax-Rate Elasticity of Local Business Profits. *German Economic Review*, 19(2):162–189.

Grubert, H. and Slemrod, J. (1998). The Effect of Taxes on Investment and Income Shifting to Puerto Rico. *The Review of Economics and Statistics*, 80(3):365–373.

Gupta, S. and Mills, L. F. (2002). Corporate Multistate Tax Planning: Benefits of Multiple Jurisdictions. *Journal of Accounting and Economics*, 33(1):117–139.

Heckemeyer, J. H. and Overesch, M. (2017). Multinationals' Profit Response to Tax Differentials: Effect Size and Shifting Channels. *Canadian Journal of Economics*, 50(4):965–994.

Hines, J. R. (2022). Evaluating Tax Harmonization. *University of Michigan and NBER*, (Working Paper).

Hines, J. R. and Rice, E. M. (1994). Fiscal Paradise: Foreign Tax Havens and American Business. *The Quarterly Journal of Economics*, 109(1):149–182.

Hong, Q. and Smart, M. (2010). In Praise of Tax Havens: International Tax Planning and Foreign Direct Investment. *European Economic Review*, 54(1):82–95.

Ilchmann, C., Rösel, F., and Steinbrecher, J. (2015). Steuerwettbewerb im Kleinen - Ein Blick auf den Fall Monheim. *ifo Dresden berichtet*, 22(4):26–38.

Janeba, E. and Osterloh, S. (2013). Tax and the city - A Theory of Local Tax Competition. *Journal of Public Economics*, 106:89–100.

Johannesen, N. (2010). Imperfect Tax Competition for Profits, Asymmetric Equilibrium and Beneficial Tax Havens. *Journal of International Economics*, 81(2):253–264.

Johannesen, N. (2022). The Global Minimum Tax. *Journal of Public Economics*, 212:104709.

Kanbur, R. and Keen, M. (1993). Jeux Sans Frontières: Tax Competition and Tax Coordination When Countries Differ in Size. *The American Economic Review*, 83(4):877–892.

Keen, M. and Konrad, K. A. (2013). The Theory of International Tax Competition and Coordination. In Auerbach, A. J., Chetty, R., Feldstein, M., and Saez, E., editors, *Handbook of Public Economics*, volume 5, pages 257–328. Elsevier.

Klassen, K. J. and Laplante, S. K. (2012). Are U.S. Multinational Corporations Becoming More Aggressive Income Shifters? *Journal of Accounting Research*, 50(5):1245–1285.

Langenmayr, D. and Simmler, M. (2021). Firm Mobility and Jurisdictions' Tax Rate Choices: Evidence from Immobile Firm Entry. *Journal of Public Economics*, 204:104530.

Lyytikäinen, T. (2012). Tax Competition among Local Governments: Evidence from a Property Tax Reform in Finland. *Journal of Public Economics*, 96(7):584–595.

Oberteis, R. (2002). Taxes Saved Behind The Dike (Steuern sparen hinterm Deich). *Tagesspiegel*.

Ruding, O. (1992). *Report of the Committee of Independent Experts on Company Taxation. Executive Summary. March 1992*.

Schmidt, W. (2008). Norderfriedrichskoog - The Lost Tax Haven Behind the Dike (Norderfriedrichskoog - das verlorene Steuerparadies hinterm Deich). *Die Welt*.

Schwerin, A. v. and Buettner, T. (2016). Constrained Tax Competition - Empirical Effects of the Minimum Tax Rate on the Tax Rate Distribution. In *Demographischer Wandel - Session: Fiscal Competition*, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016.

Slemrod, J. (2008). Why Is Elvis on Burkina Faso Postage Stamps? Cross-Country Evidence on the Commercialization of State Sovereignty. *Journal of Empirical Legal Studies*, 5(4):683–712.

Slemrod, J. and Wilson, J. D. (2009). Tax Competition with Parasitic Tax Havens. *Journal of Public Economics*, 93(11):1261–1270.

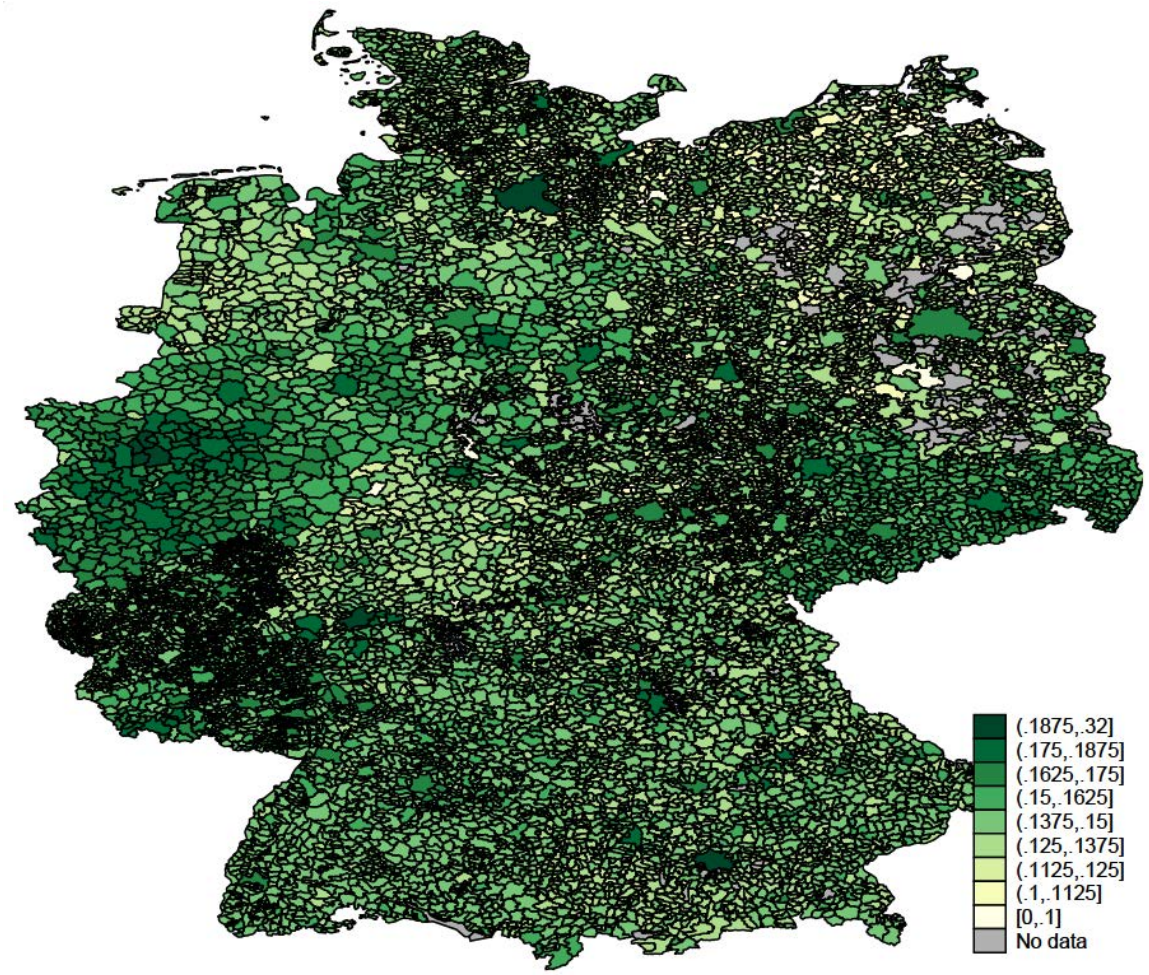
Tørsløv, T. R., Wier, L. S., and Zucman, G. (2018). The Missing Profits of Nations. *NBER*, (Working Paper No. 24701).

Wang, Y.-Q. (1999). Commodity Taxes under Fiscal Competition: Stackelberg Equilibrium and Optimality. *American Economic Review*, 89(4):974–981.

Wilson, J. D. (1986). A Theory of Interregional Tax Competition. *Journal of Urban Economics*, 19(3):296–315.

Zodrow, G. R. and Mieszkowski, P. (1986). Pigou, Tiebout, Property Taxation, and the Underprovision of Local Public Goods. *Journal of Urban of Economics*, 19(3):525–542.

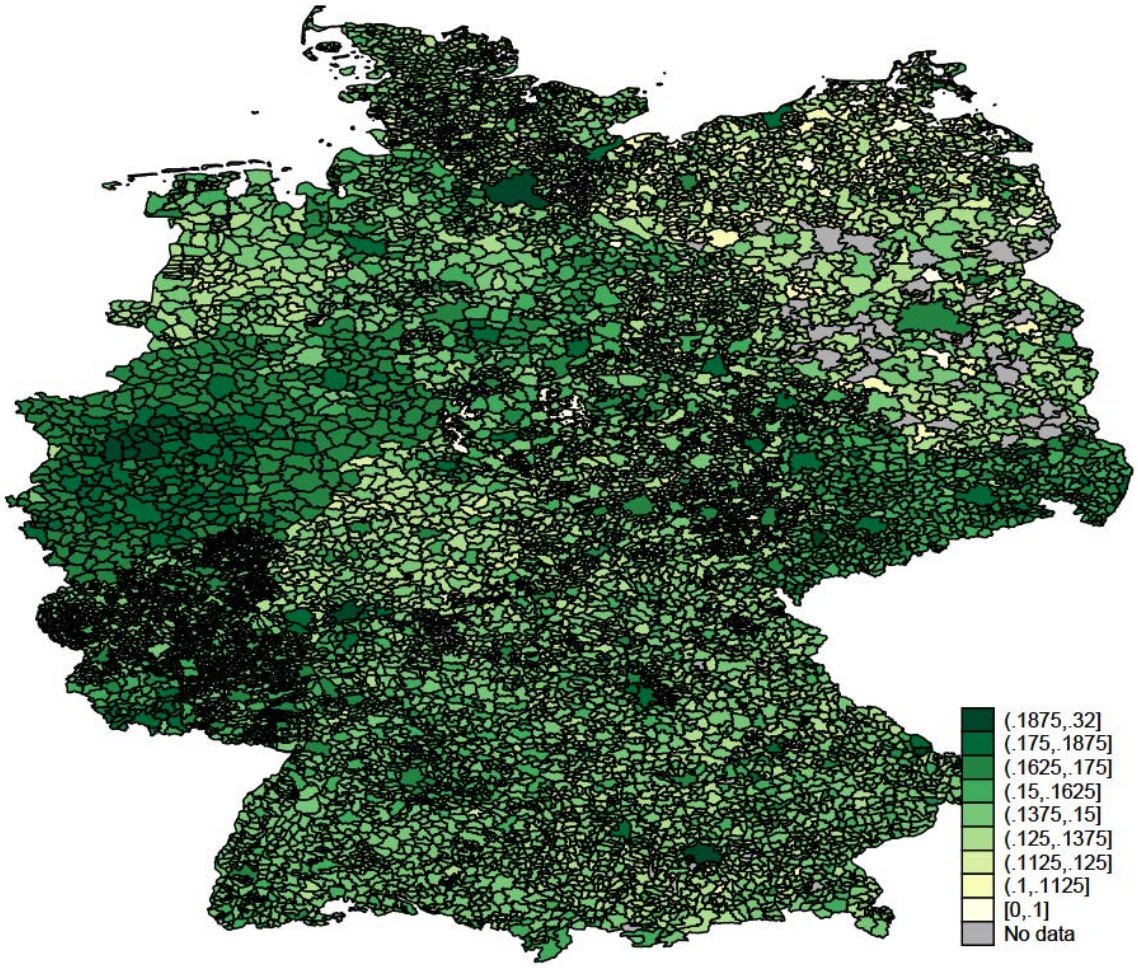
Figure 1: Spatial Distributions of the LBT Rates (2001)



Notes: The gray areas indicate municipalities with missing information on the LBT rate (e.g., due to territory reforms during sample period).

[Click here to return to reference in text]

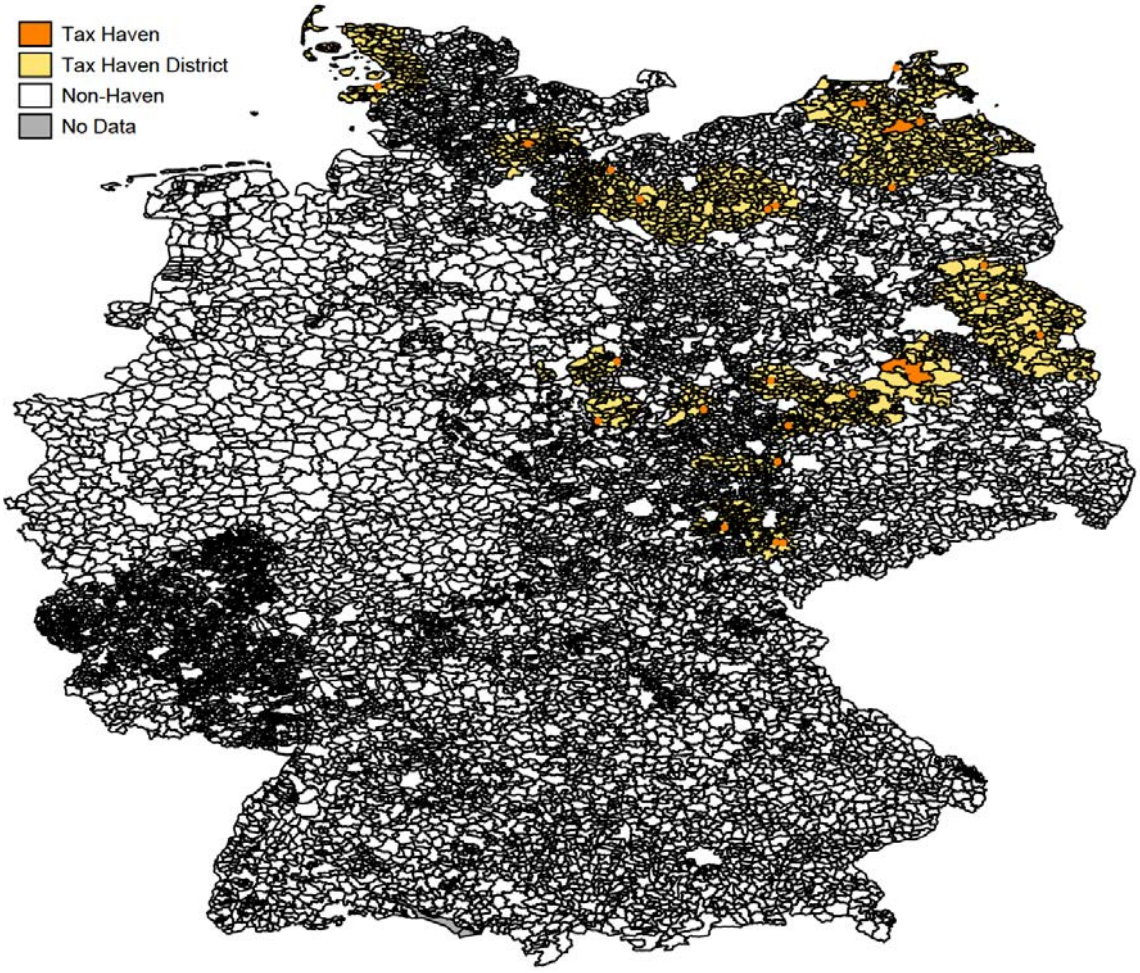
Figure 2: Spatial Distributions of the LBT Rates (2006)



Notes: The gray areas indicate municipalities with missing information on the LBT rate (e.g., due to territory reforms during sample period).

[Click here to return to reference in text]

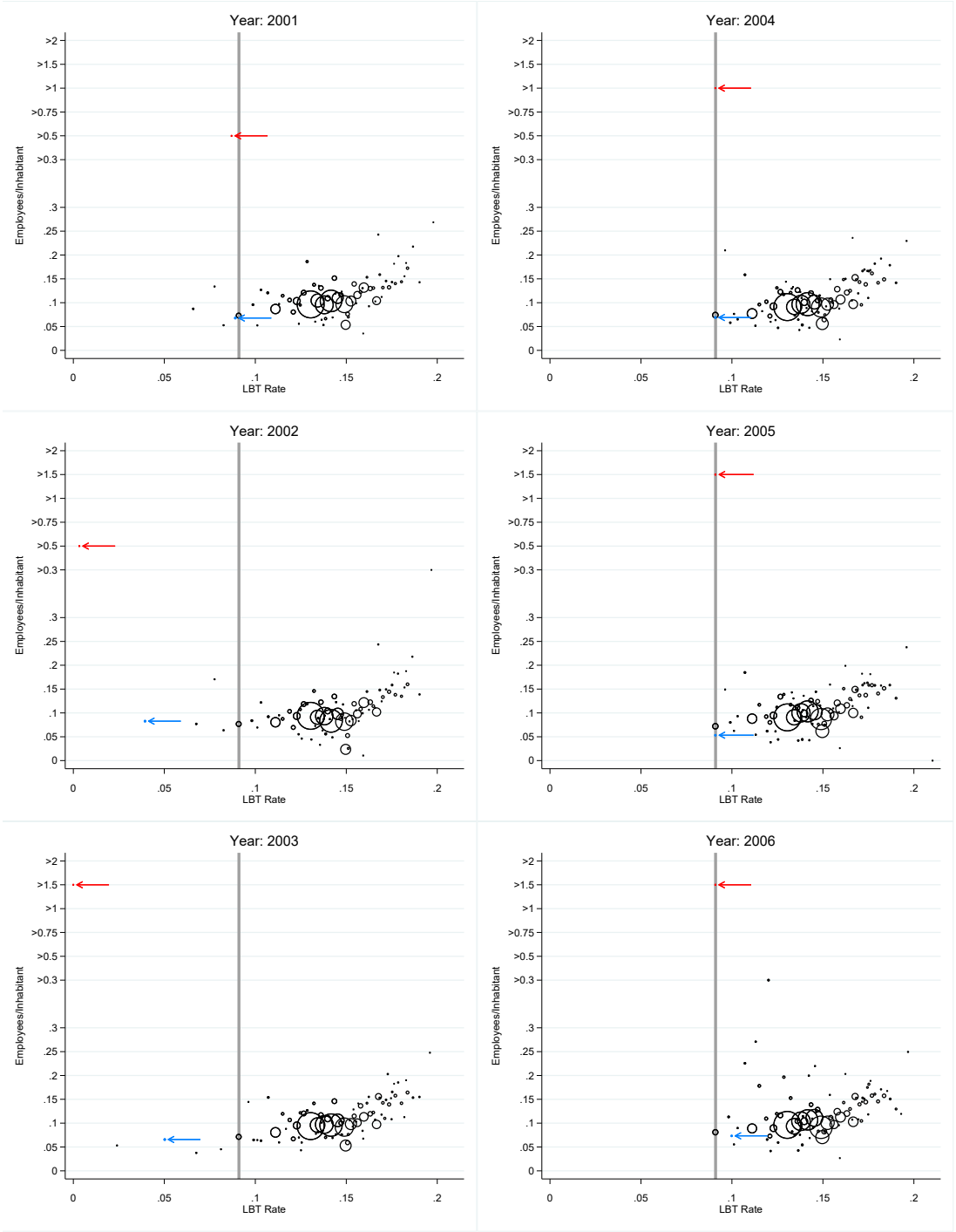
Figure 3: Geographic Location of Tax Havens in Germany (2002)



Notes: The orange areas indicate tax havens, i.e. municipalities with LBT rates below 9.1%. The districts that contain tax havens are indicated by the yellow areas. The grey areas indicate municipalities with missing information on the LBT rate (e.g., due to territory reforms during sample period).

[Click here to return to reference in text]

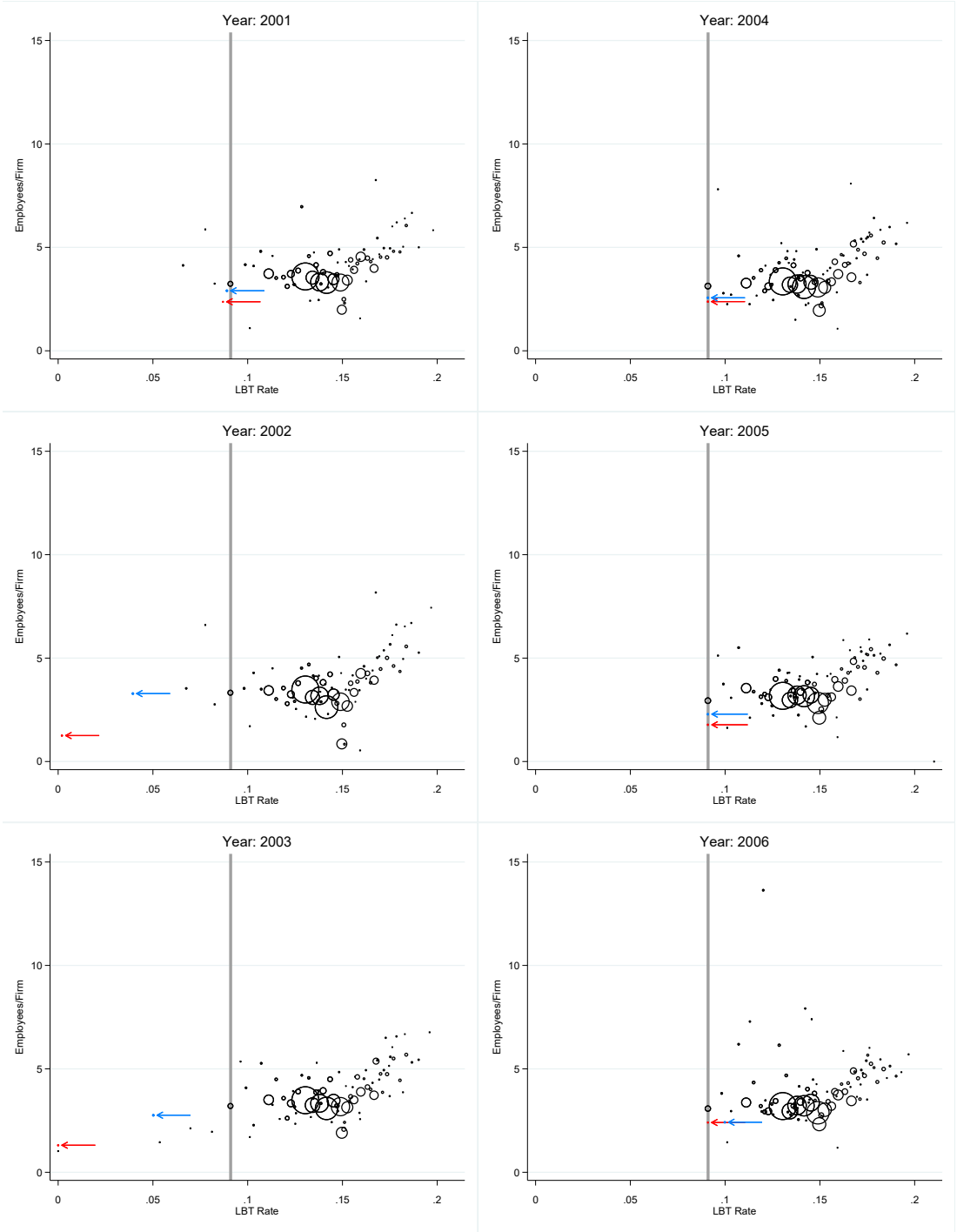
Figure 4: Employees per Inhabitant (2001-2006)



Notes: The dots show the average LBT rate as well as the average for the variable of interest. The red dots indicate the most aggressive tax havens (based on the LBT rates in 2002). The blue dots indicate the second most aggressive tax havens. The size of the dots indicates the number of municipalities included. The gray vertical line shows the minimum tax rate of 9.1%, which applies from 2004.

[Click here to return to reference in text]

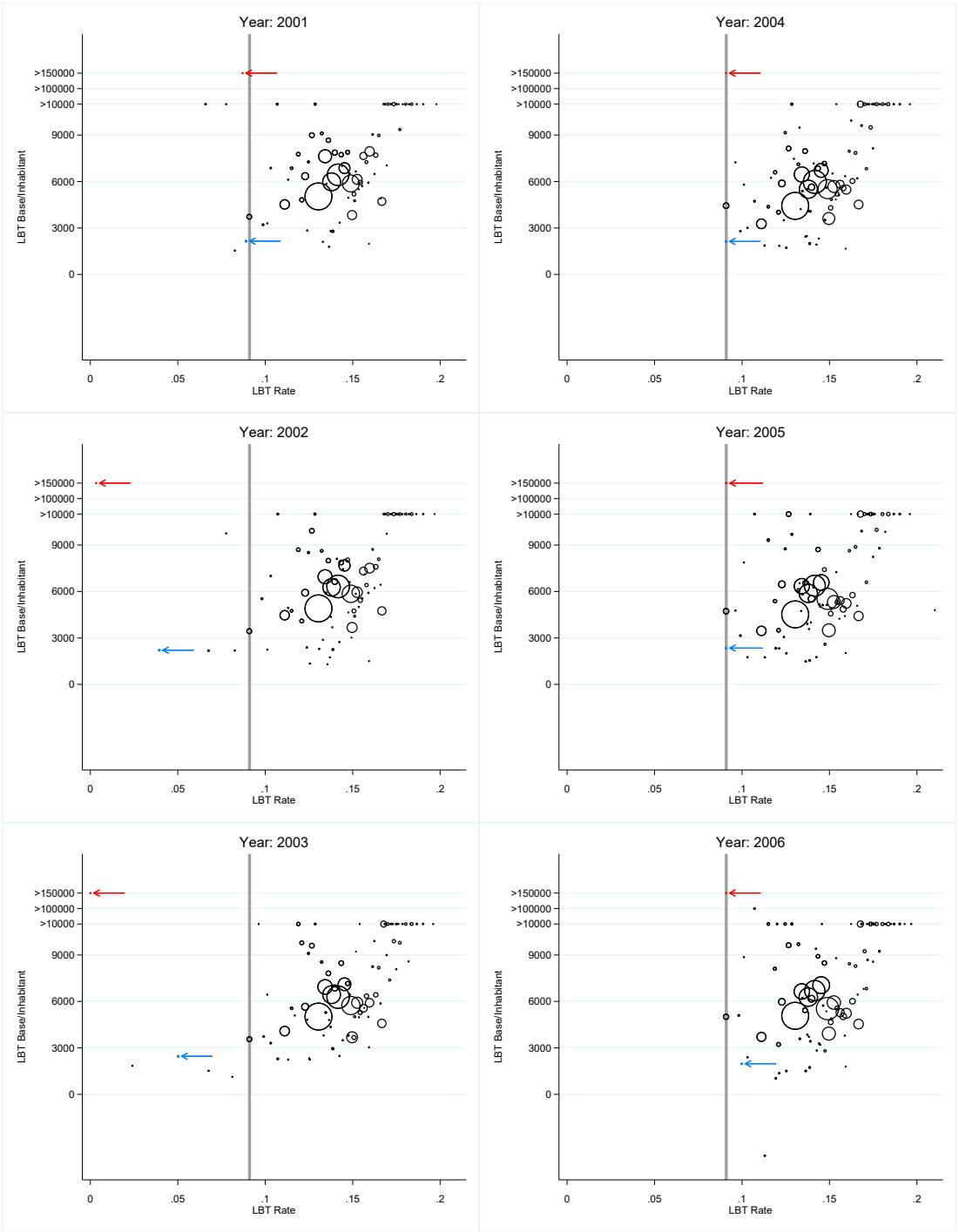
Figure 5: Employees per Firm (2001-2006)



Notes: The dots show the average LBT rate as well as the average for the variable of interest. The red dots indicate the most aggressive tax havens (based on the LBT rates in 2002). The blue dots indicate the second most aggressive tax havens. The size of the dots indicates the number of municipalities included. The gray vertical line shows the minimum tax rate of 9.1%, which applies from 2004.

[Click here to return to reference in text]

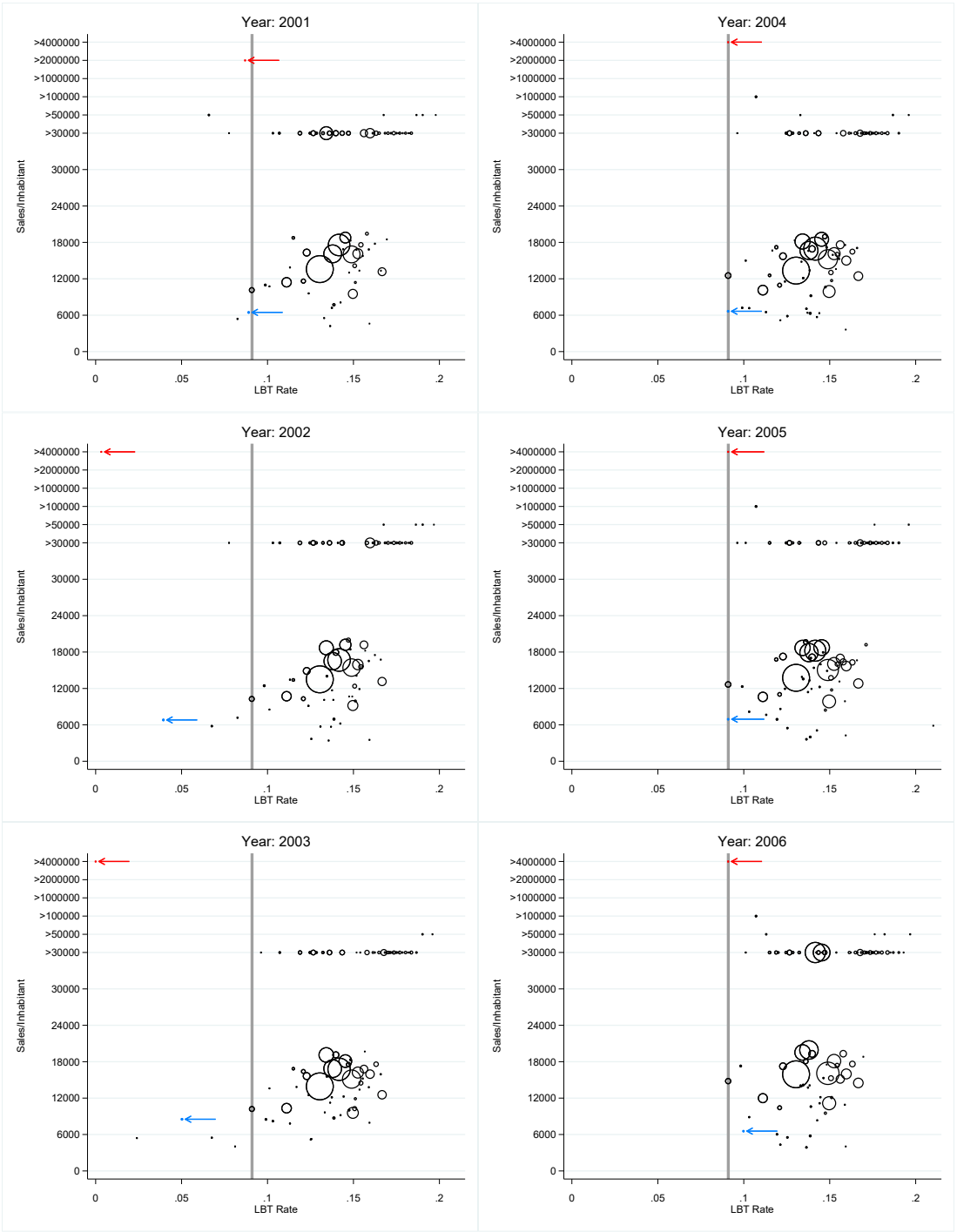
Figure 6: Estimated LBT Base per Inhabitant (2001-2006)



Notes: The dots show the average LBT rate as well as the average for the variable of interest. The red dots indicate the most aggressive tax havens (based on the LBT rates in 2002). The blue dots indicate the second most aggressive tax havens. The size of the dots indicates the number of municipalities included. The gray vertical line shows the minimum tax rate of 9.1%, which applies from 2004.

[Click here to return to reference in text]

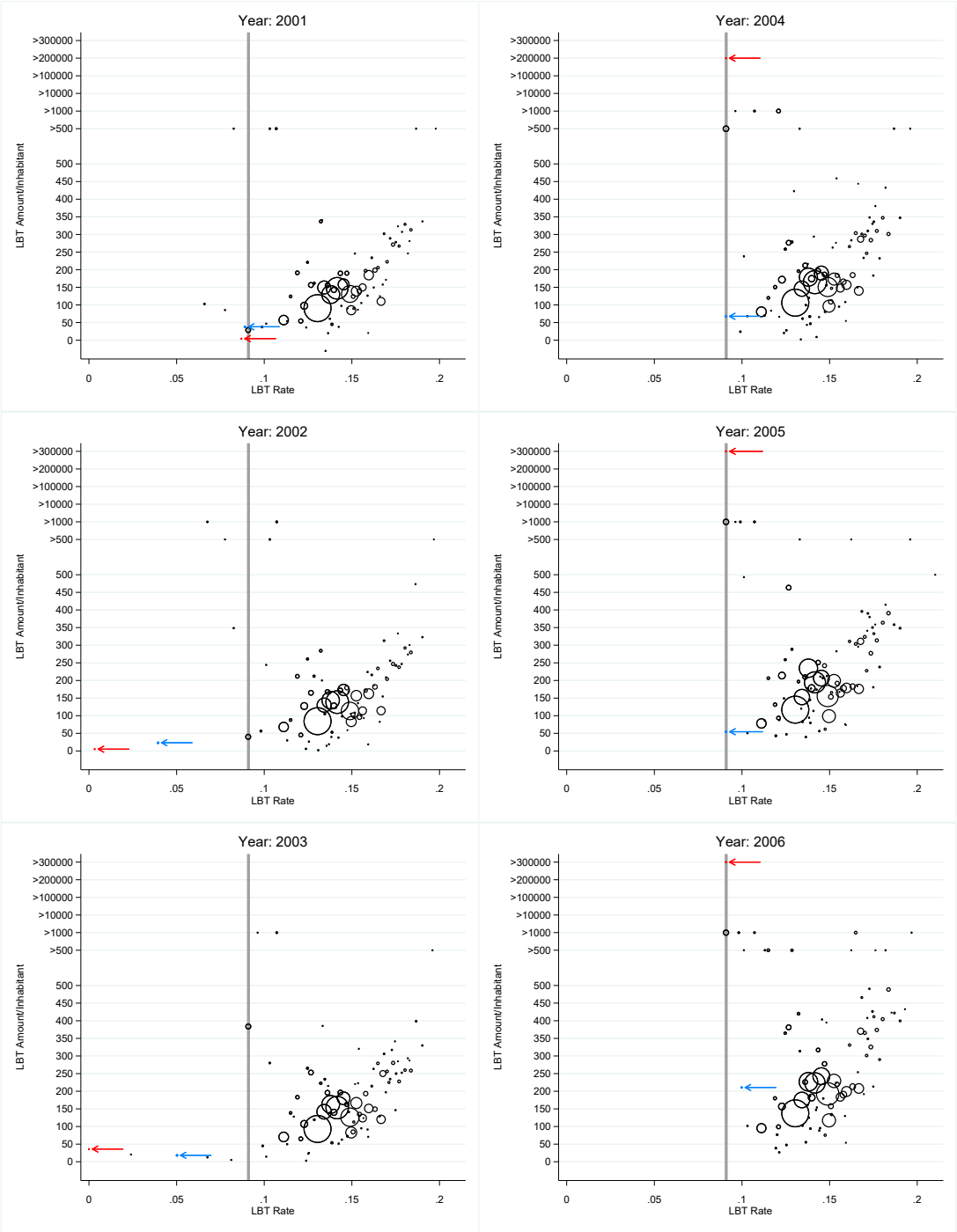
Figure 7: Net Sales per Inhabitant (2001-2006)



Notes: The dots show the average LBT rate as well as the average for the variable of interest. The red dots indicate the most aggressive tax havens (based on the LBT rates in 2002). The blue dots indicate the second most aggressive tax havens. The size of the dots indicates the number of municipalities included. The gray vertical line shows the minimum tax rate of 9.1%, which applies from 2004.

[Click here to return to reference in text]

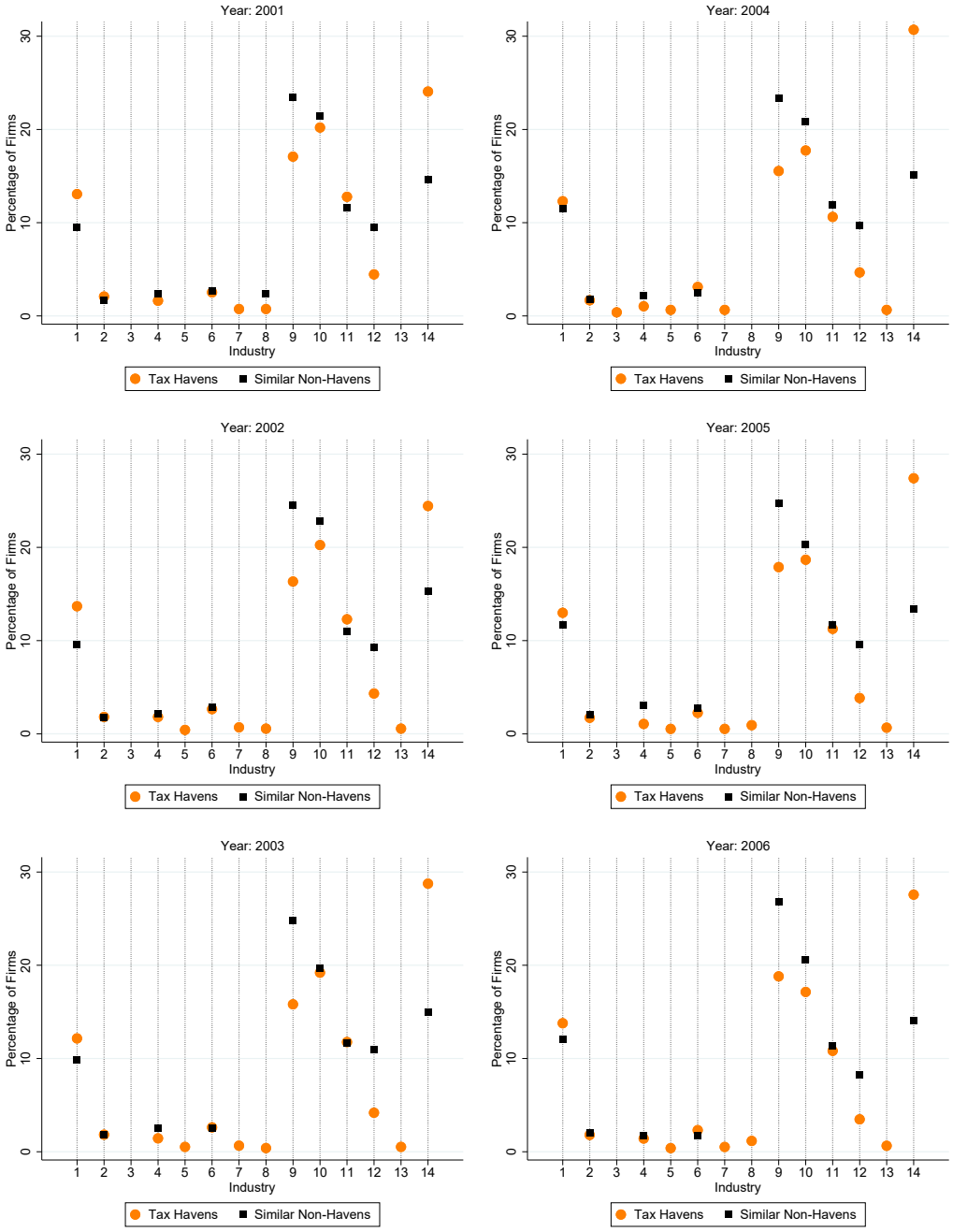
Figure 8: Actual LBT Amount per Inhabitant (2001-2006)



Notes: The dots show the average LBT rate as well as the average for the variable of interest. The red dots indicate the most aggressive tax havens (based on the LBT rates in 2002). The blue dots indicate the second most aggressive tax havens. The size of the dots indicates the number of municipalities included. The gray vertical line shows the minimum tax rate of 9.1%, which applies from 2004.

[Click here to return to reference in text]

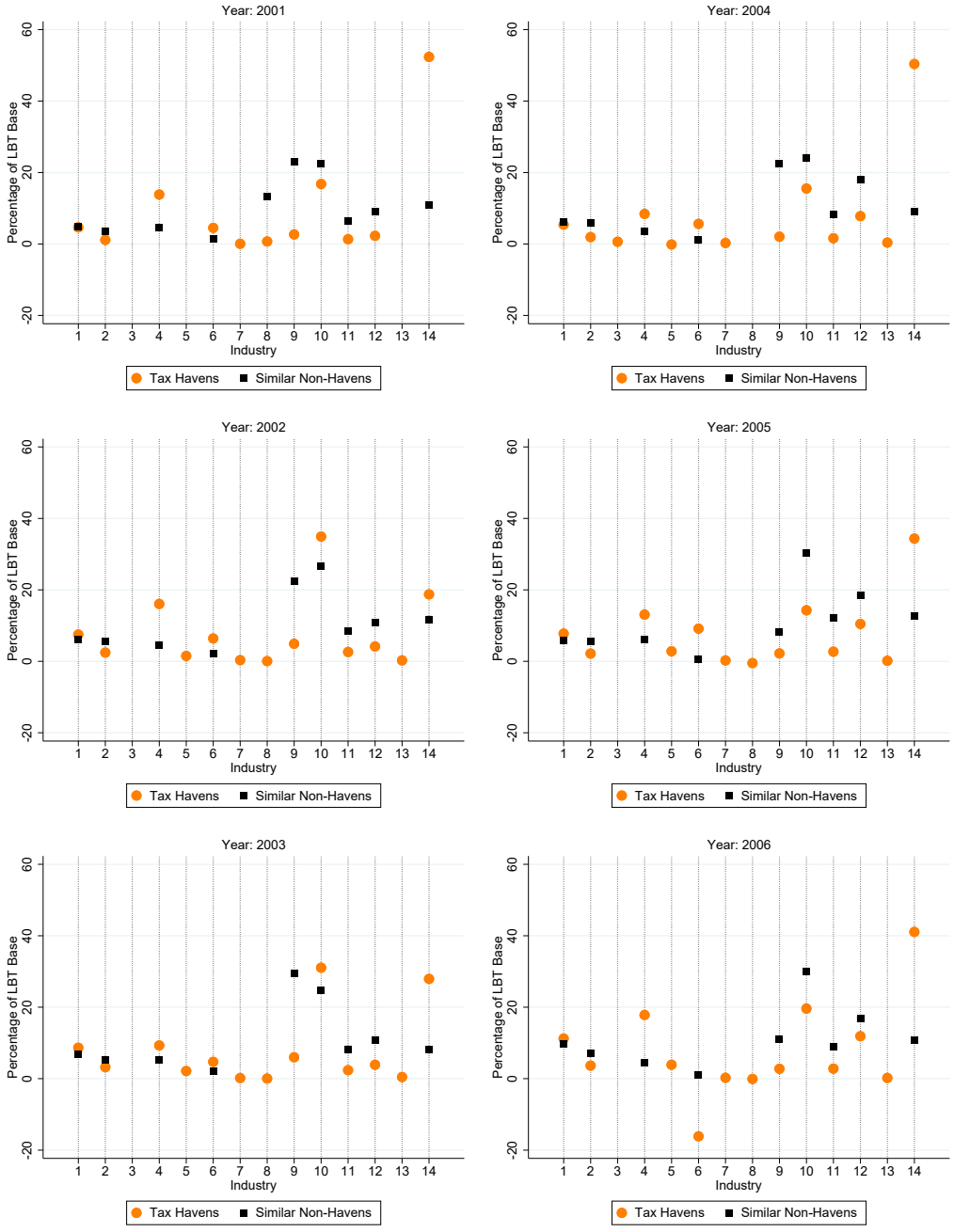
Figure 9: Industry Breakdown of Firms in Tax Havens and Similar Non-Havens: Firms



Notes: The orange circles indicate tax havens (LBT rate below 9.1% in 2002). The black squares indicate similar non-havens identified by 3-nearest neighbor propensity score matching based on a set of municipality demographics of tax havens in 2002. Industries: (1) agriculture, forestry & mining; (2) food & consumables; (3) apparel; (4) wood processing, glass & ceramics; (5) chemicals; (6) metal production & mechanical engineering; (7) furniture, jewelry & recycling; (8) energy & water supply; (9) construction; (10) wholesale & retail; (11) hospitality; (12) traffic & communication; (13) finance & insurance; (14) real estate, renting of movable property & services for enterprises.

[Click here to return to reference in text]

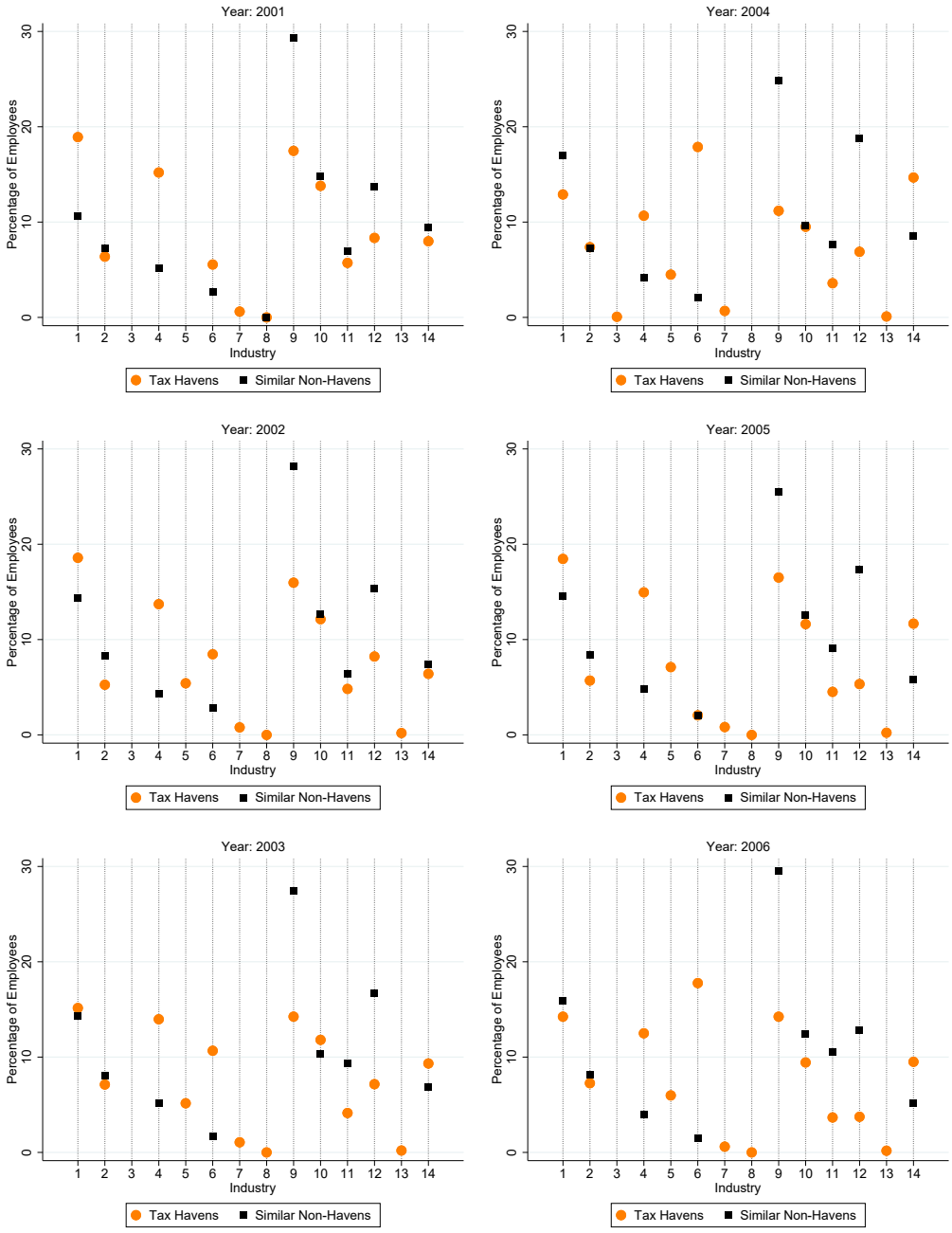
Figure 10: Industry Breakdown of Firms in Tax Havens and Similar Non-Havens: LBT Base



Notes: The orange circles indicate tax havens (LBT rate below 9.1% in 2002). The black squares indicate similar non-havens identified by 3-nearest neighbor propensity score matching based on a set of municipality demographics of tax havens in 2002. Industries: (1) agriculture, forestry & mining; (2) food & consumables; (3) apparel; (4) wood processing, glass & ceramics; (5) chemicals; (6) metal production & mechanical engineering; (7) furniture, jewelry & recycling; (8) energy & water supply; (9) construction; (10) wholesale & retail; (11) hospitality; (12) traffic & communication; (13) finance & insurance; (14) real estate, renting of movable property & services for enterprises.

[Click here to return to reference in text]

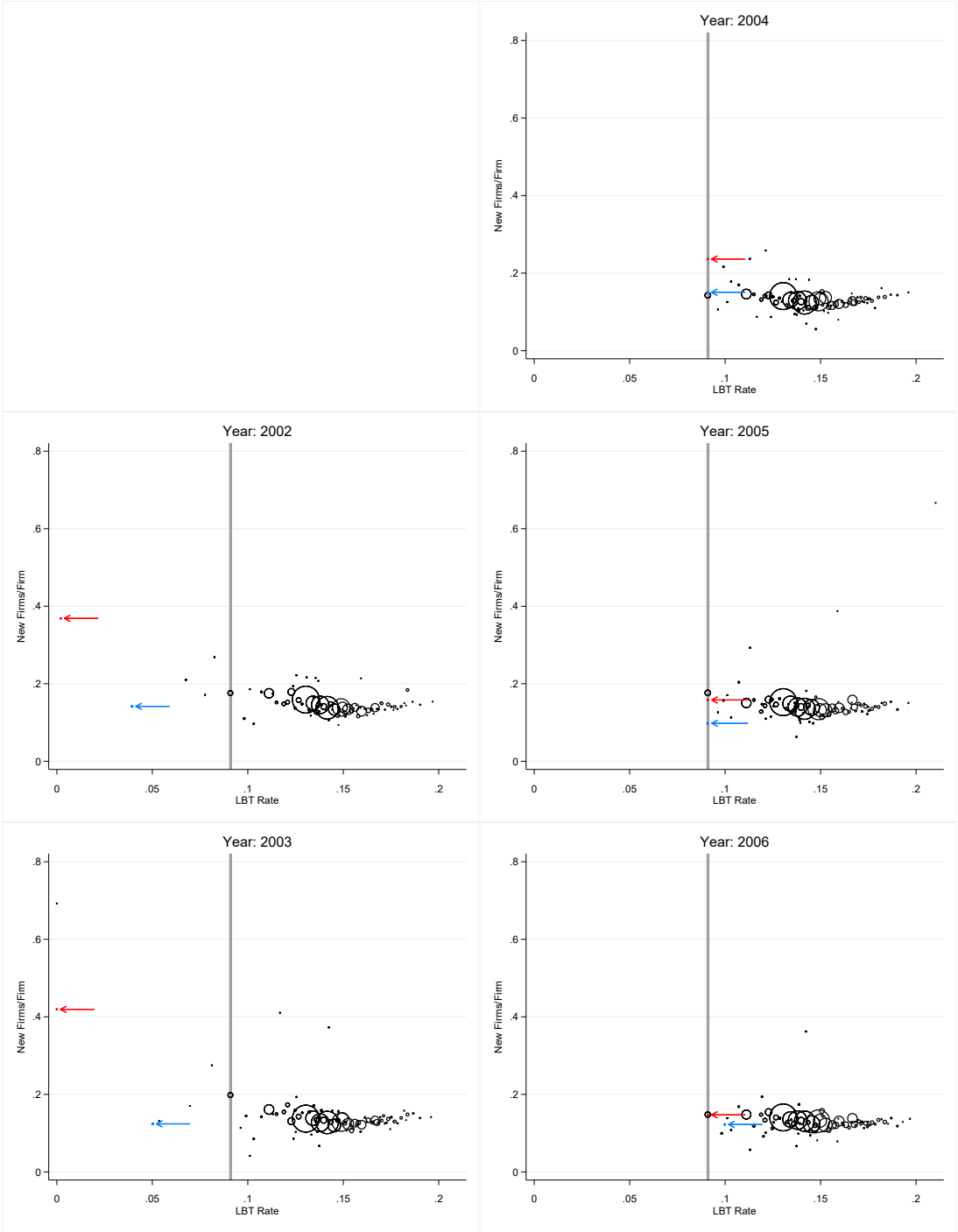
Figure 11: Industry Breakdown of Firms in Tax Havens and Similar Non-Havens: Employees



Notes: The orange circles indicate tax havens (LBT rate below 9.1% in 2002). The black squares indicate similar non-havens identified by 3-nearest neighbor propensity score matching based on a set of municipality demographics of tax havens in 2002. Industries: (1) agriculture, forestry & mining; (2) food & consumables; (3) apparel; (4) wood processing, glass & ceramics; (5) chemicals; (6) metal production & mechanical engineering; (7) furniture, jewelry & recycling; (8) energy & water supply; (9) construction; (10) wholesale & retail; (11) hospitality; (12) traffic & communication; (13) finance & insurance; (14) real estate, renting of movable property & services for enterprises.

[Click here to return to reference in text]

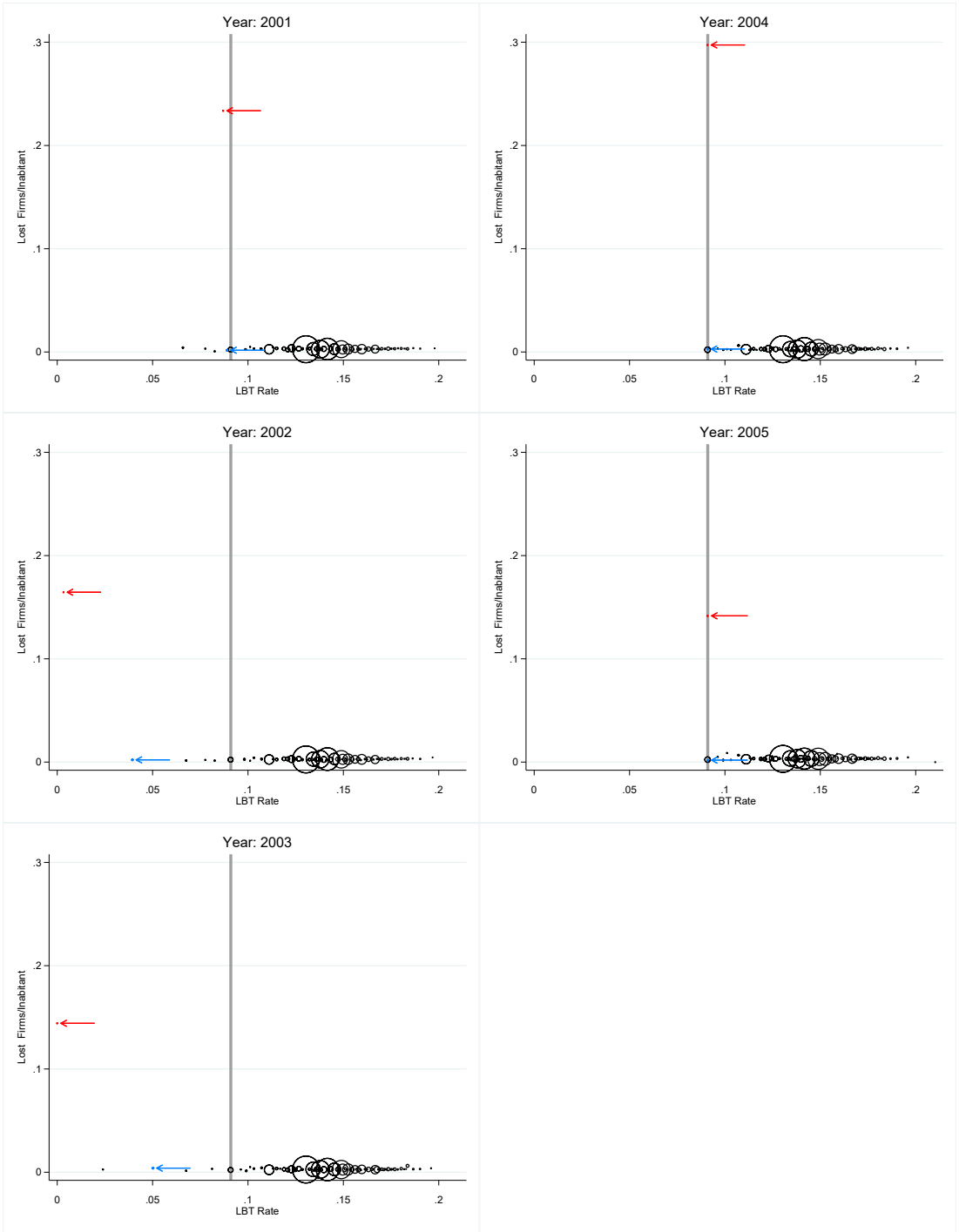
Figure 12: Firm Entries per Inhabitant (2001-2006)



Notes: The dots show the average LBT rate as well as the average for the variable of interest. The red dots indicate the most aggressive tax havens (based on the LBT rates in 2002). The blue dots indicate the second most aggressive tax havens. The size of the dots indicates the number of municipalities included. The gray vertical line shows the minimum tax rate of 9.1%, which applies from 2004. No data for 2001.

[Click here to return to reference in text]

Figure 13: Firm Exits per Inhabitant (2001-2006)



Notes: The dots show the average LBT rate as well as the average for the variable of interest. The red dots indicate the most aggressive tax havens (based on the LBT rates in 2002). The blue dots indicate the second most aggressive tax havens. The size of the dots indicates the number of municipalities included. The gray vertical line shows the minimum tax rate of 9.1%, which applies from 2004. No data for 2006.

[Click here to return to reference in text]

Table 1: Descriptive Statistics for Tax Havens and Non-Havens (2001-2003 Means)

				Quartiles		
	N	**Mean**	**Std-Dev**	**25%**	**50%**	**75%**
Panel A: Tax Havens						
LBT Rate (%)	25	6.60	2.91	5.33	7.52	8.53
Surface Area (km²)	25	36.35	69.29	6.57	15.03	29.69
Used Area (%)	21	99.99	0.04	100.00	100.00	100.00
Settlement Area (%)	21	6.50	5.76	4.01	5.19	6.58
Farming Area (%)	21	55.90	29.34	37.19	68.04	76.06
Business Area (%)	18	0.31	0.70	0.00	0.07	0.17
Population	25	1,069	1,604	285	624	1,149
Δ Population	25	-3.70	28.01	-15.00	-4.00	0.50
Population/km²	25	46.98	53.61	21.69	30.97	46.76
Females (%)	23	49.07	2.12	48.11	49.69	50.62
Births (%)	23	0.59	0.26	0.40	0.61	0.75
Deaths (%)	23	1.14	0.52	0.71	1.19	1.32
Youth (%)	25	17.15	1.55	15.87	16.94	17.90
Elderly (%)	25	17.77	1.44	16.55	17.66	19.05
Land Value (€/m²)	10	24.00	12.50	16.70	22.81	28.82
Unemployed (%)	23	8.64	3.28	6.83	9.20	10.64
GDP/Capita, district (€)	11	16,944	3,890	14,309	14,544	21,363
Panel B: Non-Havens						
LBT Rate (%)	12,104	14.00	1.32	13.04	14.04	14.89
Surface Area (km²)	12,125	27.88	33.66	8.20	16.94	34.46
Used Area (%)	11,769	99.98	1.38	100.00	100.00	100.00
Settlement Area (%)	11,769	11.56	7.95	6.67	9.35	13.58
Farming Area (%)	11,769	57.92	20.59	43.61	59.16	74.24
Business Area (%)	10,783	0.76	1.43	0.07	0.31	0.83
Population	12,125	6,732	43,979	599	1,512	4,565
Δ Population	12,051	13.36	230.48	-10.00	0.00	14.00
Population/km²	12,125	179.69	266.09	52.02	92.91	188.91
Females (%)	12,123	50.16	1.92	49.30	50.30	51.19
Births (%)	12,123	0.84	0.30	0.68	0.84	0.99
Deaths (%)	12,123	0.97	0.45	0.73	0.91	1.12
Youth (%)	12,115	19.16	2.07	17.62	19.53	20.69
Elderly (%)	12,115	17.65	1.71	16.46	17.45	18.89
Land Value (€/m²)	8,374	74.61	71.05	28.82	50.24	90.85
Unemployed (%)	12,112	5.07	3.38	2.65	3.65	6.98
GDP/Capita, district (€)	9,787	20,240	5,656	16,745	20,159	22,485

Notes: Tax havens (Panel A) are defined as those municipalities that set an LBT rate below 9.1% in 2002. Non-havens (Panel B) are all the remaining municipalities.

[Click here to return to reference in text]

Table 2: Nature of Economic Activity in Tax Havens and Non-Havens (2001-2003 Means)

				Quartiles		
	N	**Mean**	**Std-Dev**	**25%**	**50%**	**75%**
Panel A: Tax Havens						
Employees/Capita	23	0.21	0.56	0.04	0.08	0.10
Employees/Firm	25	3.26	3.04	1.29	2.64	3.71
LBT Base/Capita	23	175,765	794,158	1,210	2,407	5,158
LBT Base/Firm	25	334,107	804,781	51,754	119,772	150,848
LBT Base/Employee	23	170,877	416,265	27,444	38,777	74,036
Sales/Capita	23	512,123	2,368,697	4,109	6,881	12,930
Sales/Firm	25	690,384	1,241,163	187,744	277,295	376,118
Sales/Employee	23	381,576	952,310	87,774	120,246	205,320
Firms/Capita	23	0.17	0.68	0.02	0.02	0.03
Δ Firms/Capita	23	0.04	0.19	0.00	0.00	0.00
LBT Amount/Capita	23	407	1,051	6	27	203
Panel B: Similar Non-Havens						
Employees/Capita	52	0.08	0.08	0.03	0.06	0.09
Employees/Firm	52	3.31	2.79	1.52	2.92	4.03
LBT Base/Capita	52	2,944	3,123	1,053	2,199	3,735
LBT Base/Firm	52	117,911	97,344	52,608	97,896	145,768
LBT Base/Employee	52	47,529	41,836	30,469	37,226	52,427
Sales/Capita	52	8,025	8,448	2,658	5,465	9,641
Sales/Firm	52	328,432	293,870	138,260	241,052	399,738
Sales/Employee	52	118,686	103,645	68,728	87,366	137,099
Firms/Capita	52	0.02	0.01	0.02	0.02	0.03
Δ Firms/Capita	52	0.00	0.00	0.00	0.00	0.00
LBT Amount/Capita	52	139	645	5	19	40
Panel C: All Non-Havens						
Employees/Capita	12,123	0.10	0.09	0.04	0.08	0.13
Employees/Firm	12,125	3.36	3.05	1.71	2.78	4.24
LBT Base/Capita	12,123	6,058	10,494	2,170	3,992	7,091
LBT Base/Firm	12,125	201,693	312,833	92,697	142,154	228,078
LBT Base/Employee	11,908	74,136	99,981	40,268	56,963	77,764
Sales/Capita	12,123	16,344	27,572	5,315	10,045	18,639
Sales/Firm	12,125	541,683	788,655	224,325	360,323	610,359
Sales/Employee	11,908	189,164	255,360	103,320	144,669	202,598
Firms/Capita	12,123	0.03	0.01	0.02	0.03	0.03
Δ Firms/Capita	12,051	0.00	0.00	0.00	0.00	0.00
LBT Amount/Capita	12,123	130	298	25	65	149

Notes: Tax havens (Panel A) are defined as those municipalities that set an LBT rate below 9.1% in 2002. Similar non-havens (Panel B) are identified using 3-nearest neighbor propensity score matching based on a set of municipality demographics of tax havens in 2002. All non-havens (Panel C) are all the remaining municipalities.

[Click here to return to reference in text]

Table 3: Volume of Economic Activity in Tax Havens

Year	Tax Havens		All Municipalities		Havens/ All
	Obs.	Total	Obs.	Total	(in %)
Panel A: LBT Base (in € Million)					
2001	24	469.62	12,076	1,024,277	0.046
2002	25	263.16	12,139	1,040,938	0.025
2003	25	277.55	12,179	1,032,236	0.027
2004	25	372.17	12,216	969,438	0.038
2005	24	261.00	12,227	957,958	0.027
2006	23	226.53	12,239	1,028,244	0.022
Mean	24	311.67	12,179	1,008,849	0.031
Panel B: Sales (in € Million)					
2001	24	869.23	12,076	2,877,777	0.030
2002	25	762.07	12,139	2,816,767	0.027
2003	25	900.69	12,179	2,842,287	0.032
2004	25	1086.29	12,216	2,827,239	0.038
2005	24	866.93	12,227	2,900,232	0.030
2006	23	1082.56	12,239	3,167,470	0.034
Mean	24	927.96	12,179	2,905,295	0.032

Notes: Tax havens are defined as those municipalities that set an LBT rate below 9.1% in 2002. All municipalities are all the municipalities included in our sample (including tax havens).

[Click here to return to reference in text]

Table 4: Responsiveness of Municipality-Level Business Activity to Tax Rates

Dependent Variable	**log(LBT Base)**		**log(Sales)**		**log(Input Costs)**		**log(Firms)**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
LBT Rate	-6.025***	-0.956	*-7.047****	*-1.087*	*-7.855****	*-1.134*	*-0.592*	*-0.264*
***Pre**	(0.848)	(0.830)	*(0.859)*	*(0.668)*	*(0.958)*	*(0.865)*	*(0.383)*	*(0.233)*
LBT Rate	-6.570***	-1.169	*-8.414****	*-1.756***	*-9.316****	*-1.983***	*-1.013***	*-0.603***
***Post**	(0.893)	(0.851)	*(0.881)*	*(0.676)*	*(0.942)*	*(0.917)*	*(0.390)*	*(0.235)*
ZeroHaven	*7.110****		*7.184****		*7.343****		*4.672****	
***Pre**	*(0.124)*		*(0.125)*		*(0.139)*		*(0.0572)*	
ZeroHaven	*5.268***		*4.966***		*4.532**		*2.623**	
***Post**	*(1.679)*		*(2.131)*		*(2.609)*		*(1.423)*	
OtherHaven	*-0.165*		*-0.139*		*-0.192*		0.0618	
***Pre**	*(0.243)*		*(0.216)*		*(0.203)*		(0.117)	
OtherHaven	*0.226*		*0.211*		*0.171*		0.102	
***Post**	*(0.233)*		*(0.216)*		*(0.223)*		(0.115)	
Background Charact.	Yes	No	Yes	No	Yes	No	Yes	No
Municipality Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
State-by-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R2	0.85	0.97	0.86	0.98	0.83	0.98	0.95	0.99
N	70,712	70,712	71,603	71,603	71,601	71,601	71,603	71,603

Notes: These results are from an ordinary least squares regression. Unclustered standard errors shown in parentheses. *** p<0.01, ** p<0.005, * p<0.1. Italics indicate that the difference between the coefficients for the pre-minimum tax rate and post-minimum tax rate periods is statistically significant at conventional confidence levels. Background characteristics are the natural logarithm of the surface area, proportions of the surface area in use overall, for settlement and streets, and for farming; the natural logarithm of total population, proportion of the population that is female; and births, deaths, youth population and elderly population per capita.

[Click here to return to reference in text]

Table 5: LBT Rate Changes by Year

	2002	2003	2004	2004E	2005	2006	Diff. 2004 2002	Diff. 2004E 2002	Diff. ≥2004 ≤2003
# Rate Increases to/above Min.	3	10	21	1	0	0	18	-2	0.50
# Rate Decreases to/below Min.	9	10	9	9	9	4	0	0	-2.17
Rate Increases, % of Mun.	7.56	8.89	8.12	7.97	10.37	7.34	0.57	0.41	0.38*
Mean Change (Increase), p.p.	0.78	0.80	0.91	0.81	0.75	0.75	0.12***	0.02	0.00
Median Change (Increase), p.p.	0.67	0.74	0.73	0.73	0.73	0.38	0.06***	0.06***	-0.01**
Rate Decreases, % of Mun.	0.68	0.65	0.62	0.62	0.69	0.86	-0.05	-0.05	0.06
Mean Change (Decrease), p.p.	-1.71	-1.45	-1.36	-1.36	-1.16	-1.02	0.35	0.35	0.42**
Median Change (Decrease), p.p.	-0.73	-0.38	-0.75	-0.75	-0.73	-0.72	-0.02	-0.02	-0.05
Rate Changes, % of Mun.	8.23	9.54	8.74	8.59	11.06	8.19	0.51	0.36	0.44*
Mean Change (Change), p.p.	0.58	0.65	0.74	0.65	0.63	0.56	0.16***	0.07	0.03
Median Change (Change), p.p.	0.50	0.73	0.73	0.72	0.72	0.37	0.23***	0.22***	-0.15***
Uncond. Mean Change, p.p.	0.05	0.06	0.07	0.06	0.07	0.05	0.02***	0.01*	0.01*
Uncond. Median Change, p.p.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00*
Municipalities	11,990	12,011	12,042	12,022	12,106	12,158			

Notes: 2004E indicates the sample that excludes municipalities that raised rates to the minimum. *** p¡0.01, ** p¡0.005, * p¡0.1 based on p-values of the two-sample t test for means and the non-parametric median test for medians.

[Click here to return to reference in text]

Table 6: 2SLS Regressions of the 2002-2004 Changes in own LBT Rate, Instrumenting for Neighbors' LBT Rates with Increases Required to Comply with the Minimum Tax Rate

Weighting	**Closest 3 by Midpoint Distance**	**Closest 5 by Midpoint Distance**	**All in Same District**	**Inverse Distance**	**Inverse Distance Squared**	**Population/ Distance**	**Population/ Distance Squared**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Change in Neighbors' Avg. LBT Rate	-0.00737	-0.00897	-0.0137	0.380	0.0388	73.03	0.456
	(0.0181)	(0.0219)	(0.0311)	(0.552)	(0.0555)	(154.9)	(0.417)
Change in Background Charact.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	11,672	11,693	11,586	11,632	11,632	11,698	11,698
Adj. R2	0.05	0.05	0.06	0.06	0.06	.	0.06

Notes: Sample excludes municipalities forced to raise tax rates to the minimum. Standard errors shown in parentheses are clustered at the municipality level. *** p<0.01, ** p<0.005, * p<0.1.

[Click here to return to reference in text]

Acknowledgments

We thank Shafik Hebous, Petro Lisowsky, Dominika Langenmayr, and Reinald Koch as well as the participants of the National Tax Association Annual Conference on Taxation 2017, Annual Symposium of the Centre of Business Taxation 2018, Conference on Accounting, Auditing and Taxation Siegen 2018, Annual MaTax Conference 2018, Augolstadt Seminar 2021, and Annual Conference on Finance and Accounting 2022 for their helpful comments. We are indebted to Melanie Heiliger, Anette Erbe, and Hannes Fauser (all the RDC of the Federal Statistical Office and the Statistical Offices of the Federal States) for their invaluable support in facilitating remote analysis of the confidential tax return data.

Data Source

The RDC of the Federal Statistical Office and the Statistical Offices of the Federal States, VAT Panel, 2001-2006 (DOI: 10.21242/73311.2017.00.01.2.1.0).