# Why the Current Tax Rate Tells You Little: Competing For Mobile and Immobile Firms*

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**Preliminary**

**Abstract**

This paper analyses if, and to which extent, firms anticipate future tax rate changes. Differing weights of future tax rates in firms' location decisions may explain observed differences in the sensitivity of firms' location decision to current tax rates. Firms with high relocation costs, for example, are more sensitive to expected future changes in the tax rate, as they find it more costly to react to tax rate increases later. Governments react to this behavior by increasing the corporate tax rate if the share of firms with high relocation costs is high. We first derive these effects in a simple model and then test for them empirically, using the evolution of a new and highly immobile industry (wind turbines) for identification.

**Keywords:** corporate taxation, firm mobility, commitment, tax competition

**JEL Classification:** H25, H71, F21

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# 1 Introduction

Corporate tax rates are an important determinant of firms' location decisions. A ten percentage point lower corporate tax rate increases foreign direct investment by 16% on average (Feld and Heckemeyer, 2011). However, it is not only the tax rate today, but also the expected future tax rates over the lifetime of the investment that matter for the investment decision. Consider, for example, a firm that decided in 2000 to invest in either the United States or Canada. In that year, both countries had a corporate tax rate of around 40%. Over the next ten years, Canada lowered its tax rate by more than ten percentage points, while the U.S. tax rate remained constant. A firm that foresaw these changes would have preferred to invest in Canada (assuming that it would have been indifferent between the two countries in the absence of taxes).

The academic literature has so far largely neglected such expectations about future tax rates. In this paper, we provide a first study that considers both theoretically and empirically whether firms anticipate future tax rate changes. We show that the relative importance of future tax rates in a firm's location decision depends on the firm's relocation mobility. Firms with high relocation costs, for instance, are more sensitive to expected future changes in the tax rate, as they find it more costly to react to tax rate increases later. Governments anticipate firm behavior and set their tax rates accordingly; that is, they increase the tax rate when the share of immobile firms in the tax base rises.

Our results have important implications for policymakers. We show that decreases in the corporate tax rate are unlikely to be effective in attracting investments if the government cannot credibly commit to keep the tax rate low. As its credibility is strongly influenced by the mobility of firms locating in the jurisdiction, the government may not be able to influence its credibility, at least in the short term. Furthermore, our results suggest that prior empirical studies analyzing the role of tax policy on firm' decisions or the welfare costs of corporate taxation may be biased, as they use the current tax rate to approximate firms' current and future tax burden.

In more detail, our paper starts by setting up a model in which governments compete for mobile and immobile firms (i.e. firms with very low and very high relocation costs). We show that governments face commitment problems as a higher share of immobile firms poses an incentive to increase the tax rate. Accordingly, immobile firms prefer to enter in jurisdictions with a large share of mobile firms, as the mobile firms continue to pressure the government to keep tax rates low. Similarly, mobile firms are less likely to locate in (and more likely to relocate away from) a jurisdiction if the share of immobile firms in this jurisdiction is high.

We test our hypotheses empirically using the evolution of a new industry with very high relocation costs in Germany after 2000. Due to generous subsidies for green electricity, the number of wind turbines increased from roughly 5,000 in 2000 to over 23,000 in 2012. Since the most important factor in the location decision of wind turbines is wind strength, our setting allows us to explore exogenous variation in the local business tax base share of immobile firms in municipalities in Germany.

Based on panel data for 1998 to 2011 and using OLS and IV estimations in differences, we show that municipalities increase their tax rate on immobile and mobile firm profits by on average 6%, or 1.1%-points, if the tax base share of immobile firms increases from 0 to 50%. Furthermore, we estimate Poisson models on the municipality level to study firms' location decision between 1998 and 2006. Our results suggest that an increase in the share of immobile firms multiplies the negative effect of the tax rate significantly. Finally, we employ an instrumental variable approach to quantify the relative importance of the current and the future tax rate in firms' location decision. Our excluded instrument for the future tax rate is the interaction between the wind strength, the natural logarithm of agricultural to urban and industrial land in the municipalities and a trend variable. The excluded instrument for the current tax rate is an institutional reform. We find that the weight of the future tax rate is at least 80%. This suggests that firms do anticipate future tax rate changes and take them into account when making their location decision.

Our paper relates to several lines of literature. First, it relates to the literature that considers the tax sensitivity of firms' location decisions. Taxes deter firms' from locating in a particular jurisdiction (Mooij and Ederveen, 2008; Feld and Heckemeyer, 2011). However, firms greatly differ in their tax rate sensitivity. For example, theoretical models have shown that agglomeration benefits reduce the tax rate sensitivity of firms (Baldwin and Krugman, 2004; Borck and Pflüger, 2006). Using a sample of Swiss startups, Brülhart et al. (2012) test these predictions empirically and find that agglomeration forces diminish firms' sensitivity to tax differentials. Agglomeration and urbanization rents are therefore a major determinant of corporate tax rates, as they can be taxed away by jurisdictions (e.g. Jofre-Monseny, 2013; Koh et al., 2013).

Second, we also contribute to the literature on the determinants of corporate tax rates. A major explanation of the overall downward movement of corporate tax rates worldwide is that states compete for increasingly mobile capital (this tax competition literature is surveyed by Zodrow, 2010). Within this literature, our paper is closest related to Haupt and Krieger (2013), who set up a two-period model in which governments first compete in subsidies to attract firms, and then compete in taxes to avoid firm relocation. They find that higher relocation mobility increases net tax revenue, as the resulting fall in subsidy competition overcompensates the intensified tax competition.

Lastly, our paper is related to the literature on commitment in fiscal policy going back to Kydland and Prescott (1977), who established that a rational and forward-looking government that chooses a time plan for policy to maximize welfare will later re-optimize and change its plan if it can.

This paper proceeds as follows. Section 2 provides a theoretical model of firms' location decisions and the government's tax rate choice. Section 3 introduces our identification strategy and provides some background information on the renewable energy sector in Germany. Section 4 analyses how municipalities react to a larger share of immobile firms. Section 5 studies whether firms anticipate the municipalities' behavior using a reduced-form approach as well as an instrumental variables strategy. Section 6 concludes.

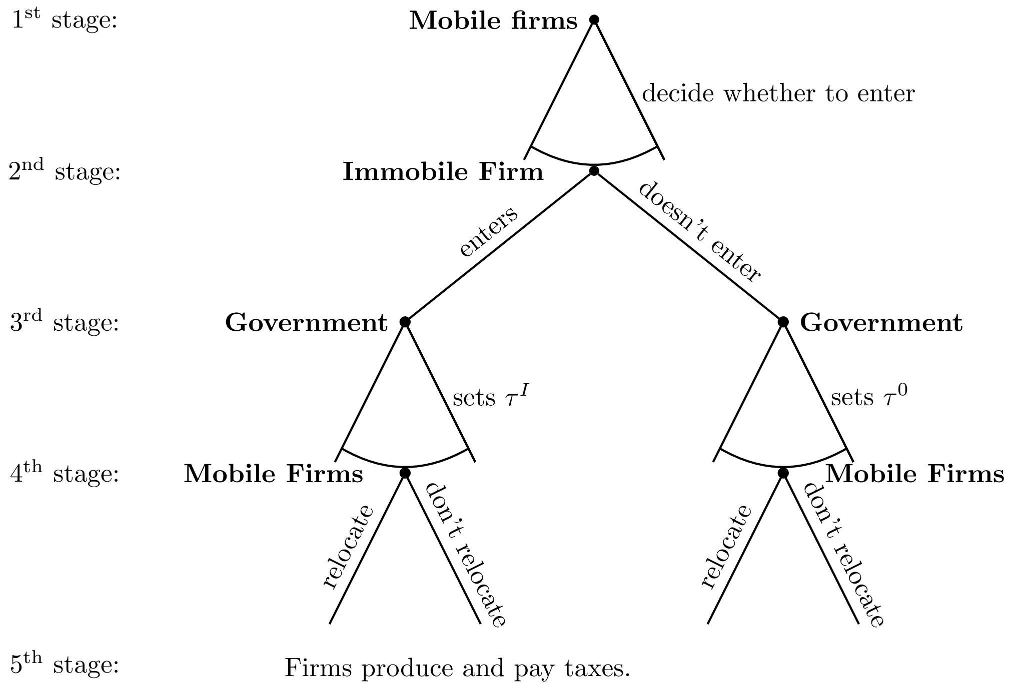
# 2 Model

## 2.1 Setup

The world in our model has many jurisdictions $j$, which offer different locational advantages for firms. Each jurisdiction sets a tax rate $\tau_{jt}$, which it can adjust in every period $t$ to maximize current period tax revenues. The jurisdictions compete with a tax haven, which offers no locational advantage for the firms but also does not tax profits. There are two firm types which differ in their mobility.

The model proceeds in four stages (see Figure 1). In the first and second stage, mobile and immobile firms decide whether to enter the market. These entry decisions may take place simultaneously or sequentially; in any case, the mobile firms do not know whether an immobile firm will enter. In the third stage, the government sets the tax rate, observing which firms are active. This ordering of the stages of the game reflects that the tax rate can be adjusted after firms have entered: For example, in the

Figure 1: Game tree




empirical study presented below, a municipality is able to adjust its tax rate as soon as an immobile firm has entered. In the fourth stage, mobile firms may relocate after observing the tax rate. In the last stage, firms produce and pay taxes.

Mobile firms realize a profit of $\beta_j \pi^M$, where $\beta_j \geq 1$ is the locational advantage for mobile firms in jurisdiction $j$. A mass $M_j$ of potential entrants has the option to enter the market in jurisdiction $j$ at a fixed cost $f_i \pi^M$. This fixed cost is firm-specific, with $f_i$ following a uniform distribution in $[0, 1]$. Firms have to enter in this specific jurisdiction ("latent start-up" model).[1] If the firm decides to relocate to the tax haven ($\beta_{Haven} = 1$), it has to pay the same fixed cost $f_i \pi^M$ to build a new factory in the tax haven.

The immobile firms use a different technology which makes them unable to relocate (because they are bound to resources that exist only in this jurisdiction or the cost of relocation is prohibitively high). Examples could be mining companies, oil extractors, or wind turbines (which will be the focus of our empirical test). These immobile firms

[1] The implicit assumption is that potential entrepreneurs are immobile and decide in each period whether to start a new firm. A successful firm is then sold to an investor, who can decide to move the firm to the tax haven (see e.g. Becker and Henderson, 2000; Brülhart et al., 2012). Using a sample of Portuguese firms, Figueiredo et al. (2002) show that indeed most entrepreneurs (72%) start firms in their home district.

realize a profit of $\alpha_j \pi^I$, where $\alpha_j$ is the locational advantage for immobile firms in location $j$. Immobile firms have a fixed set-up cost of $c_i$ when they become active, with $c_i$ uniformly distributed in $[0, 1]$. Only one immobile firm may be active in each jurisdiction. This is normalization enables us to focus on the share of mobile vs. immobile firms later on and allows us to abstract from the size of the jurisdiction.

We will first consider a benchmark model, in which only mobile firms are active. This benchmark model corresponds to a situation in which neither firms nor the government anticipate that the technology of the immobile firms will become available in the future. Therefore, in the empirical test, the results from the benchmark model correspond to the situation before wind turbines became widespread.

## 2.2 Benchmark Model: Mobile Firms Only

We start with the benchmark model, in which only mobile firms are active (i.e. the model without stage 2). We denote all variables in this benchmark case by the subscript $b$ and drop the index $j$ for the jurisdiction for ease of notation.

Solving backwards, we first consider the relocation decision of mobile firms. Mobile firms relocate if their after-tax profit, $(1-\tau_b)\beta\pi^M$, is lower than the profit they would realize when relocating to the tax haven, $\pi^M - f_i\pi^M$. Thus, in the benchmark model, those mobile firms with

$$f_i < 1 - (1-\tau_b)\beta \tag{1}$$

relocate.

Anticipating this relocation decision, the government sets the tax rate to maximize tax revenue. Tax revenue in this benchmark case, $T_b$, is

$$T_b = \tau_b \left\{ \mu_b M \beta \pi^M - \left[1 - (1-\tau_b)\beta\right] M \beta \pi^M \right\}, \tag{2}$$

where $\mu_b M$ is the mass of mobile firms that has entered in stage 1.

The revenue-maximizing tax rate in the benchmark model, $\tau_b$, is

$$\tau_b = \frac{\mu_b + \beta - 1}{2\beta}. \tag{3}$$

This tax rate is higher when the tax base is larger, i.e. when there are either more firms (higher $\mu_b$), or the firms are more profitable (higher $\beta$).

Anticipating this tax rate, the firms decide whether to enter. A firm will enter if it will be profitable, i.e. if its fixed costs are such that $(1-\tau_b)\beta\pi^M - f_i\pi^M \geq 0$. Using eq. (3) and that $f_i$ is uniformly distributed in $[0,1]$, the mass of firms that enters is

$$\mu_b M = \frac{\beta+1}{3} M. \tag{4}$$

Thus, more firms enter in jurisdictions with a high locational advantage. Lastly, for later use, note that the equilibrium tax rate $\tau_b^*$ is

$$\tau_b^* = \frac{2\beta-1}{3\beta}. \tag{5}$$

## 2.3 Mobile and Immobile Firms

Now we turn to the full model with both mobile and immobile firms, as described in Figure 1. The main difference is that the government will now differentiate its tax rate based on whether an immobile firm has entered or not. Thus, the mobile firms can only base their entry decision on an expected tax rate. This yields an additional rationale to relocate in the fourth stage, namely when the tax rate turns out to be higher than expected.

We again solve the model backwards and start with the relocation decision of mobile firms. Mobile firms relocate if their fixed costs are sufficiently low, i.e. if

$$f_i < 1 - (1-\tau)\beta, \tag{6}$$

where $\tau \in \left\{\tau^I, \tau^0\right\}$ is the tax rate that the government chose in the third stage ($\tau^I$ if an immobile firm is active, $\tau^0$ if not). The immobile firms cannot relocate by assumption.

In the third stage, the government observes which firms have entered and anticipates the relocation decisions. It maximizes its expected tax revenue, which depends on whether an immobile firm entered in the second stage:

$$T = \begin{cases} \tau^0 \left\{\mu M \beta \pi^M - \left[1-(1-\tau^0)\beta\right] M\beta\pi^M\right\}, & \text{if no immobile firm entered,} \\ \tau^I \left\{\alpha\pi^I + \mu M \beta \pi^M - \left[1-(1-\tau^I)\beta\right] M\beta\pi^M\right\}, & \text{if an immobile firm entered.} \end{cases} \tag{7}$$

The revenue-maximizing tax rates are

$$\tau^0 = \frac{\mu+\beta-1}{2\beta}, \qquad \tau^I = \frac{\eta}{2\beta} + \frac{\mu+\beta-1}{2\beta} = \frac{\eta}{2\beta} + \tau^0, \tag{8}$$

with $\eta = \frac{\alpha\pi^I}{\beta\pi^M M}$ denoting the potential tax base share of the immobile firm. Thus, the government always chooses a higher tax rate if the an immobile firm is active. The tax rate rises in the tax base: $\tau^0$ increases both with $\mu$ (i.e. the number of active firms) and $\beta$ (their profitability). In addition, the mark-up in the tax rate if an immobile firm enters is higher, the higher the tax base share of the immobile firm.

**Lemma 1 (Optimal Tax Rates)** *A jurisdiction sets a higher tax rate after an immobile firm has entered.*

Anticipating these tax rates, firms decide whether to enter or not. Mobile firms decide based on an expected tax rate, $E(\tau) = p\tau^I + (1-p)\tau^0$, where $p$ is the probability that an immobile firm enters. In contrast, the immobile firm anticipates that if it enters, the tax rate will be increased to $\tau^I$. Therefore, it enters only if $\alpha\pi^I(1-\tau^I) \geq c_i\pi^I$. Given that $c_i$ is uniformly distributed, $p$ is

$$p = (1-\tau^I)\alpha = \left(1 - \frac{\eta}{2\beta} - \frac{\mu + \eta - 1}{2\beta}\right)\alpha. \tag{9}$$

Mobile firms base their entry decision on the expected tax rate, $E(\tau)$: Given that $f_i$ is uniformly distributed, a mass $\mu M$ of mobile firms which enters is

$$\begin{aligned} \mu M &= [1 - E(\tau)]\,\beta M, \\ &= \left(\frac{\beta+1}{3} - \frac{p\eta}{3}\right) M. \end{aligned} \tag{10}$$

Using eq. (10) in eq. (9), we can now solve for the equilibrium probability of entry by an immobile firm, $p^*$, and the equilibrium entry by mobile firms, $\mu^*$,

$$p^* = \frac{2\beta + 2 - 3\eta}{6\beta - \eta\alpha}\alpha = (1-\tau_b)\frac{6\beta\alpha}{6\beta - \eta\alpha} - \frac{3\eta\alpha}{6\beta - \eta\alpha}, \tag{11}$$

$$\mu^* = \frac{\beta+1}{2} - \frac{2\alpha\eta(\beta+1) - 3\alpha\eta^2}{12\beta - 2\eta\alpha}. \tag{12}$$

It is less likely that an immobile firm will enter if the tax rate when the new technology first became available ($\tau_b$) is higher. A higher potential share of the tax base (higher $\eta$) will increase $p^*$ if the locational advantage of immobile firms ($\alpha$) is high relative to the locational advantage of mobile firms ($\beta$). Fewer mobile firms enter if the location is more attractive for immobile firms.

**Proposition 1 (Firm Entry)**

1. *The immobile firm's entry decision depends on $\tau^I$, i.e. the future tax rate which takes into account that the government will increase the tax rate after the immobile firm's entry.*
2. *Mobile firms entry decision depends on the expected future tax rate. Fewer firms enter than in the benchmark model.*

**Proof.** Rewriting eq. (10) as $\mu = \mu_b - \frac{p\eta}{3}$ shows that fewer firms enter. ■

As soon as the new technology used by the immobile firm becomes available, firms will try to anticipate future tax rates. In particular, they will be interested to know how much tax rates might rise. To see which information they can use, we rewrite $\tau^I$ from eq. (8) as a function of exogenous parameters and the benchmark tax rate, $\tau_b$:

$$\tau^I = \tau_b + \frac{\eta(3-\alpha) + \tau_b \eta\alpha}{6\beta - \eta\alpha}. \tag{13}$$

We see that this tax rate will be a function of the locational advantages, $\alpha$ and $\beta$, the prior tax rate, $\tau_b$, and an interaction of the prior tax rate with the expected tax base share of the immobile firms ($\eta\alpha$). Here, $\eta$ captures the potential tax base share of immobile firms, and $\alpha$ proxies the probability of entry by an immobile firm.

# 3 Empirical Strategy

Our model has two main implications: First, it finds that governments increase tax rates when an immobile firm enters a jurisdiction. Second, it shows that forward-looking firms anticipate such increases. In particular, the model implies that firms prefer to locate in jurisdictions with few immobile firms, as this decreases the likelihood of future tax rate hikes.

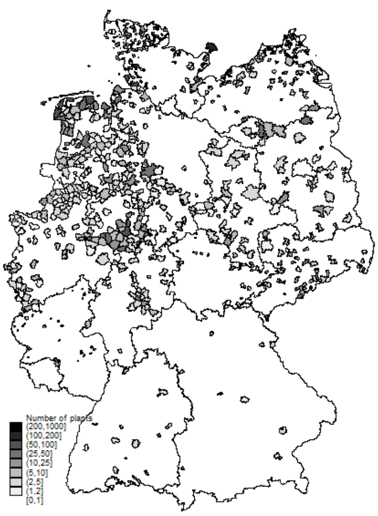
In the following, we empirically test these hypotheses. To do so, we exploit a specific setting; that is, the evolution of a new and highly immobile industry within Germany. The setting within Germany is particularly suited for our analysis. In Germany, municipalities have the right to tax corporate profits. This local business tax accounts for roughly 50% of the tax burden on profits. In most of the over 11.000 municipalities, the tax rate is between 14% and 19%, with a mean of 16%.[2] While the municipalities decide about the tax rate, the tax base is defined by the federal government. Profits are subject to the local business tax in the municipality where the plant (and not, for example, the firm's HQ) is located. Thus, this setting in Germany provides ample vari-

[2]The reader should note that not the tax rate but the local business tax multiplier is set by the municipality. The calculation of the tax is however straight forward. As a rule of thumb, the multiplier has to be multiplied with 5% before 2008 and 3.5% afterwards to derive the tax rate. The tax rate of 14 to 19% are based on the years up to 2008 and without consideration of the deductibility of the local business tax from the local business tax. Taking the deductibility into account gives a range from 12.2% to 16%.

ation in tax rates without regulatory or tax base differences that could be problematic in a cross-country setting.

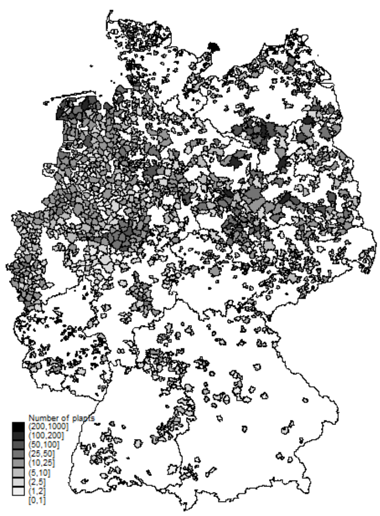
Our identification strategy relies on changes in the mobility of the tax base. To identify such changes, we consider the market entry of very immobile firms: wind turbines. At the beginning of our sample period in 1998, only very few wind turbines existed in Germany (see Figure 2). The installed turbine capacity grew by more than 400% until 2011 (see Figure 3). In 2011, the profits of wind turbines were a significant source of tax revenue for many rural municipalities – on average about 13% of the local business tax revenue in the municipalities with at least one wind turbine.

Figure 2: Number of Wind Turbines 1998




*Source:* Own calculations based on data of the operator database 1990 to 1998.

Figure 3: Number of Wind Turbines 2011




*Source:* Own calculations based on data of the operator database 1990 to 2011.

The evolution of this new firm type is particularly suitable for our setting for two reasons. Firstly and most importantly, it is extremely costly for wind turbines to relocate. Most of the investment is very specific to the location of the investment. The choice of turbine technology, for example, is strongly influenced by wind conditions at a particular location. Land is often bought or leased at with a very long contract[3] Moreover, the actual cost of relocating is extremely high, even if an alternative location for which the particular technology is suited can be found.

Second, the location decision of wind turbines is relatively simple. The most important location specific factor is the wind strength, the two others are local business

[3]As the lifetime of a wind turbine is 20 years, lease contracts are commonly concluded for 20 years.

taxes and agricultural land prices.[4] Differences in wage costs are not important as there is almost no labor involved in wind electricity generation. Given the limited number of determinants for wind turbines' location decision, municipalities have few options to attract wind turbines, except for the local business tax rate.

In particular, there are no subsidies for renewable energies at the municipal, county or state level. The main subsidy for wind turbines is a guaranteed wholesale price, which is the same across all German municipalities as it is set by the federal government. It stems from the Renewable Energy Act from 2000, which the German government introduced to promote investment into renewable energies as agreed in the Kyoto Protocol and in the Lisbon Treaty. It guarantees a wholesale price above the market price for energy produced by renewable energy sources for 20 years after the installation of the plant.[5] Following the introduction of this law in 2000, the share of electricity produced by renewable energy sources more than tripled until 2011.

# 4 Municipality Level: Tax Rate Choice and Immobile Firms

In this section, we provide evidence that municipalities raise the tax rate on firm profits if the tax base share of immobile firms in the municipality increases. We use the tax base share as this capture the number of mobile and immobile firms as well as their profitability.

## 4.1 Data and Descriptive Statistics

To test the predictions of our theoretical model, we use municipality level data for the years 1998 to 2011. Due to substantial changes in the administrative boundaries of municipalities in Saxony-Anhalt during the whole sample period, we excluded this

[4]Wind turbines are mainly build on agricultural land as a minimum distance to populated areas is required.

[5]For further details see Haan and Simmler (2016).

state from the empirical analysis.[6] In our empirical analysis, we use the following variables: the local business tax multiplier, set by the municipality, the local business tax base implied by taxes paid, the population and the share of agricultural land in the municipality. All data is from the German Federal Statistical Office.

We simulate the tax base from wind turbines using information on the average wind strength in a municipality, provided by the German Weather Service, and information on the location and the technological details of each wind turbine in Germany from the operator database (for further details see Haan and Simmler, 2016). To capture the incentives at work outlined in the theoretical model, we construct the tax base share of immobile firms, by dividing the simulated tax base of wind turbines build up to t-2 by the local business tax base in 1998 and the tax base of wind turbines build up to t-2. We consider only the wind turbines build up to t-2 as we are interested in municipalities' behavior and are thus interested about what they know at which time. Municipalities do not assess the tax base of the local business tax, which is done by the tax authority. Due to the involvement of these two institutions, local business taxes are usually paid in the year after the profits have been generated. Thus, when a municipalities decides about its tax rate in year $t$ (a decision that has to be made by law until end of June of year $t$), its information about its overall tax base is based on its tax receipt in year $t-1$, which in turn are based on the profits in year $t-2$. Further, we scale by the tax base of mobile firms in 1998 (which we assumed to be the overall tax base in 1998) and the tax base of immobile firms in t-2 as using the observed tax base in t-2 as denominator would introduce endogeneity.[7] The only variation in the tax base share measure comes therefore from additional wind turbines in the municipality and changes in the profits of wind turbines.

Since wind turbines have mostly been build in municipalities with a large share of agricultural land and a sufficiently high wind strength, we construct a suitable control group of similar municipalities. In particular, we use a propensity score matching approach to find a suitable control group (municipalities without wind turbines in 2011). We define the treatment group as municipalities with at least one wind turbine in 2011.

[6] Other changes in administrative borders during our sample period are handled as if they had occurred at the beginning of the sample period. Administrative reforms took place in all eastern states after 1990 to reduce the number of municipalities. After excluding Saxony-Anhalt, municipalities in the state of Brandenburg (between 1998 and 2003) are affected strongest. By accounting for the border changes right from the beginning, we aim to increase comparability over time.

[7] On average our measure is very close to the true one.

We match on the average wind strength 80 meter above ground, the share of agricultural land, the natural logarithm of the local business tax base in 1998, the natural logarithm of the population in 1998, and the local business tax multiplier in 1998. We employ the one to one nearest neighbor matching method. Table A1 in the Appendix provides descriptive statistics for the treatment and control group before and after the matching, suggesting that the difference in observable characteristics are strongly reduced by the matching approach.

Table 1 shows descriptive statistics based on the matched sample. The average local business tax multiplier amounts to 340 points, which translate to a tax rate of roughly 15%.[8] The average population in our sample is 11,000. The average tax base share of immobile firms is 4%, and for the subset of municipalities with at least one wind turbine it is 13%.

Table 1: Descriptive Statistics Municipality Level

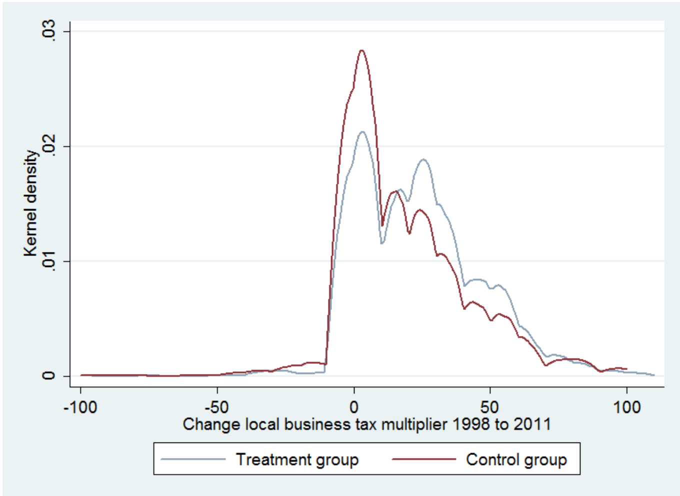
| | All municipalities | | | Municipalities with at least 1 wind turbine | | |
|---|---|---|---|---|---|---|
| | Mean | P50 | SD | Mean | P50 | SD |
| Local Business Tax Multiplier (LBT) | 342.41 | 340.00 | 38.86 | 351.05 | 343.00 | 42.76 |
| Wind Strength | 5.76 | 5.67 | 0.76 | 5.86 | 5.81 | 0.63 |
| TaxBase Share Immobile Firms | 0.04 | 0.00 | 0.13 | 0.13 | 0.03 | 0.21 |
| Population | 11,211 | 5,125 | 102,586 | 13,454 | 7,163 | 23,025 |
| d.LBT | 1.62 | 0.00 | 7.86 | 2.05 | 0.00 | 8.22 |
| d.TaxBase Share Immobile Firms | 0.01 | 0.00 | 0.05 | 0.02 | 0.00 | 0.08 |
| d.log(Population) | -0.00 | -0.00 | 0.06 | -0.00 | -0.00 | 0.02 |
| Observations | | 42,172 | | | 13,140 | |

*Source:* Authors' calculation based on Statistik Lokal, 1998 to 2011, operator data base, 1990 to 2011, and data from the German Weather Service.

We start with reporting some descriptive evidence on the relationship between the local business tax multiplier and the tax base share of immobile firms. In Figure 4, we plot the kernel density for the local business tax multiplier changes between 2000 and 2011. The figure suggest that municipalities with at least one wind turbine in 2011 (treatment group) have increased their tax rate between 1998 and 2011 compared to municipalities with no wind turbines in 2011 (control group). Figure 5 shows the average change in the local business tax points between 1998 and 2011 for five intervals

[8]More precisely, to 17% before 2008 and 12% after 2007. To derive the tax rate the multiplier is multiplied with a base rate, which was changed in 2008.

Figure 4: Kernel Density for Local Business Tax Multiplier Changes for Municipalities with (Treatment) and without Wind Turbines (Control Group) in 2011




*Notes:* Treatment group includes municipalities with wind turbines in 2011, control group includes municipalities with similar characteristics as the treatment group but with no wind turbines in 2011. Control groups municipalities are selected using propensity score matching.
*Source:* Own calculations based on data of the operator database 1990 to 2011 and Statistik Lokal 1998 to 2011.

of equal length for the change in the tax base share of immobile firms. It suggest that municipalities with larger changes in the tax base share have increased their local business tax multiplier to a larger extend.

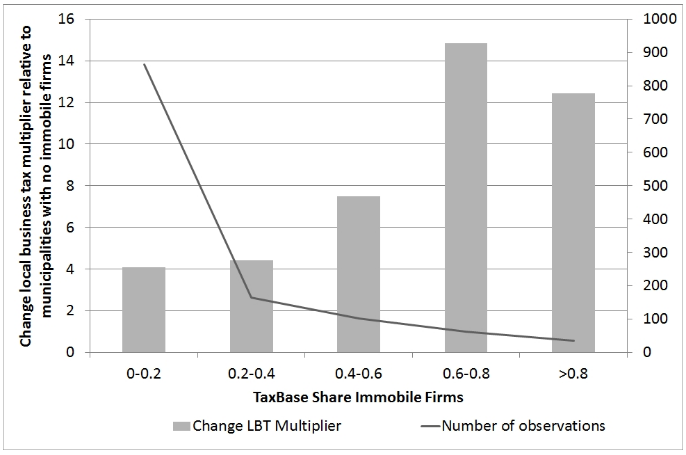
## 4.2 Estimation Equation and Results

We estimate the following linear specification to provide further evidence that municipalities increase the tax rate on firm profits when the tax base share of immobile firms rises:

$$\tau_{i,t} = c_i + \alpha WS_{i,t} + \beta \frac{T_{I,t}}{T_{0,t)}} + \gamma X_{i,t} + \epsilon_{i,t}. \tag{14}$$

The dependent variable is the local business tax multiplier in municipality $i$ at time $t$. It depends on a municipality specific fixed effect ($c_i$), on the wind strength as an indicator of the profitability of a wind turbine in the municipality ($WS_{i,t}$), and the tax base share of immobile firms ($\frac{T_{I,t}}{T_{0,t)}}$). We further include the natural logarithm of the population to capture changes in municipalities' size in the estimations as well as

Figure 5: Changes of Local Business Tax Multiplier for different Intervals of Changes of the Tax Base Shares of Immobile firms between 2000 and 2011




*Notes:* The bars indicate the change in the local business tax multiplier, the line the number of municipalities within a particular class of changes of the tax base share of immobile firms.
*Source:* Own calculations based on data of the operator database 1990 to 2011, Statistik Lokal 1998 to 2011 and the German Weather Service.

full set of time dummies. In a sensitivity analysis we also include state specific time dummies to captures any kind of political cycle. These variables are included in the matrix $X$.

We estimate equation (14) in differences to account for municipality specific effects. More precisely, we estimate in 13-year differences (between 1998 and 2011) and in 5-year differences, the latter is also used in the last part of the paper. Further, we employ an instrumental variable estimator to deal with two challenges to the empirical estimation strategy. The first is measurement error in the tax base share of immobile firms. This measurement error arises as we have to simulate the taxable profits of wind turbines. The second challenge is the potential delayed impact on the local business tax multiplier choice. The excluded instrument we employ in the IV difference equation is the interaction between the average wind strength in the municipality, the natural logarithm of the agricultural land to urban and industrial land and a trend variable.[9] In a sensitivity check, we use the interaction between the average wind strength, the natural logarithm of the tax base 1998 and a trend variable. The idea behind the variables is that more agricultural land and a higher wind strength are related to a larger tax base share of immobile firms, and a larger tax base in 1998 and more urban

[9]To ensure that the measure is well defined, we add one to the ratio.

and industrial land are related to a larger tax base of mobile firms and thus a smaller tax base share of immobile firms.

Table 2 shows the results of our regression analysis. Column (1) to (4) report the estimated coefficients for the 1998 to 2011 difference estimation, column (5) to (6) using 5-year differences. Column (1) and (5) present the OLS, column (2), (3) and (6) the IV estimates using the interaction between wind strength, the logarithm of the agricultural land to urban and industrial land and the trend as excluded instruments. In column (4) we use the interaction between wind strength, the natural logarithm of the tax base in 1998 and the trend as excluded instrument. Comparing the estimated coefficients across specifications suggests that the imprecise modeling of the timing of the tax rate change biases the OLS but not the IV results. The OLS estimate is almost twice as large for the 13-year than for the 5-year difference specification. The estimated coefficient in column (3), which is our preferred specification as state-year fixed effects are included - suggests that an increase in the tax base share of immobile firms from 0% to 50%-points causes an increase in the local business tax multiplier by 20%-points. This translate to an increase in the tax rate by 1.1%-points or roughly 6% (based on the average multiplier in the sample of 340). These results are not sensitive to the employed matching strategy, in particular if we exclude the tax variables from the matching variables, or exclude treatment observations for which no match can be found within the optimal caliper size (see Table A2, column (1) and (2)). Further, they are unaffected if we exclude Brandenburg as well, in which several municipality mergers occured in our sample period (see Table A2, column (3)).

Table 2: Estimation Results: Municipalities' Tax Rate Choice and the Tax Base Share of Immobile Firms

| Model | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dep. Var. | Change local business tax multiplier | | | | | |
| Method | OLS | | IV | | OLS | IV |
| Difference | | | 13-years | | | 5-year |
| d.TaxBase IF | 9.201*** | 28.225** | 40.686*** | 23.080** | 5.582*** | 25.525** |
| | (2.972) | (11.408) | (10.837) | (9.423) | (1.769) | (11.502) |
| d.log(Population) | 2.780 | 3.011 | -0.367 | -0.258 | 3.801 | 4.031 |
| | (1.778) | (1.883) | (1.989) | (1.978) | (2.484) | (2.569) |
| $R^2$ | 0.049 | 0.031 | 0.100 | 0.145 | 0.023 | 0.004 |
| Observations | 8,743 | 8,743 | 8,743 | 8,743 | 27,195 | 27,195 |
| Wind * YearDummies | x | x | x | x | x | x |
| State-Year-FE | | | x | x | | |
| Excluded instrument | | | | | | |
| Wind*Log($\frac{Agric.}{Urban}$) | | x | x | | | x |
| Wind*Log(Tax Base 1998) | | | | x | | |
| F-Statistic IV | . | 137 | 148 | 121 | | 107 |

*Notes:* Table shows estimated coefficient for the impact of the tax base share of immobile firms (measured as tax base immobile firms to tax base in 1998 and the tax base of immobile firms) on municipalities tax rate choice. The dependent variable is the municipality specific local business tax multiplier. To derive the tax rate the multiplier has to be multiplied with 5% before 2008 and with 3.5% after 2007. IF stands for immobile firms. In column (1) to (4), we estimate in 13-year differences, in column (5) to (6) in 5-year differences. In each regression wind strength 80 meter above ground interacted with year dummies and the year dummies itself are included (not reported). In column (1) and (5) are OLS, and in column (2), (3), (4) and (6) IV estimates are reported. The excluded instrument for the tax base share of immobile firms in column (2), (3) and (6) is the interaction between wind strength, the natural logarithm of agricultural land to urban and industrial land and a trend variable, and in column (6) the interaction between the wind strength, the natural logarithm of the tax base 1998 and a trend variable. Standard errors, shown in parentheses, are robust to heteroscedasticity and clustered at the municipality level. ***,**,* indicate significance at the 1%, 5%, 10% levels.
*Source:* Authors' calculations based on Statistik Lokal, 1998 to 2011, the operator database, 1990 to 2011, and data from the German Weather Service.

# 5 Firm Level Evidence

As we have seen in the last section, municipalities increase the tax burden on firm profits when the tax base share of immobile firms in the municipality increases. We now investigate to which extend firms anticipate these future tax rate changes when making their location decision. We start by analyzing the location decision of new firms in Germany on the municipality level using a reduced form approach, and then use an IV strategy to analyze the same questions.

## 5.1 Data and Descriptive Statistics

The firm data used for our analysis stems from the Gewerbeanzeigenstatistik, the registry of firms in Germany. It covers all firm births and exits within all German municipalities and is provided by the Federal Statistical Office. Our data covers the years 1998 to 2006 for almost all German states.[10] We use only data until 2006 as a major corporate tax reform took place in 2008 and was announced in 2007. The main tax rate variation in our sample period comes thus from local business tax rate changes.

Besides the type of the registry (new firms, re-allocated new firms), we observe the industry the firms are active in as well as their legal form. We enrich the data with the municipality information. The reader should note that we only consider "real" firm births and thus exclude firm relocations[11] as well as the start of self-employment. Although there is no clear cut between firms and self-employment, we follow the classification of the Federal Statistical Office and consider as self employed non-incorporated firms with no employees, that are not registered in the commercial register and that do not have a specific craftsmanship license.

Our main explanatory variables of interest are the local business tax rate, the tax base share of immobile firms, and the interaction between the two variables to test whether firms anticipate future tax rate changes. This proxy is based on the theoretical prediction stated in equation (13). If firms anticipate future tax rate changes, the estimated coefficient for the interaction between the tax rate and the tax base share

[10] Not available are the information for Hessen until 2000 and for Baden-Wuerttemberg and the Saarland for the whole time period. Further, we exclude Saxony-Anhalt due to changes in the administrative boundaries.

[11] Relocations are influenced by the municipality in which the firm was located and would thus require modeling this decision as well.

should be negative as a higher tax base share of immobile firms increase the likelihood that tax rates will increase in the future.

Our control variables are the spending on the municipality level in euro per capita, the population, and the size of the municipality. Due to the endogeneity of spending as well as population changes, we use 1998 values and interact them with year dummies. Since there is no time series variation in the size of the municipalities, we interact the natural logarithm of the municipality size with year dummies.

Descriptive statistics for the variables used are shown in Table 3. The sample includes 72,762 municipality-year observations between 1998 and 2006. The average local business tax is around 16%. On average, there are 5,000 inhabitants in one municipality and the average number of new firms is 10. The reader should note that we exclude the top 1% of the municipality-average number of new firms to avoid that outliers drive the results.

Table 3: Descriptive Statistics Mobile Firms

| | Mean | P25 | P50 | P75 | SD |
|---|---|---|---|---|---|
| Number of new firms | 9.85 | 1.00 | 3.00 | 9.00 | 20.17 |
| *Control Variables* | | | | | |
| LBT(t) | 16.36 | 15.00 | 16.00 | 17.50 | 1.76 |
| LBT(t+5) | 16.58 | 15.00 | 16.50 | 17.50 | 1.79 |
| TaxBase Share IF | 0.02 | 0.00 | 0.00 | 0.00 | 0.11 |
| Spending per capita | 1,419 | 1,149 | 1,339 | 1,586 | 450 |
| Population | 4,934 | 810 | 1,754 | 4,826 | 8,819 |
| Area Size | 306,241 | 93,100 | 195,400 | 391,000 | 336,086 |
| *Excluded Instruments* | | | | | |
| D(Reference Multiplier - LBT > 0) | 0.47 | 0.00 | 0.00 | 1.00 | 0.50 |
| Observations | 72,762 | | | | |

*Source:* Authors' calculations based on Statistik Lokal, 1999 to 2006, the operator database 1990 to 2006, and information from the German Weather Service.

## 5.2 Methodology

Following Brülhart et al. (2012) we estimate a Poisson model on the municipality level. As shown by Guimaraes et al. (2003) and Becker and Henderson (2000), the

Poisson model is appropriate to estimate the determinants of the location decision based on the footloose start-up as well of latent start up model. The dependent variable in our main specification is the number of new firms within a municipality in a given year.[12] We report estimated coefficients and not the marginal effects of the Poisson model as the latter are misleading for the interpretation of interaction effects. To interpret the results, we later provide graphical illustrations of the marginal effects. The reader should note that in all regression a full set of municipality specific fixed effects as well as year dummies are included in the model.

## 5.3 Results: Reduced Form Approach

The regression results are presented in Table 4. Column (1) presents the baseline specification, where no interaction effect is included. We do not find a negative impact of the local business tax on the number of new firms. In column (2) to (5) we include the proxy for the future tax rate, which is negative and statistically significant, with and without including labor market control variabels as the share of the population with and without vocational training and with university degree on the county level (column (3)). Further, the result is almost unaffected when including additional interaction effects with the tax rate, in particular, we include the natural logarithm of the number of new wind turbines and its interaction with the tax rate. If our tax base measure would simply capture that people dislike wind turbines, the estimated coefficient for the interaction between the tax base share and the tax rate should shrink to zero. Finally, results are unaffected when including state-year effects (column (5)).

The graphical illustration of the marginal effects are shown in Figure 6 and 7. In Figure 6, the marginal effect of the specification shown in column (2) is depicted. In Figure 7, marginal effects are shown for a more flexible specification in which we used 3 groups of municipalities instead of the tax base share of immobile firms: Municipalities with a tax base share of immobile firms of less than 10%, between 10 and 50%, and above 50%. Comparing Figure 6 and 7 suggest that the linear specification is a plausible approximation.

To assess the sensitivity of our results further, we also estimated a linear model using OLS. Results are reported in Table A3. In column (1) and (2) we use the inverse

[12] In a robustness check, we also used the number of new firms within a particular 2-digit industry and municipality in a given year. Results are qualitatively and quantitatively very similar to the ones presented.

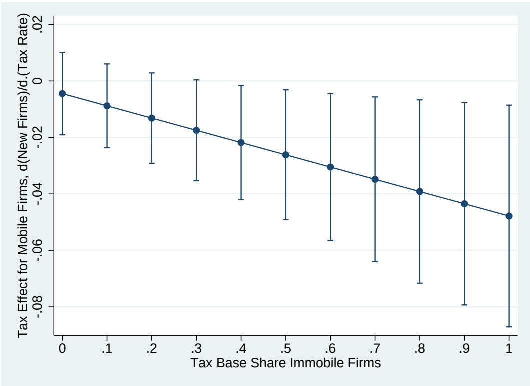
Table 4: Poisson Estimation Results: Location Decision Mobile Firms

| Model | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dep. Var. | | | Number of New Firms | | |
| LBT(t) | -0.005 | -0.005 | -0.005 | -0.076 | -0.011 |
| | (0.008) | (0.008) | (0.007) | (0.108) | (0.007) |
| LBT(t)*TaxBase Share IF | | -0.036** | -0.036** | -0.035** | -0.032** |
| | | (0.017) | (0.016) | (0.017) | (0.015) |
| LBT(t)*Log(Area) | | | | 0.005 | |
| | | | | (0.009) | |
| LBT(t)*Log(Population 1998) | | | | 0.001 | |
| | | | | (0.007) | |
| LBT(t)*Log(1+# Wind Turbines) | | | | -0.000 | |
| | | | | (0.004) | |
| TaxBase Share IF | | 0.453* | 0.519** | 0.439* | 0.493** |
| | | (0.263) | (0.251) | (0.263) | (0.237) |
| log-likelihood | -134,500 | -134,480 | -133,936 | -134,475 | -131,873 |
| Observations | 72,762 | 72,762 | 72,762 | 72,762 | 72,762 |
| Control Variables | x | x | x | x | x |
| Mun. FE | x | x | x | x | x |
| Labour Market Controls | | | x | | |
| State*Year-FE | | | | | x |

*Notes:* Poisson estimations at the municipality level for the years 1998 to 2006. The dependent variable is the number of new firms within a municipality and year. Heteroscedasticity-robust SE in parentheses. **,**,* indicate significance at the 1%, 5%, 10% levels.

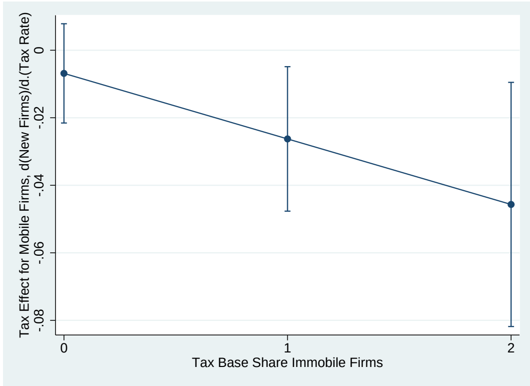
*Source:* Authors' calculations based on Statistik Lokal, 1998 to 2006, the operator database 1990 to 2006 and the German Weather Service.

Figure 6: Implied Tax Effects (Interaction Poisson Estimates)




*Notes:* The graph shows the effect of a percentage-point increase in a location's tax rate on the number of new firms within the jurisdiction for different tax base shares of immobile firms in the jurisdiction. The underlying computations are based on the coefficients and standard errors reported in Table 4, column 2. Vertical lines represent 95% confidence intervals.
*Source:* Authors' calculations based on data of the operator database, 1990 to 2006, Statistik Lokal, 1998 to 2006, and information from the German Weather Service.

Figure 7: Implied Tax Effects (3 Groups Poisson Estimates)




*Notes:* The graph shows the effect of a percentage-point increase in a location's tax rate on the number of new firms within the jurisdiction for different tax base shares of immobile firms in the jurisdiction. The underlying computations are based on a specification with 3 groups of municipalities, the first has a tax base share of immobile firms up to 10%, the second up to 50% and the third above 50%. Vertical lines represent 95% confidence intervals.
*Source:* Authors' calculations based on data of the operator database, 1990 to 2006, Statistik Lokal, 1998 to 2006, and information from the German Weather Service.

hyperbolic sine (IHS) transformation for our dependent variable and in column (3) and (4) the natural logarithm. Using the IHS transformation does change the distribution but allows to include zero observations as well, which are excluded from the analysis when taking the natural logarithm. Results are qualitatively very similar to the Poisson model for both dependent variables, but less precisely estimated.

## 5.4 Instrumental Variable Approach

In the last part of the paper, we aim to quantify the relative importance of the current and the future tax rate in firms' location decision as well as to quantify the bias in empirical work that results from neglecting the future tax rate. To do so, we include the current as well as the expected future tax rate in estimations of the firms' location decisions. Equation (15) shows the basic model we estimate. The tax rate consists of two components, the current as well as the future tax rate. Their relative importance is given by the weights $\alpha$ and $(1-\alpha)$. $\epsilon_{i,t}$ is an i.i.d error term. If we estimate the coefficients for the current and the expected future tax (as shown in eq. (16)), we are able to derive the weights of the two tax rates.[13].

$$Y_{i,t} = a + \beta(\alpha\tau_{i,t} + (1-\alpha)E[\tau_{i,t+1}]) + \epsilon_{i,t}. \tag{15}$$

$$Y_{i,t} = a + \gamma_1\tau_{i,t} + \gamma_2 E[\tau_{i,t+1}]) + \epsilon_{i,t}. \tag{16}$$

There are two main challenges when estimating equation (16). First, we do not observe the expected future tax rate by firms. Thus, we will use the observed tax rate five years ahead and use an instrumental variable approach to account for the measurement error and the potential reversed causality of firms' location decisions on the tax rate five years ahead. The excluded instrument for the future tax rate is the same variable as used on the municipality level to instrument the tax base share of immobile firms, namely the interaction between the average wind strength in the municipality, the natural logarithm of the agricultural land to urban and industrial land and a trend variable. In a robustness check, we will also use the interaction between the natural logarithm of the tax base 1998, the wind strength and the trend variable. The second difficulty is that there are - beside the problem related to the future tax rate - also other reasons why the estimate for the current tax can be biased, for example endogeneity and omitted variable bias. Thus, we will also use an instrumental variable approach for the current tax rate.

Our excluded instrument for the current tax rate is based on the state funding of municipalities. The amount of state financing allocated to a particular municipalities depends (mainly) on the budget need compared to the financing capacity of the municipality. If the difference is positive, the municipality receives a fraction of the difference as state funding. The budget need is determined by several parameters e.g. the size of the municipality, number of children, and so on. The financing capacity is determined by municipalities' own potential tax revenues and its allocated part of the income and value added tax. To derive the potential tax revenue, a fictitious tax rate instead of the tax rate chosen by the municipality is used. This fictitious tax rate is multiplied with the tax base (two years before) to derive the financing capacity of the municipality with respect to the particular tax. The fictitious tax rate differs between states and varies over time. Since the fictitious tax rate has a distinct impact on the allocation of state funds, it affects municipalities tax rate choice. This impact is independent of the

[13]The weights can be derived by solving for $\alpha$: $\alpha = \gamma_1/(\gamma_1+\gamma_2)$.

economic performance in the municipality as it changes for all municipalities within a state.[14] Baskaran (2014) uses a reform of this fictitious reference multiplier in one German state to study tax mimicking of German municipalities.

For our analysis, we collect the information for all German non-city states from 1998 to 2006 and construct in a first step the difference between the state and year specific reference multiplier and the twice lagged local business tax multiplier. Afterwards, we calculated our excluded instrument, which is a dummy that is one if the difference is positive. The idea behind the variable is that the incentive to increase the local business tax multiplier is only given if the reference multiplier is larger than the municipalities own multiplier.

The instrumental variable strategy is implemented in a linear model using 2SLS, which has the advantage of being a more robust strategy than relying on a control function approach in combination with the Poisson model (see Wooldridge, 2015; Cameron and Trivedi, 2013). As before, we will use on the one hand the natural logarithm of the number of new firms as dependent variable as well as the inverse hyperbolic sine transformation for the number of new firms.

Table 5 reports the results for the linear specification using the inverse hyperbolic sine transformation for our dependent variable (column (1) to (3)) and the natural logarithm of the number of new firms (column (4) to (6)). As the inverse sine approximately corresponds to the log transformation for most values, we interpret the coefficients as the semi-elasticity.[15] We find for both tax rates negative coefficients (with one exception in column (2)). The future tax rate is in all specification significantly different from zero, the current tax rate in contrast only in one specification. Based on the most conservative estimate shown in column (6) our result suggest the the weight of the current tax rate is about 20% and the weight of the future tax rate is about 80%. The results should, however, be interpreted with caution as the F-statistic for the excluded instrument for the future tax rate is only around 10, which suggests a weak instrument problem.

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[14] There are two general types of reference multipliers. The first are multipliers that have an absolute value. They are in particular used in West German states. The second multipliers are relative multipliers, which are in particular used in East German states. They refer for example to the (tax base weighted) average local business tax multiplier two years ago.

[15] To be exact, the inverse sine of $x$ is approximately equal to $\ln(2) + \ln(x)$ (except for very small values). Thus the marginal effect can be interpreted as a semi-elasticity.

Table 5: IV Poisson Estimation Results: Mobile Firms' Location Decision

| Model | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dep. Var. | IHS(Number of New Firms) | | | Log(Number of New Firms) | | |
| Excluded Instrument | | | | | | |
| Inst.Reform | x | x | x | x | x | x |
| Trend*Wind *Log($\frac{Agr.}{Urban}$) | | x | | | x | |
| Trend*Wind*Log(Tax Base) | | | x | | | x |
| LBT(t) | -0.215** | 0.093 | -0.092 | -0.273*** | -0.133 | -0.224*** |
| | (0.105) | (0.127) | (0.091) | (0.082) | (0.097) | (0.081) |
| LBT(t+5) | | -1.677** | -1.119** | | -1.049** | -0.760** |
| | | (0.665) | (0.488) | | (0.467) | (0.370) |
| Observations | 72,762 | 72,762 | 72,762 | 57,423 | 57,423 | 57,423 |
| Control Variables | x | x | x | x | x | x |
| Mun. FE | x | x | x | x | x | x |
| F-Statistik | 49 | 29 | 32 | 63 | 35 | 37 |
| Shea's Partial $R^2$ | 0.003 | 0.003 | 0.004 | 0.004 | 0.004 | 0.006 |
| F-Statistik 2 | | 8 | 9 | | 9 | 12 |
| Shea's Partial $R^2$ 2 | | 0.000 | 0.000 | | 0.000 | 0.001 |

*Notes:* IV estimations at the municipality level for the years 1998 to 2006. The dependent variable is in column (1) and (2) the number of new firms using the inverse hyperbolic sine transformation and in column (3) and (4) the natural logarithm of the number of new firms. Each regression includes a full set of time dummies and municipalities dummies (not reported). Heteroscedasticity-robust SE in parentheses. **,**,* indicate significance at the 1%, 5%, 10% levels.

*Source:* Authors' calculations based on Statistik Lokal, 1998 to 2006, the operator database 1990 to 2006 and the German Weather Service.

## 6 Conclusion

Governments face commitment problems in their tax policy choice due to the presence of firms with high relocation costs. Although low tax rates attract both firms with low and high relocation costs, governments face the incentive to increase tax rate on immobile firm profits once these firms have made their location decision.

We show in this paper that firms anticipate government behavior by adjusting the information content of the current tax rate with respect to the future tax burden. This implies that empirical estimates on the impact of tax policy on firm' decision using the current tax rate to approximate the future tax burden are likely biased. Another implication of our work is that firm mobility influence the impact of tax policy on firms' location decision, as firms prefer to locate in jurisdictions with many highly mobile firms as they continue to pressure government for low tax rates.

Our analysis can be extended in various directions. Mobility is only one of many predictors of corporate tax rates. Future studies could, for example, consider other determinants of corporate tax rates such as revenue needs or political preferences and determine if firms also anticipate their influence on the corporate tax rate.

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# Appendix: Additional Tables

Table A1: Descriptive Statistics: Treatment and Control Group Municipality Level 2000

| | Control Group | | | | Treatment Group | |
|---|---|---|---|---|---|---|
| | Before Matching | | After Matching | | | |
| | Mean | SD | Mean | SD | Mean | SD |
| Local Business Tax Multiplier (LBT) | 321.31 | 29.83 | 330.20 | 35.09 | 334.77 | 38.84 |
| Wind strength (WS) | 5.46 | 0.69 | 5.74 | 0.89 | 5.77 | 0.61 |
| Share agric. land | 55.02 | 20.13 | 59.15 | 19.18 | 61.16 | 17.58 |
| Tax base ’98 | 342 | 3,892 | 909 | 8,388 | 863 | 2,813 |
| log(Tax base ’98) | 3.70 | 2.14 | 4.84 | 2.19 | 5.12 | 2.09 |
| Population | 7,130 | 243,615 | 23,232 | 534,183 | 11,811 | 20,862 |
| log(Population) | 7.55 | 1.26 | 8.39 | 1.35 | 8.57 | 1.33 |

*Notes:* The number of observations in the control group before applying nearest neighbor matching is 7,276. The number of observations in the treatment and control group after matching is 1,512.
*Source:* Authors’ calculations based on Statistik Lokal, 1998, the German Weather Service and the operator database, 1990 to 2000.

Table A2: Estimation Results: Sensitivity Analysis Municipalities Tax Rate Choice: IV Estimation in Differences between 1998 and 2011

| Model | (1) | (2) | (3) |
|---|---|---|---|
| Dep. Var. | Change business tax multiplier | | |
| Matching | w/o tax variables | w opt. caliper | as baseline |
| Sample | | | w/o Brandenburg |
| d.TaxBase Share IF | 38.717*** | 28.018** | 43.697*** |
| | (10.952) | (11.516) | (11.698) |
| d.log(Population) | -2.547 | -2.347 | -1.515 |
| | (2.882) | (2.725) | (2.273) |
| $R^2$ | 0.058 | 0.083 | 0.051 |
| Observations | 28,541 | 23,430 | 27,202 |
| F-Statistic IV | 129 | 102 | 113 |

*Notes:* Table shows estimated coefficient for the impact of the share of immobile firms on municipalities tax rate choice. The dependent variable is the municipality specific local business tax multiplier. To derive the tax rate the multiplier has to be multiplied with 5% before 2008 and with 3.5% after 2007. IF for immobile firms. Each regression is estimated in 13 year differences (between 1998 and 2011). In each regression wind strength 80 meter above ground interacted with year dummies and the year dummies itself are included (not reported). Standard errors, shown in parentheses, are robust to heteroscedasticity and clustered at the municipality level. In column (1) to (3) IV estimates are reported. The excluded instrument for the tax base share of immobile firms is the interaction between the wind strength, the logarithm of the agricultural area to urban and industrial area, and a trend variable. In column (1) we exclude the tax variable from the matching variables. In column (2) we only used treatment observations for which a nearest neighbor is found within the optimal caliper size. In column (3) we exclude municipalities in Brandenburg. ***,**,* indicate significance at the 1%, 5%, 10% levels.

*Source:* Authors' calculations based on Statistik Lokal, 1998 to 2011, and the operator database, 1990 to 2011.

Table A3: OLS Results Firms location decision

| Model | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dep. Var. | IHS(Number of new firms) | | log(Number of new firms) | |
| LBT(t) | -0.000 | 0.001 | 0.001 | 0.003 |
| | (0.005) | (0.005) | (0.005) | (0.005) |
| LBT(t)*TaxBase Share IF | | -0.019 | | -0.022 |
| | | (0.020) | | (0.022) |
| TaxBase Share IF | | 0.209 | | 0.248 |
| | | (0.321) | | (0.337) |
| log-likelihood | -60,485 | -60,464 | -36,598 | -36,586 |
| Observations | 72,762 | 72,762 | 57,423 | 57,423 |
| Control Variables | x | x | x | x |
| Mun. FE | x | x | x | x |

*Notes:* OLS estimations are at the municipality level for the years 1998 to 2006. The dependent variable is in column (1) and (2) the number of new firms using the inverse hyperbolic sine transformation and in column (3) and (4) the natural logarithm of the number of new firms. IF stands for immobile firms. Each regression includes a full set of time dummies and municipalities dummies (not reported). Heteroscedasticity robust SE clustered by municipality in parentheses. **,**,* indicate significance at the 1%, 5%, 10% levels.
*Source:* Authors' calculations based on Statistik Lokal, 1998 to 2006, the operator database 1990 to 2006 and data from the German Weather Service.