Property Taxation, Local Labor Markets and Rental Housing*

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Abstract. Although being heavily analyzed and discussed, there is neither a theoretical nor an empirical consensus on the incidence of the property tax in rental markets. In this paper, we suggest a novel theoretical approach by introducing property taxation into a Rosen-Roback type local labor market model. Besides the standard relative elasticity result, we find that the tax incidence depends on location preferences. The advantageous institutional setting of property taxation in Germany enables us to test our theoretical predictions and provide a clean estimate of the tax incidence using a non-parametric event study research design. Using a panel of German municipalities over more than 20 years, we show that in the short run, the incidence is borne by landlords since housing supply is inelastic. As housing supply becomes more elastic over time, landlords are able to shift the burden onto tenants. After six years, net rents are on the pre-reform level, implying full shifting of the tax.

Keywords: property taxation, tax incidence, local labor markets, rental housing

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1 Introduction

What is the incidence of the property tax? The answer to this question is very important to policymakers. It affects government and individual budget sets and thus has important efficiency and distributional implications. Given the importance of the question, it is not surprising that economists have engaged in answering these questions for over a century[1]. A long, broad and comprehensive literature has emerged. However, there is still no consensus on the question of who bears the burden of property taxation. There are two main reasons for this "sad state" of "our understanding of the incidence of local property taxes" (Fischel et al., 2011). First, two competing theoretical models with quite different perspectives on local property taxation exist. On the one hand, the "capital tax view" adopts a general equilibrium perspective and regards property taxation as a tax whose burden is eventually borne by landlords on average (Mieszkowski, 1972).[2] On the other hand, the "benefit view" adopts a Tiebout (1956) type of model with fully mobile individuals, who choose among a universe of municipalities offering different combinations of tax rates and local public goods financed through property taxes (Hamilton, 1976). In the benefit view, the tax is equivalent to a fee for local public services, whereas it is regressive, falling on richer landlords in the capital tax view,

Second, from an empirical point of view, identification of the incidence of property taxation is challenging for various reasons. First of all, there is generally a lack of high-quality data with a sufficiently large number of observations and oftentimes only cross-sectional data is available. With cross-sectional variation, tax rates and public services vary simultaneously as criticized by Palmon and Smith (1998). Another complication arises as municipalities may not only differ in their property tax rates, but also their assessment practice of property values, which makes statutory tax rates a rather coarse approximation of the effective municipal tax burden. Last, most papers adopts a partial equilibrium perspective and only look at quantity or price effect – one exception being a recent paper by Lutz (2015) who looks at both capitalization and capital investment)

In this paper, we make a novel contribution to estimating the incidence of local property taxation. Theoretically, we introduce property taxation into a Rosen-Roback type local labor market model (see Moretti, 2011, Kline and Moretti, 2014b, Suárez Serrato and Zidar, 2014, for recent applications). In the model, renters are mobile and respond to changes in net rents and/or wages even if tax revenues are not used to increase local public amenities. At the same time, they have an individual location-specific preference, which limits regional mobility. We find that property taxes are fully shifted onto tenants if housing supply is

[1] See, e.g., Marshall (1890), Edgeworth (1897), Bickerdike (1902), Simon (1943) for early contributions.

[2] Only tax differentials, i.e., local deviations from the average tax rate, are passed on and thus borne by tenants instead of landlords.

sufficiently elastic, which is in line with the stylized textbook model of the incidence of any tax. Besides relative supply and demand elasticities, the property tax incidence on rents is determined by the strength of location specific preferences and the share of housing expenditures in overall consumption. Moreover, the incidence is affected by the assumption made on the use of the tax revenue. As suggested by the "Benefit view" literature, property taxes do not affect rents if renters are perfectly mobile and tax revenues are fully used to finance municipal consumption amenities.[3] In addition to the incidence of the property tax on rents, our model predicts that municipal population is expected to decrease in the medium run if property taxes increase. Moreover, wages are expected to increase following a tax increase.

We test the theoretical predictions using rich administrative panel data from German municipalities. Specifically, we make use of the quasi-experimental setting of property taxation in Germany (*Grundsteuer*), where municipalities can independently set the local property tax rate (*Hebesatz*) each year. At the same time, and unlike to other settings, the assessment of property values is done by the federal states and all other regulations determining the total tax burden are set at the federal level.[4]

We obtained administrative data on the universe of 8,481 West German municipalities over more than twenty years.[5] As rent data is much harder to obtain, we rely on a smaller sample with rent indices for different apartment qualities and construction types from 547 municipalities, providing us with more than 44,000 apartment type-municipality-year observations. This subsample covers roughly 40 percent of the German population, namely all cities with a population of 100,000 or more and a third of all municipalities with between 20,000 and 100,000 inhabitants. Local property tax rates differ both across municipalities as well as within municipalities over time. More than ninety percent of all municipalities change their tax multiplier within the observation period. These tax reforms provide a valuable source of variation that we use to identify the effect of property taxes on rents, population and wages.

We implement a non-parametric event study research design to assess the effect of property

[3] We empirically show that the latter condition is not supported by the German data, which is not surprising given the institutional set-up of property taxation.

[4] Some authors refer to the *Grundsteuer* literally as land tax, although the tax is levied on land and improvements. Local tax rates function as multipliers (also translated as collection rates or leverage factors) to a basic rate set at the federal level. To the best of our knowledge, we are the first to exploit this institutional setting on a national level. Buettner (2003) uses a cross-section of municipalities in one of the German states to analyze whether the property tax is consistent with a Tiebout (1956) type model. He finds that property taxes are indeed capitalized into land values. Tax-inclusive gross rents levels seem to be unaffected by the tax, which would imply that the property tax burden is fully borne by landlords.

[5] We excluded East German municipalities for several reasons. First, 60 percent of the municipalities experienced at least one merger following reunification. Second, the East German housing market seems not representative given the tremendous population loss after reunification. In fact, from 1990 to 2009 East German municipalities lost 15% of the population on average (Fuchs-Schündeln and Schündeln, 2009). As a consequence, housing markets in many East Germany regions are subject to substantial excess supply.

taxes on rents, population and wages. Accounting for municipal fixed effects, the empirical set-up enables us to assess the evolution of the tax effects in the short and medium run (up to five periods after the tax reform). In addition, we can test the exogeneity of tax reforms by investigating pre-trends. In the absence of a pre-trend, the identifying assumption is that there is no systematic regional factor driving both municipal tax reforms and outcome variables. We explicitly test this assumption by non-parametrically controlling for shocks at the very local level. Concretely, our estimates are robust to the inclusion of commuting zone times year fixed effects, which suggest that regional time-varying confounders are not systematically driving our results.

Our results verify the theoretical priors. Relying on a non-parametric event study research design, we show that real net rents decrease in the short run (implying that the tax burden is on the landlord), but revert back to pre-reform levels after four to six years, when housing supply had sufficient time to adjust. This suggests that in the medium run, tenants bear the full burden of the property tax. Likewise, municipal population responds negatively to higher local property taxes. We do not find significant effects on local wages in reaction to property tax increases. We also show that rents, population levels and wages do not react prior to a tax change, which suggests that reverse causality is not an issue.

We add to the literature by investigating the effects of property taxes in a local labor market framework, which has been used to study the effects of other taxes before. Thereby, we overcome the antagonism between capital tax and benefit view. Our theoretical model nests the two competing theories to explain the incidence of the local property tax as special cases. In addition, the model combines the predictions of standard and simple tax incidence models and local labor market models, focusing on the mobility of workers (in our case: renters). Empirically, we provide clean, non-parametric evidence on the incidence of the property tax on tenants using high-quality administrative data from German municipalities. Using Germany is a case study is particularly relevant in this context, as it has one of the highest tenant rates and one of the largest private rental markets in the Western world (in relation to the housing stock). We hence add to the existing empirical literature on the incidence of the property tax, which has predominantly focused on the US. As mentioned above, the studies offer a wide range of estimates of the property tax incidence. Recently, Palmon and Smith (1998) investigated 50 subdivisions located in the suburbs of Houston, Texas) and showed that property taxes are capitalized by 60-100% into house values. In contrast, de Bartolomé and Rosenthal (1999) find a considerably lower incidence of 40%, looking at 566 homes in 265 neighborhoods. Our findings of a negative effect of property taxes on municipal population levels are in line with evidence provided by Shan (2010), who shows that higher property tax burdens increase mobility rates of the elderly. Last, our study is related to a recent contribution by Lutz (2015) who investigates 158 municipalities in the Boston area in New Hampshire and finds that property taxes reduce building permits and capital investment in rural areas, but not in the suburban ring: in urban areas property taxes are capitalized into land prices instead. [6].

The remainder of this paper is organized as follows. In Section 2 we set up our theoretical model. Section 3 presents the institutional framework of property taxation in Germany. Section 4 provides information on the used data and shows some descriptive statistics. In Section 5 we present our estimation strategy and empirical results. Section 6 concludes.

2 Theory

In this section, we introduce local property taxation into a Rosen-Roback type general equilibrium model of local labor markets as recently put forward by, e.g. Moretti (2011), Kline and Moretti (2014b) and Suárez Serrato and Zidar (2014). We are in a world with N workers that locate in one of the C cities. Without loss of generality, we normalize the total number of workers to one ($N = 1$). The model consists of three groups of agents, namely workers (Section 2.1), firms (Section 2.2) and house owners (Section 2.3). In Section 2.4, we solve for the equilibrium and show how changes in the property tax rate affect the equilibrium outcomes, i.e. population size, rents and wages.

2.1 Workers

We assume that labor is homogeneous and each worker provides one unit of labor. Each worker earns a wage w_c and pays a rent of r_c. Each municipality c has a specific unproductive consumption amenity A_c. Workers maximize utility over housing h, a composite non-housing good x and locations c. We normalize the price of the composite good x to one. Moreover, labor is mobile across municipal borders, but not perfectly due to individual location preferences, so that local labor supply is not necessarily infinitely elastic. In addition to the rent, there is a property tax in each city, denoted by t_c, with the statutory incidence on the renters (that is the workers). The household's maximization problem in a given municipality c is:

$$\max_{h,x} U = Ah^{\gamma}x^{1-\gamma} \qquad \text{s.t. } r(1+t)h + x = w$$

with $h, x, A, r, w, t > 0$ and $0 < \gamma < 1$. The solution to the household problem is given by:

$$h^* = \gamma \frac{w_c}{r_c(1+t_c)} \tag{1}$$

[6] Older studies also found very wide and inclusive range of estimates of shifting the tax burden onto tenants, ranging from 0 to 115 percent (see, e.g., Orr, 1968, 1970, 1972, Heinberg and Oates, 1970, Hyman and Pasour, 1973, Dusansky et al., 1981, Carroll and Yinger, 1994)

$$x^* = (1-\gamma) w_c \tag{2}$$

where γ is share of the household's budget spent for housing. Using the optimal consumption quantities, log indirect log utility is defined as:

$$V_c = \ln U_c(h^*, x^*) = c_v + \ln w_c - \gamma \ln r_c - \gamma \ln(1+t_c) + \ln A_c$$

with $c_v = \gamma \ln \gamma + (1-\gamma)\ln(1-\gamma)$. Now we introduce worker heterogeneity in terms of location preferences. We assume each worker i has an idiosyncratic individual-specific preference e_{ic} for location c:

$$V_{ic} = \underbrace{c_v + \ln w_c - \gamma \ln r_c - \gamma \ln(1+t_c) + \ln A_c}_{=V_c} + e_{ic}$$

Hence utility can be decomposed into city-specific systematic part V_c and worker's idiosyncratic preferences for a location e_{ic}. As in Kline and Moretti (2014b), we assume that e_{ic} is independent and identically extreme value type I distributed with scale parameter $s > 0$. The corresponding cumulative distribution function is $F(z) = \exp\left(-\exp[-z/s]\right)$. Due to these city preferences, workers are not fully mobile between cities and real wages $\frac{w_c}{r_c(1+t_c)}$ do not fully compensate for different amenity levels A_c across municipalities. The greater s, the stronger workers' preference for given locations and the lower workers' mobility. There is a city-worker match that creates a positive rent for the worker and decreases mobility.

Given the distribution of e_{ic}, it follows that the difference in preferences between two municipalities follows a logistic distribution with scale parameter $s, e_{ib} - e_{ia} \sim logistic(0, s)$. Hence the probability that worker i locates in municipality c when choosing between C cities is:

$$N_c = \Pr\left(V_{ic} \geq V_{ij}, \forall j \neq c\right) = \frac{\exp\left(V_c/s\right)}{\sum_{k=1}^{C} \exp\left(V_k/s\right)}$$

Note that this expression is equivalent to the share of workers locating in municipality b given that we normalize the total number of workers N to one. Taking logs we arrive at the (log) labor supply in municipality c:

$$\ln N_c = \frac{\ln w_c}{s} - \gamma \frac{\ln r_c}{s} - \gamma \frac{\ln(1+t_c)}{s} + \frac{\ln A_c}{s} - \ln C - \ln \pi \tag{3}$$

with $\pi = \frac{1}{C}\sum_{k=1}^{C} \exp\left(V_k/s\right)$ being the average utility across all municipalities. Note that C is given and for large C, a change in V_c does not affect the average utility π.

2.2 Firms

The representative firm in each city produces one output good Y_c using labor and capital ($N_c, K_c > 0$). The firms in municipality c produce with a Cobb-Douglas technology. Following Kline and Moretti (2014a), we assume $\alpha, \beta > 0$ and $\alpha + \beta < 1$), which implies that there is a third location specific production factor such as land.[7]. The production function is defined as

$$Y_c = N_c^{\alpha} K_c^{\beta}.$$

Capital markets are global, yielding a fixed interest rate of $0 < \rho < 1$. We normalize the price of the output good to one. Firms profits in c are given by:

$$\Pi_c = N_c^{\alpha} K_c^{\beta} - w_c N_c - \rho K_c$$

Using the first-order conditions follow profit maximization and taking logs, we can derive labor demand as

$$\ln N_c = c_{ND} - \frac{\beta}{(1-\alpha-\beta)} \ln \rho - \frac{1-\beta}{(1-\alpha-\beta)} \ln w_c \tag{4}$$

with $c_{ND} = \frac{1-\beta}{(1-\alpha-\beta)} \ln \alpha + \frac{\beta}{(1-\alpha-\beta)} \ln \beta$. Note that the labor demand curve is downward sloping with a constant labor demand elasticity $\frac{1}{\eta} = \frac{\partial \ln N_c}{\partial \ln w_c} = -\frac{1-\beta}{(1-\alpha-\beta)}$, with $\frac{1}{\eta} \leq -1$, given that $\alpha + \beta < 1$. [8]

2.3 Housing market

Aggregate housing demand in city c is determined by the number of workers in city c and their individual housing demand as indicated by equation (1). Multiplying the number of workers in city c with the housing budget share and taking logs we arrive at the following log housing demand function :

$$\ln H_c^d = \ln N_c + \ln \gamma + \ln w_c - \ln r_c - \ln(1 + t_c) \tag{5}$$

[7] To keep the notation and the model as tractable as possible, we do not model this third factor explicitly. Moreover, it would be possible to account directly for a location specific amenity as done by Suárez Serrato and Zidar (2014). Such extensions are certainly interesting in other institutional settings but not important in the context of our study.

[8] For completion, inverse capital demand in city c is given by $\ln \rho = \ln \beta + \frac{\alpha}{1-\alpha} \ln \alpha - \frac{\alpha}{1-\alpha} \ln w_c - \frac{1-\alpha-\beta}{1-\alpha} \ln K_c$.

Housing demand increases in local population, wages and the expenditure share spent for housing. It decreases with higher rents and higher taxes. Let housing supply in city c be described by the following simple log supply function:

$$\ln H_c^s = k_c \ln r_c \tag{6}$$

Housing supply is increasing in the rent r_c; the higher the elasticity of housing supply $k_c > 0$, the stronger this effect. The housing supply elasticity is exogenously determined by geography and land regulations.[9]

2.4 Equilibrium

The spatial equilibrium is determined by equalizing supply and demand on the labor and the housing market in each city, and hence given by equations (3), (4), (5), and (6). Solving the equation system, we arrive at the following spatial equilibrium outcomes for city c:

$$\begin{aligned}
\ln N_c^* &= c_N + \frac{1+k_c}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} \ln A_c - \frac{\gamma k_c}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} \ln \tau_c \\
\ln H_c^* &= c_H + \frac{(1+\eta)k_c}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} \ln A_c - \frac{(\gamma+\eta(\gamma-1)+s)k_c}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} \ln \tau_c \\
\ln w_c^* &= c_w + \frac{\eta(1+k_c)}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} \ln A_c - \frac{\eta\gamma k_c}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} \ln \tau_c \\
\ln r_c^* &= c_r + \frac{1+\eta}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} \ln A_c - \frac{\gamma+\eta(\gamma-1)+s}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} \ln \tau_c
\end{aligned}$$

with c_N, c_H, c_w, c_r being constant terms.

We can now analyze how an increase in the local property tax affects the equilibrium outcomes. As property taxes in city c increase, the city becomes less attractive and workers leave the municipality:

$$\frac{\partial \ln N_c^*}{\partial \ln \tau_c} = \frac{-\gamma k_c}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} < 0 \tag{7}$$

Intuitively, the number of apartment decreases as well:

$$\frac{\partial \ln H_c^*}{\partial \ln \tau_c} = \frac{-(\gamma+\eta(\gamma-1)+s)k_c}{\gamma+\eta(\gamma-k_c-1)+s(1+k_c)} < 0 \tag{8}$$

In terms of price effects, workers who stay or move to city c, must be compensated and see

[9] In the model workers and landowners are two distinct agents, which is convenient to analyze the welfare effects of changing housing parameters. Note that while this assumption is commonly made in the literature, it seems even plausible considering Germany's large rental housing market.

a wage increase:

$$\frac{\partial \ln w_c^*}{\partial \ln \tau_c} = \frac{-\eta\gamma k_c}{\gamma + \eta(\gamma - k_c - 1) + s(1 + k_c)} > 0. \tag{9}$$

As people leave and housing demand decreases, net rents decrease:

$$\frac{\partial \ln r_c^*}{\partial \ln \tau_c} = \frac{-\gamma - \eta(\gamma - 1) - s}{\gamma + \eta(\gamma - k_c - 1) + s(1 + k_c)} < 0. \tag{10}$$

The effect on real wages is still negative ($\frac{w_c^*}{r_c^*\tau_c} \downarrow$)

$$\frac{\partial \ln \frac{w_c^*}{r_c^*\tau_c}}{\partial \ln \tau_c} = \frac{\partial \ln w_c^*}{\partial \ln \tau_c} - \frac{\partial \ln r_c^*}{\partial \ln \tau_c} - 1 = \frac{-k_c\,(s - \eta[1 - \gamma])}{\gamma + \eta(\gamma - k_c - 1) + s(1 + k_c)} < 0 \tag{11}$$

The marginal effects also inform about the incidence of the property tax on landlords, tenants and firm owners. If local housing supply is perfectly elastic, equation (10) implies that net rents are unchanged by the tax increases. As a consequence, tax-inclusive gross rents increase with the tax. Wages increase more strongly, and population in city c declines. If housing supply is instead perfectly inelastic ($k_c = 0$), net rents decrease one-to-one to a marginal increase in $\ln(1 + t_c)$, wages remain unchanged as workers do not have to be compensated and real wages are unaffected as is population size. Thus, our model nests the general stylized textbook model on the tax incidence which depends on the (relative size) of the elasticities. In a general case with somewhat but not perfectly elastic housing supply, the tax burden is shared between renters and landlords. Wages partly compensate for parts of the worker's burden, which means that firms also bear part of the property tax burden. The magnitude of these effects depends on housing supply, labor demand, local amenities, the expenditure share spent for housing and location preferences.

As a special case, we now assume that labor demand is perfectly elastic ($\eta = 0$). In such a case wages are not responsive to the change in the property tax, independently of the housing supply elasticity. If workers are perfectly mobile ($s = 0$), net rents fully adjust to changes in the tax. Likewise population responses are determined solely by the housing supply elasticity $\left.\frac{\partial \ln N_c^*}{\partial \ln \tau_c}\right|_{\eta=0,s=0} = -k_c$. For completely inelastic housing, the population of city c is not affected and the burden is fully borne by landlords in c.

Verify that besides the incidence of the property tax rate, the model produces standard results when doing comparative statistics on the consumption, production and housing amenities. Population and rent levels are increasing in the local consumption amenities (A_c), while wages work as a compensating differential and decrease.

2.5 Spending of property tax revenues

So far we have made the implicit assumption that local amenities A_c are exogenous, hence, for instance, purely determined by geographical location and weather conditions. While this is close to the German situation, where municipalities used property tax revenues to reduce the liability on debt rather than to increase public spending, it seems worthwhile to consider the theoretical case of property taxes being used to increase finance local amenities.

Formally, we assume that amenities A_c positively depend on municipal taxes, $A_c = A_c(t_c)$, $\frac{dA_c}{dt_c} = \frac{dA_c}{d\tau_c} > 0$. Now, we reassess the effect of an exogenous increase in the tax rate.

$$
\begin{aligned}
\frac{\partial \ln N_c^{**}}{\partial \ln \tau_c} &= \frac{\partial \ln N_c^{*}}{\partial \ln \tau_c} + \frac{1+k_c}{\gamma + \eta(\gamma - k_c - 1) + s(1+k_c)} \tau \frac{dA_c}{d\tau_c} \\
\frac{\partial \ln H_c^{**}}{\partial \ln \tau_c} &= \frac{\partial \ln H_c^{*}}{\partial \ln \tau_c} + \frac{(1+\eta)k_c}{\gamma + \eta(\gamma - k_c - 1) + s(1+k_c)} \tau \frac{dA_c}{d\tau_c} \\
\frac{\partial \ln w_c^{**}}{\partial \ln \tau_c} &= \frac{\partial \ln w_c^{*}}{\partial \ln \tau_c} + \frac{\eta(1+k_c)}{\gamma + \eta(\gamma - k_c - 1) + s(1+k_c)} \tau \frac{dA_c}{d\tau_c} \\
\frac{\partial \ln r_c^{**}}{\partial \ln \tau_c} &= \frac{\partial \ln r_c^{*}}{\partial \ln \tau_c} + \frac{1+\eta}{\gamma + \eta(\gamma - k_c - 1) + s(1+k_c)} \tau \frac{dA_c}{d\tau_c}
\end{aligned}
$$

Intuitively, the indirect effect of a tax increase leading to higher amenities attenuates the direct negative (positive) property tax effect on the population, rents (wages).

3 Institutional background

Property taxes are one of the oldest forms of taxation that is still used today (see, e.g., Wallis, 2001). In Germany, the first universal property tax was implemented in Prussia in 1861. The current property tax regulations are based on a law from 1938. In the following we provide a short overview on the institutional setting of property taxation in Germany (see Spahn, 2004, for more details). All legal regulations of the German property tax, i.e., the definition of the tax base, federal tax rates as well as legal norms regarding the property assessment are set at the federal level and have rarely been changed over the last decades. Besides the federal legal framework, the 11,442 German municipalities decide yearly on tax multipliers for all local taxes, including the property tax. The property tax law distinguishes between taxes on agricultural land (*Grundsteuer A*) and taxes on other land and improvements (*Grundsteuer B*). We focus solely on the latter one in this paper as only this type of the tax is relevant for real estate property and the residential housing market.

The property tax due is calculated in three steps: First, the rateable value of the property, including both land and buildings is assessed (*Einheitswert*). Second, the rateable value is multiplied with a federal tax rate according to the type of the land or building (*Grundsteuer-*

messzahl). The product of rateable values and federal tax rates yields the so called taxable value. Third, the actual tax payments are calculated as product of assessed values, federal tax rates and the current property tax multiplier of the local municipality:

$$Tax = Tax\ Multiplier_{local} \times \underbrace{Tax\ Rate_{federal} \times Rateable\ Value}_{Taxable\ Value} \tag{12}$$

Property owners are liable for the tax payment irrespective of whether the house is owner-occupied, for rent or vacant. Only few exceptions from the tax exist for public sector property and the property of religious communities or charitable organizations, but even these exemptions do not apply if the property is for rent. Despite the fact that the tax is levied on the landlord, property taxes are part of the ancillary costs that tenants have to pay on top of net rents according to the legal regulations on operating costs (*Betriebskostenverordnung*). Landlords have the right to pass the full amount of the tax onto tenants and it is a common procedure to do so. The total tax bill of a specific property is therefore usually split according to the number of square meters for each apartment. The national property tax average corresponds to a four percent tax rate on top of net rents.

Besides local business taxes and municipal shares on federal income and sales taxes, the property tax is one of the three most important income sources for the German municipalities. Around 14 percent of their tax revenues are collected by property taxes, which amounted to 11.6 billion EUR in 2012. The property tax is especially important for the funding of municipalities because the tax base is very stable over time. Moreover, there is hardly any possibility to avoid the tax or tax increases once the rateable value of the property has been assessed. While corporate, income and sales taxes vary substantially over the business cycle and the tax base may react to tax changes, property tax revenues are highly predictable.

Property assessment. The property's rateable value is assessed when the property is built. Reassessments take place only in case the property is sold or if the owner creates a new building or substantially improves an existing structure on her land. Once the rateable value of the property has been assessed, there are rarely changes over time. In particular, there is no regular reassessment of properties to adjust the rateable value to the market value of the property or to inflation rates. To make property values comparable also for new buildings, the assessment refers to market values of 1964 for land and buildings in West Germany and values of 1935 for properties in East Germany (the former German Democratic Republic). Even new buildings are assessed as if they were built several decades ago, rateable values thus differ substantially from current market values. This practice makes the assessment highly complicated and barely transparent for both landowners and tenants.

The tax is collected by the local authorities. City treasurers however have no influence on

Table 1: Federal tax rates (in %)

West Germany		East Germany			
			Tax rate by population 1933		
Building type	Tax rate	Building type	<25k	25k-1,000k	>1,000k
		Built before 1924			
One-family houses		One-family houses			
First 38,347 EUR	0.26	First 15,339 EUR	1.0	0.8	0.6
Additional value	0.35	Additional value	1.0	1.0	1.0
Two-family houses	0.31	Other houses	1.0	1.0	1.0
		Built after 1924			
		One-family houses			
		First 15,339 EUR	0.8	0.6	0.5
		Additional value	0.8	0.7	0.6
		Other houses	0.8	0.7	0.6
		Unimproved land			
		Business purpose	1.0	1.0	1.0
Other/Unimproved land	0.35	Other	0.5	0.5	0.5

Source: §§ 15, 41 *Grundsteuergesetz*, §§ 29-33 *Grundsteuerdurchführungsverordnung*.

the assessment, which is done by the tax offices of the sixteen German states. State tax offices assess all properties in a city and transfer a list with rateable values to local authorities.

Federal tax rates. The taxable value is calculated on the rateable value with federal tax rates ranging from 0.26 to 1.0 percent. Table 1 shows the different federal property tax rates. Tax rates mainly differ between East and West Germany to balance the two reference years regarding the assessment of rateable values in both parts of the country. In addition to that, tax rates in the former German Democratic Republic differ also depending on the year of construction and the size of the municipality in 1933. To reduce the tax burden for "average families", lower tax rates are levied on one-family houses (and two-family houses in West Germany). For example, consider a one-family house in West Germany. The first 38,347 EUR are taxed at 0.26 percent while every Euro above that threshold is taxed with the standard rate of 0.35 percent. Similar thresholds exist in East Germany as well. The property tax is thus progressive for one-family houses and otherwise flat.

Local tax multipliers. While the assessment of rateable values is done on the state level and federal tax rates are set at the federal level, the municipal councils decide yearly on their local tax multipliers for local business taxes, agricultural land taxes and property taxes. Usually this takes place in the last months of the preceding year, most tax changes become effective on January 1st.

(a) Local property tax multipliers in 2013

(b) Number of tax changes 1992-2013

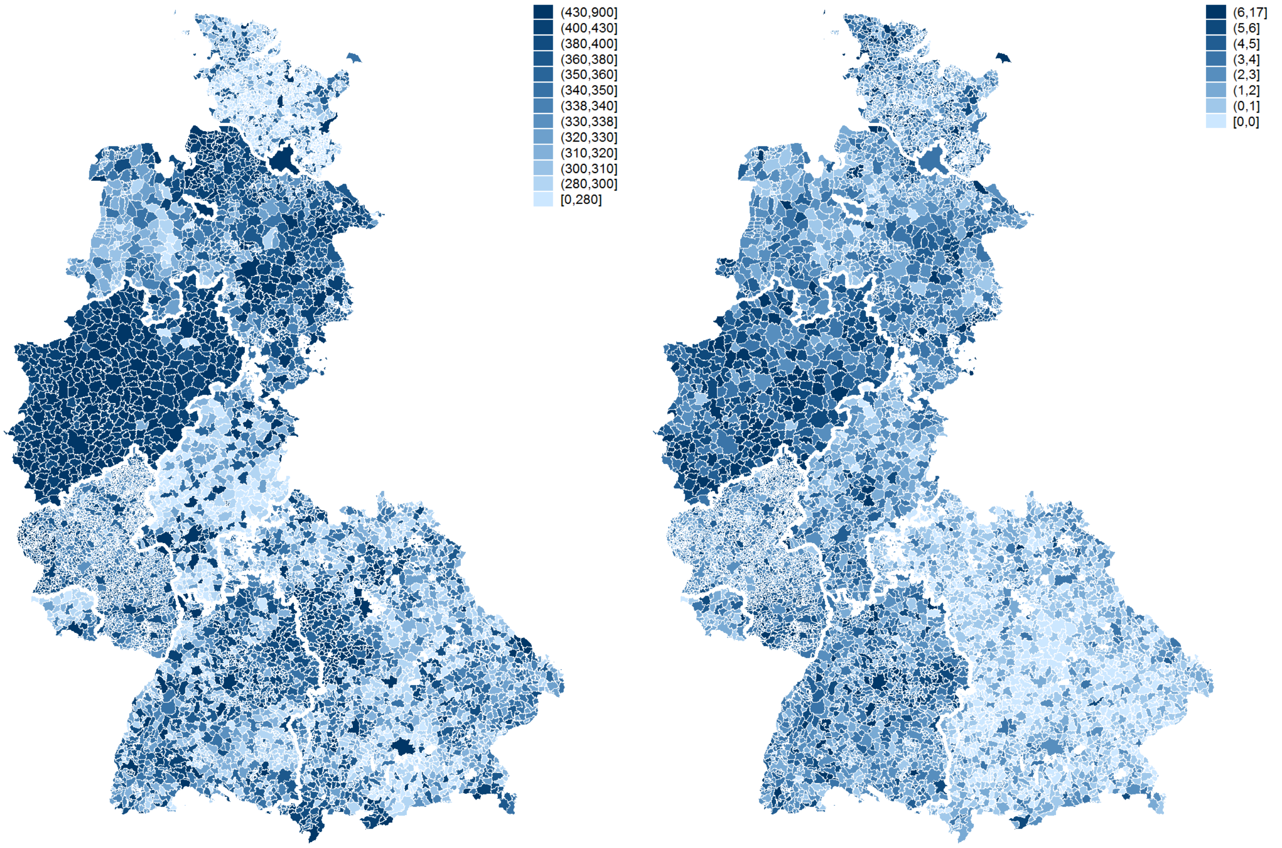


Figure 1: Local property tax multipliers in West Germany

Notes: This figure shows the local property tax multipliers in 2013 and the number of tax changes in the period 1992-2013 for all West German municipalities. Thin white lines indicate municipal borders, thick white lines indicate federal state borders. *Maps:* © GeoBasis-DE / BKG 2015.

Property tax multipliers vary substantially both across municipalities and within municipalities over time. Figure 1 shows the property tax multipliers of all West German municipalities in 2013 and the number of tax changes in the period 1992-2013. While multipliers range from 0 to 900 %, only one percent of all municipalities has a multiplier below 230, another one percent has a multiplier above 535 %. The mean and median tax multiplier increased steadily from around 270 % in 1992 to 340 % in 2013 which also reflects the fact that property values are not adjusted to inflation. Taking together local multipliers and federal tax rates, we can calculate the effective tax rate in a city. Consider a local tax multiplier of 340 % and a federal tax rate of, e.g., 0.35 %, the effective tax rate is thus 1.19 % on the assessed value of the property.

Over the period from 1992 to 2013, more than ninety percent of all municipalities changed their property tax multiplier at least once, while less than nine percent of municipalities still have the same multiplier as in the beginning of the Nineties. The multiplier of a given municipality has changed on average three times during this period, i.e., every seven years. Many municipalities experienced even more changes. One percent of municipalities changed their property tax multiplier more than eight times since 1992, the first year of our data.

4 Data and descriptive statistics

This sections gives an overview on the data used for our empirical analysis. It also provides descriptive statistics on the tax setting of local municipalities and the local housing markets in Germany. We combine rich administrative data on the fiscal, budgetary and economic situation of German municipalities (Section 4.1) with detailed housing market data including land costs, house prices and rents (Section 4.2) and administrative wage and employment records from the Federal Employment Agency (see Fuest et al., 2013, for details).

4.1 Municipalities

Administrative data on German municipalities are provided by the Statistical Offices of the German federal states. The Statistical Offices collect annual data of all German municipalities, including information on the economic, fiscal and budgetary situation, population indicators, the housing stock and construction activity. The data also includes local property tax multipliers, our main explanatory variable. In addition we collect district level unemployment rates from the Federal Employment Agency and district level GDP data from the Working Group Regional Accounts. The Federal Institute for Research on Building, Urban Affairs and Spatial Development (*BBSR*) provides us with definitions of labor market regions that are defined by commuting flows (*Arbeitsmarktregionen*). Using these sources we construct a panel for all 8,481 West German municipalities from 1992 to 2013. We had to exclude East German municipalities for several reasons. First, and foremost, there were substantial mergers of East German municipalities after reunification. In fact, 60 percent of the municipalities experienced at least one merger since 1990. Given that our data are based on the boundaries of 2010, the property tax rate of municipalities that saw a merger before to 2010 is unobservable prior to the merger.[10] Second, the East German housing market seems not representative given the tremendous population loss after reunification. In fact, from 1990 to 2009 East German municipalities lost 15% of the population on average (**??**). As a consequence, housing markets in many East Germany regions are subject to substantial excess supply.

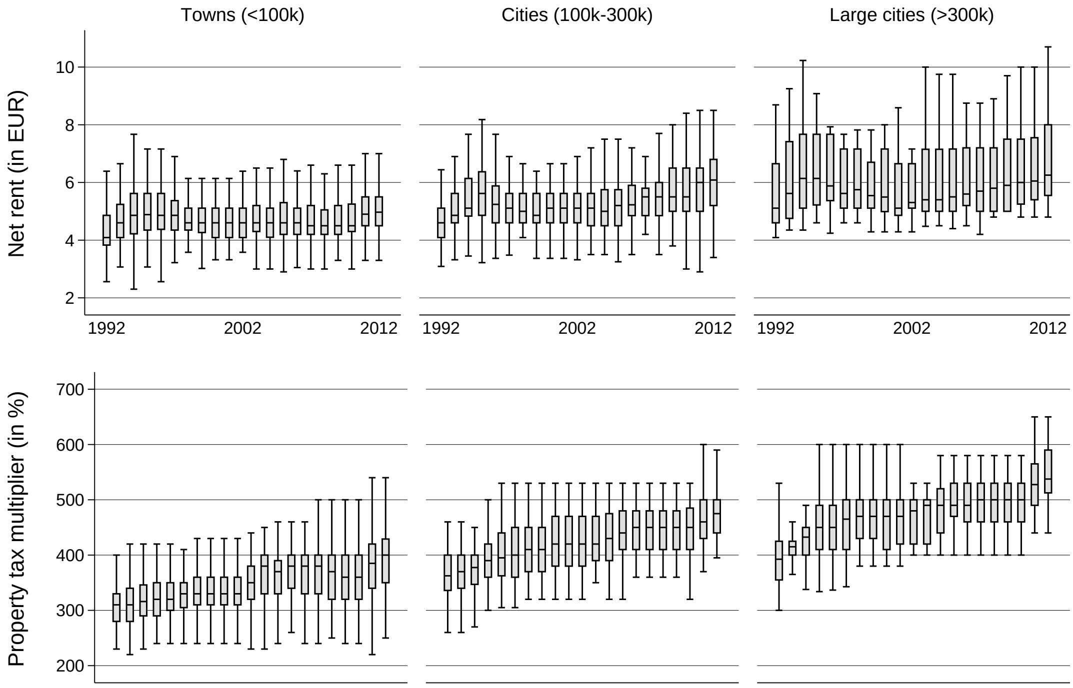
4.2 Rental housing

We combine this panel with residential real estate rent indices provided by the German real estate association *IVD* (*Immobilienverband Deutschland*). This dataset delivers eight distinct price indices for standardized apartments with 70 square meter and three bedrooms. These indices differ by construction year and apartment quality and thus allow us to study heterogeneous effects of property taxes. It is important to note, that this data only includes net rents (*Nettokaltmiete*) and does not contain information on ancillary costs. Thus, we do not observe the gross price including the property tax, but only rents net of taxes. In the upper part of figure 2, we show exemplarily the price indicator for medium quality apartments built after 1948. There is a similar trend over time and by city size as in the lower part depicting the evolution of tax multipliers, although the rent increases are smaller in magnitude. Note that this graph shows nominal prices and thus does not account for rising price levels.

Unfortunately our housing market data covers only 547 municipalities and not all municipalities are covered over the full observation period. Figure 3 shows the number of covered municipalities and the population in these cities over the observation period. The left panel shows the absolute number while the right panel shows the percentage of all municipalities and the total German population, respectively. The remaining (unbalanced) panel consists of roughly 300 municipalities in every year, starting with 162 cities in 1992 and up to 375 cities in 2009.

Although the sample represents less than five percent of all German municipalities, it includes a large share of bigger German cities. As can be seen in figure 2(b), our sample covers roughly 38-44 percent of the German population or between 28 and 36 million people. Separated by city size, our sample includes more or less the universe of municipalities

[10] A possible solution would be to use a (weighted) average of the municipalities which merged, but this would introduce considerable measurement error. Moreover, tax rates of newly merged municipalities might have changed because of the merger, which should also affect the housing market.



Note: Rents refer to medium quality apartments, construction year after 1948.

Figure 2: Net rents and property tax multipliers by city size over time

(a) Absolute values

(b) Share in sample

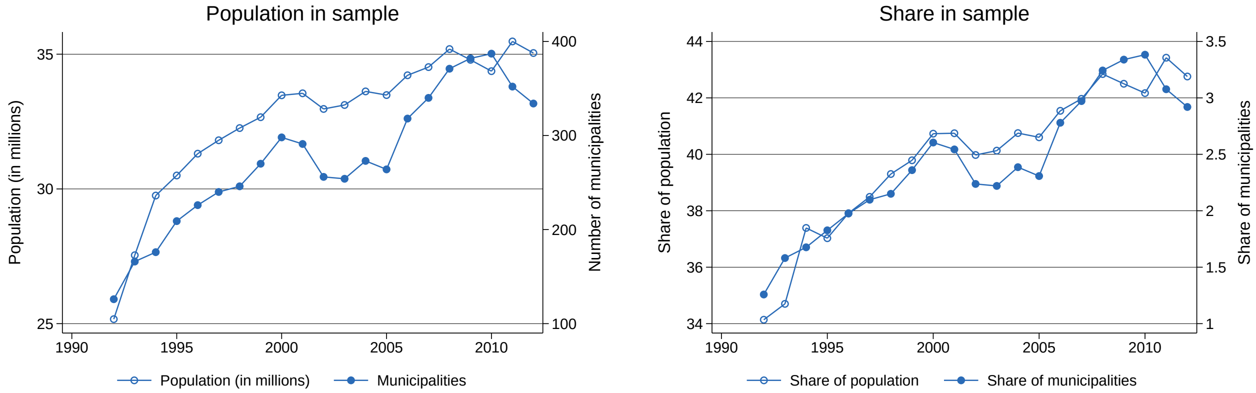
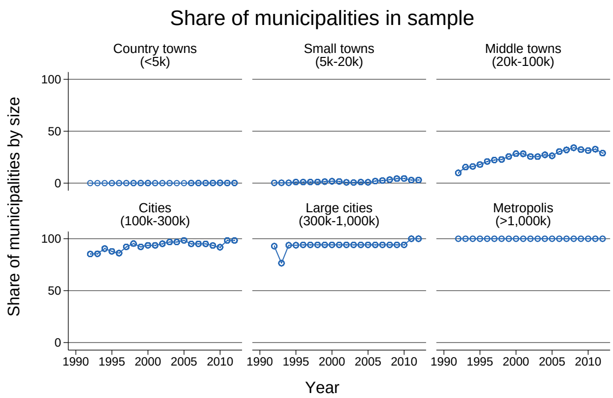


Figure 3: Sample of municipalities

with 100,000 or more inhabitants (*Großstädte*), roughly a third of all municipalities with population between 20,000 and 100,000 and rather few below (see figure 3(a) for details). Figure 3(b) shows in addition the number of municipalities in our sample differentiated by their city size in 2010. Small and middle towns still make up the biggest share of our sample (roughly 75 percent of the covered municipalities have less than 100,000 inhabitants in that year), although we cover only a rather small proportion of all German municipalities with that size.

(a) Share of observed municipalities over time



(b) Number of observed municipalities

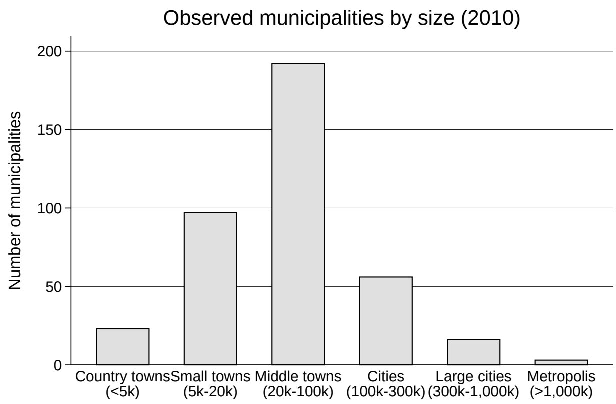


Figure 4: Municipalities in sample by city size

5 Empirical analysis

In this section, we perform an empirical analysis of the effect of property taxes on net rents, population and wages. First, we employ an event study design to analyze whether there are pre-treatment trends that may influence the political debate in local municipalities and drive the decision to increase or decrease taxes. In addition, we can test our theoretical hypotheses that the shifting of property taxes onto rents is a matter of timing. We would expect tax changes to affect rents only in the short run as housing supply is at least somewhat elastic in the medium run. As the property tax falling on a square meter can legally be shifted as part of gross rents, full shifting would show a zero effect on net rents. If landlords bore the full burden of property taxes, the effect on net rents would be negative and different from zero. In contrast, population levels should decrease permanently in reaction to property tax increases according to our theoretical model.

5.1 Event study design

Using three event study regressions, we analyze non-parametrically the dynamics of rents, wages and population before and after tax changes. We follow the estimation setup outlined by Sandler and Sandler (2014) and estimate the following multiple treatment equation:

$$\ln y_{m,t} = \beta_{-b} \sum_{i=b}^{B-t} \Delta Tax_{m,t+i} + \sum_{j=-b+1}^{a-1} \beta_j \Delta Tax_{m,t+j} + \beta_a \sum_{k=a}^{t-A} \Delta Tax_{m,t-k} + \mu_m + \zeta_{m,t} + \varepsilon_{m,t}, \tag{13}$$

where $y_{m,t}$ denotes the dependent variable of interest in municipality m at time t. We estimate separate regressions for local population figures, local wages levels and net rent indices[11]. The variable $Tax_{m,t}$ is the local property tax rate and the operator Δ denotes the first difference, hence $\Delta Tax_{m,t} = Tax_{m,t} - Tax_{m,t-1}$. We are interested in the β coefficients, which measure the effect of property tax reforms occurring in our event window, thus between b years before the reform and a years after. In our preferred specification, we set $b = 4$ and $a = 5$, thus we investigate the effect of a tax change from four years before to five years after the reform. We have to adjust both ends of the event window given that other tax changes might have happened outside of the window. If not captured, these effects outside of the event window would be attributed to the fixed effect or to the current reform and induce a bias in the estimate (see Sandler and Sandler, 2014, for a detailed discussion of this issue). Hence, the coefficient β_{-b} captures all tax changes occurring in b or more years before the reform that are observed in our data. Likewise, β_a measures the effect of all tax changes that happened a or more years after the reform that are observed in our data. The first and the last year of our data, i.e., the ends of our observation window, are denoted A and B, respectively.[12] The specification makes the set of $a + b + 1$ regressors perfectly collinear, so one variable has to be dropped. We drop the pre-reform regressors $\Delta Tax_{m,t-1}$, hence all coefficients have to be interpreted relative to the pre-reform year, which is thereby normalized to zero.

To control for time-invariant factors, we include (construction and quality specific) municipality fixed effects μ_m. Hence, identification in the event study design is within municipality. The β coefficient show the response of municipalities four years before and six years after a tax reform. The pre-treatment coefficients serve as a direct test of reverse causality. In order to obtain an unbiased estimate, we need pre-trends to be flat and insignificant.

Given flat pre-trends, the identifying assumption of the model is that there is no other

[11] Our data contains several indices for each municipality differing by construction type and building quality. We include all indices and account for type-quality-specific municipality fixed effects in the rent regressions.

[12] In principle these sums should run from or to infinity, we are however bounded by the available data. In our case $A = 1992$ and $B = 2013$.

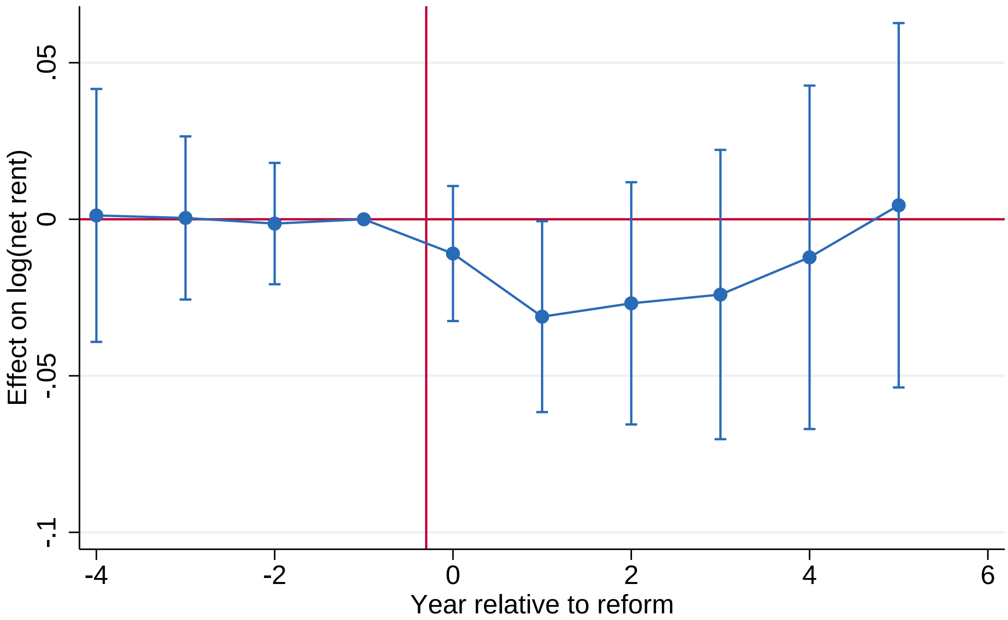
factor that simultaneously affects tax changes and outcome variables. While municipal fixed effects control for any time-invariant confounder, our estimator will be biased if local shocks affect both municipal fiscal policies and housing as well as labor markets. In order to address this issue, we test the robustness of our estimates with respect to the inclusion of a very rich set of time-varying control variables. Depending on the specification, vector $\zeta_{m,t}$ includes local unemployment rates and GDP, and/or state times year fixed effects, communing zones times year fixed effects and county time trends. The unobservable random term is denoted by $\varepsilon_{m,t}$. We allow for clustering of standard errors on the municipal level to account for correlation in unobservable components over time and between the different building and construction types.[13]

5.2 Effect on net rents

First we analyze the effect of property tax changes on the net rent index in a municipality. The results of the corresponding event study regression can be seen in figure 5. Our estimates show that pre-reform trends are flat, which suggests there are no reverse causality issues and that tax increases are not just a reaction to increasing or decreasing rents in the years before. This is well in line with anecdotal evidence from city treasurers, who see the property tax as an instrument to raise revenue, not as a redistributive policy measure. The tax setting for the next year takes place in the last months of the preceding year (thus between $t = -1$ and $t = 0$) and we see an immediate reaction to tax increases. After one year, real net rents are 0.03 log points lower and this effect is statistically different from zero. This implies that real net rents decrease by 0.8 percent in reaction to an increase in the property tax rate of 25 percentage points, which is the average increase in our sample. After two years, the negative effect on rents is going back. After five years real net rents are at the pre-reform level.

This non-parametric approach provides evidence that in the short run tax increases are borne by landlords, while in the longer run landlords can shift the tax burden fully onto tenants. These empirical results are well in-line with the theoretical model. If housing supply is inelastic in the short run, equation (10) suggests that net rents decrease one-to-one to an increase in the tax rate. This seems a quite realistic assumption in the short-run. As housing supply becomes more elastic over time and eventually more elastic than housing demand (which is in general assumed to be quite inelastic), net rents should be largely unresponsive to tax rate changes.

[13] The results are not sensitive to whether we cluster on the municipal or the level of commuting regions.



Note: 95 % confidence intervals, standard errors clustered on municipal level. Sample is restriced to municipalities with at least one tax increase and no tax decreases. Sample includes 19,672 municipality-year observations. Estimation controls for municipality fixed effects, state-year fixed effects and linear district time trends.

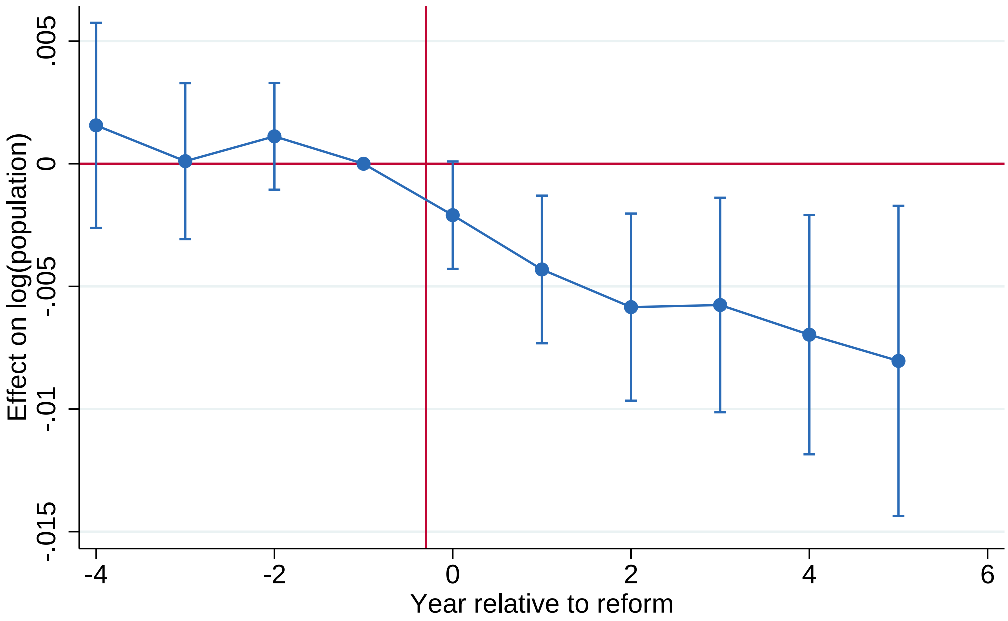
Figure 5: Effect of property tax changes on net rent indices

5.3 Effect on population levels

If our theoretical model was accurate in describing the real-world, we should see a response in the municipalities populations to increasing property tax rates. According to equation (7), we should expect a zero response in the very short-run with inelastic housing supply, and a negative effect as housing supply becomes more and more elastic. In fact, figure 6, shows the expected pattern. With a flat pre-trend, population levels start to decline after the reform. Five years after the reform, population levels are 0.2 percent lower for an average increase of 25 percentage points in the tax multiplier. Property tax increases thus lead to rising costs of living compared to other municipalities, which makes these more attractive to live in.

6 Conclusion

Despite the long and comprehensive literature on the incidence of property taxes, little is known on the actual incidence, thus, which share of a one Euro increase in property taxes is borne by landlords and which part is shifted onto tenants. The theoretical literature mainly discussed the nature of the tax—thus, whether it is a capital tax or a beneficial tax. Previous empirical studies found a wide range of estimates from no shifting at all to over-shifting of 115 percent. However, these studies faced serious problems in terms of small samples and



Note: 95 % confidence intervals, standard errors clustered on municipal level. Sample is restriced to municipalities with at least one tax increase and no tax decreases. Sample includes 85,740 municipality-year observations. Estimation controls for municipality fixed effects, state-year fixed effects and linear district time trends.

Figure 6: Event study evidence: population

endogeneity concerns due to the cross-sectional nature of their data.

We suggest a new theoretical model to study the effect of property taxes by introducing property taxes into a local labor market in the spirit of Moretti, 2011. We test our model predictions, using panel data evidence from German municipalities. Using a non-parametric event study research design, we show that the incidence of property taxes in on the landlord in the short run (when housing supply is arguably inelastic). In the medium run, i.e., five years, the burden is then shifted fully on the tenant, reflecting that housing supply is becoming more and more elastic over time.

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