The Effect of Property Taxes on Businesses: Evidence from a Dynamic Regression Discontinuity Approach

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Abstract:
The endogenous nature of property taxation makes it difficult to properly understand the effects of property taxation on businesses. We employ a dynamic regression discontinuity design comparing business outcomes in areas that barely passed additional school property taxes to business outcomes in areas that barely failed to do so. To do so, we collect data on school property tax levies in Ohio from 2003-2016 and combine it with longitudinal data on the universe of establishments during the same period. The findings suggest that passage of a property tax referendum has a negative effect on the number of establishments in the district in the following years. Further evidence suggests that the effect is driven by an immediate adverse effect on new business formation and migration of firms to new areas, and not due to firm deaths. The results suggest that areas experience negative, although inelastic, effects of property taxes on the number of local businesses.

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1. Introduction

Taxation of property is one of the most important sources of revenue for local jurisdictions in the United States, but there is a concern among academics and policymakers that the high use of property taxes hurts local businesses and the local economy. Local property taxes are potentially highly distortionary because they raise costs for local businesses, affecting firm investment and location decisions, the area's rate of new business creation, and the survival rate of existing businesses. Unfortunately, studying the distortionary impact of such taxes is difficult because local tax rates are determined endogenously with local business activity and amenities (Albouy, Leibovici, and Warman, 2013; Gabriel and Rosenthal, 2004).

We attempt to investigate the effect of property taxes on business activity in the context of school property tax levies. We do so for two reasons. First, funding for local schools comprises the largest use of property tax revenue in the United States (Kenyon, 2007). The level of property tax support going to local schools is likely to be highly salient to local businesses, not only because it comprises such a large share of overall property tax expenditures, but because the property tax levies are voted on periodically at the local level. This induces a periodic debate about local property taxes perhaps not associated with other smaller property tax levies. Additionally, property tax rates can vary dramatically across space because of differences in local support for schools, differences in local amenities and property values, and the influences of state programs to equalize spending.

Second, the voting behavior around property tax levies allow us to employ a regression discontinuity design to solve the identification problem. School property taxes are likely to be higher in districts with voters who derive high utility from local school quality and in districts where local economic activity is high, and therefore higher taxes are less likely to be damaging.

School property taxes will be lower in districts that place less value on local school funding or where local economic activity is already low. However, the probability of having a specific level of property taxes jumps discontinuously when the proportion of local voters supporting the levy equals 50 percent plus one vote. We can use this discontinuous change in the level of property taxation to estimate a local average treatment effect (LATE) of the causal effect of property taxes on local business activity.[1]

While school property tax levies provide an opportunity to study local property taxation, the results of the paper help to inform a larger debate about the efficiency and equity of relying on local property taxes to fund public education. The correlation of property tax revenues with the socio-economic status of localities have led academics and policymakers to be concerned about variation in the quality of public education across districts.[2] As part of the political debate about property taxes, supporters of school property tax levies often argue that support of local schools will lead to an increase in property values because of the increased local public good. However, negative effects of property taxes on economic activity will have adverse consequences for the local community and could erode the tax base upon which the school funding rests. While there is a large literature, discussed below, about equity issues in public school funding and the effect of school quality on local residential property values, there is less examination on the potential negative consequences on local businesses.

We gather election data on approximately 3,700 school property tax levy issues in Ohio from 2003-2016. The data includes information about size and type of tax levy as well as the

[1] A further advantage of using school district tax levy information is that businesses are unlikely to directly benefit from the public good (school quality) being purchased with the tax levy. To the extent that there is some direct benefit, our identification strategy will account for it, as we discuss later.

[2] This debate has frequently led to the courtroom with state supreme courts deciding on whether school funding formulas violate state constitutions (e.g. the Abbott decisions in New Jersey, DeRolph in Ohio). For a comprehensive list of such litigation across the United States between 1967 and 2010 see Jackson, Johnson, and Persico (2015).

votes for and against. We then gather data on local business activity from Infogroup data covering a near universe of establishments. We construct measures both of the stock of establishments in the district as well as the birth and death rate of establishments. We combine these datasets to estimate the effect of property taxes on local business for up to 5 years following referenda passage. We estimate intent-to-treat (ITT) estimates but also treatment-on-the-treated (TOT) estimates that account for the dynamics of referenda passage overtime time using the dynamic recursive estimator proposed by Cellini et al. (2010). Finally, we extend the method to estimate the effect of the *change* in property tax rates on local businesses, and use the estimates to provide an elasticity of local businesses in relation to local property taxes.

We find clear evidence that property tax referenda for schools lower the number of local businesses in a school district over time. The TOT estimates suggest that the number of local establishments falls by 3 to 5 percent from 1 to 3 years following the referenda. Beyond that time the point estimates remain negative but are not statistically significant. The magnitude of the effect suggests that the response is inelastic, with an elasticity of local firm counts to the effective tax rate of approximately -0.339. We find evidence that referenda passage decreases the entry rate of new firms in the following year, but the entry rate appears to stabilize in later years. We find no evidence that property taxes affect the death rate of firms. Combined, the evidence suggests that property taxes lower the number of establishments through a decrease in the birth rate and through relocation decisions of firms. Further analysis demonstrates that the effects of property taxes on the number of manufacturing establishments are particularly large, consistent with these firms facing a larger overall burden of property taxes. We also find large effects for firms in the service sector, driven by changes in location decisions.

The paper begins with a discussion in Section 2 of the previous literature on both taxes and businesses but also the reliance of school funding on property taxes. We then discuss our data and empirical methodology in Section 3. We present our results in Section 4 and Section 5 concludes.

2. Previous Literature

There are four threads of the existing research related to the effect of property taxation on business to discuss. First, our paper fits within an extensive literature on the general question of do state and local taxation affect business decisions. Broadly speaking, many recent papers find that state and local tax policies do indeed influence business outcomes including location and employment decisions, although to varying degrees depending on the tax policy and paper.[3] For instance, Duranton, Gobillon. and Overman (2011) find business taxes affect employment growth but not on firm entry while Papke (1991) finds a negative effect on firm births; Fox (1986) and Hoyt and Harden (2005) and Thompson and Rohlin (2012) provide evidence that state sales taxes negatively impact firms' employment decisions; Feld and Kirchgassner (2003) find corporate taxation negatively affects location and employment decisions although Brülhart, Jametti and Schmidheiny (2012) find agglomeration economies mitigate these effects; additionally Rohlin, Rosenthal and Ross (2014) find income taxes and reciprocal agreements influence business location decisions.

Secondly, our paper contributes to the existing literature on property taxation. This literature predominately focuses on how property taxes capitalize into property values (Oates (1969), Palmon and Smith (1998), Yinger et al. (1988) and, Zodrow (2014)) and the debate of the efficiency of property taxation (Youngman, 2002). The existing literature on property

[3] Earlier papers in the literature found little evidence of a deterrent effect of taxation (Carlton, 1979, 1983; Schmenner, 1982). See Wasylenko (1997) for a review of this earlier work.

taxation and business has mostly found a lack of negative effect of property taxation. Earlier work in the literature (Due, 1961) found little to no effect of the property tax on businesses, such as Bartik (1985) who finds insignificant effects on new branch plants of Fortune 500 companies while Carlton (1983) shows businesses in the fabricated plastic products, communication transmitting equipment, and electronic components industries are not affected. More recently, Gabe and Bell (2004) finds that the benefits of public goods outweigh any negative impact from increases in property taxes and Dye, McGuire, and Merriman (2001) do not find strong evidence of a negative effect of the property tax on the number of business. In contrast, Walker and Greenstreet (1991) find evidence that manufacturers in the Appalachian region were negatively affected by property taxes. An important challenge needing to be overcome in this literature is the endogenous nature of property taxation which we hope to address in this paper.

Given our focus on school property taxes, there is a clear link to a large literature surrounding local school funding. Much of that literature focuses on whether households value school quality, as measured by the impact on local property values. While results vary based on methodology and how school quality is defined, the literature generally finds that higher school quality does correlate with higher local property values (see Black and Machin (2011) for a detailed discussion). Additional support for that argument is provided by Barrow and Rouse (2004) who find that increases in state educational spending in a district substantially increase house values. They do note, however, that it appears that higher state support slightly lowers local taxes, consistent with the idea that voters value school quality but would prefer to pay lower local taxes. Cellini, Ferreira and Rothstein (2010) use a regression discontinuity design around local school bond issues, and find that passage of a bond measure to finance school capital expenditures has a positive impact on local housing prices. To the extent that higher property taxes are used to purchase higher school quality, these results generally support the argument, placed to voters, that voting in favor of tax levies will benefit them through property appreciation. Our paper will provide an answer to the other side of the debate: does raising property taxes hurt local businesses?

Lastly, finding that businesses respond to local property tax changes supports the idea of tax competition in property tax policy, including Brueckner and Saavedra (2001) who look specifically at property tax competition among local governments and find there is strategic interactions occurring. Recent work in the tax competition literature are finding jurisdictions compete along multiple dimensions. For instance, recent work by Agrawal (2014, 2015) finds local jurisdictions are competition while setting their local sales taxes. So finding that local businesses are sensitive to local property tax changes suggest local governments should be aware of their neighboring and nearby jurisdictions' property tax policy because they may be able to attract neighboring businesses by having favorable property taxes. Our main contribution to these literatures is the use of regression discontinuity design to address the endogenous nature of property tax changes.[4]

3. Methodology and Data

3.1 Identification problem and election data

Let Y_j be the number of businesses in location *j* at time *t*. We can then express the level of business activity as $Y_{jt} = f\left(T_{jt}, X_{jt}\right)$ where T_{jt} the local property tax rate at time *t* and X_{jt} is a vector of local characteristics that can include business amenities such as local productivity or agglomeration effects. We expect that the number of firms in a location will increase with local

[4] An exception to this is Kneller and McGowan (2011) who investigate income taxation and self-employment income using a regression discontinuity approach.

amenities but would decrease with property taxes ($\frac{dY_{jt}}{dX_{jt}} > 0, \frac{dY_{jt}}{dT_{jt}} < 0$). Higher property taxes raise the cost of operating in location *j*, so we expect that the stock of establishments would fall over time if property taxes are increased. This could occur along three dimensions. First, higher costs could cause firms to exit the overall market (not operate in any location), which we refer to as firm death. Second, new firms could choose to not enter the market in location *j* (lower births). Finally, firms could choose to relocate from area *j* to another location *k* (or less firms could choose to relocate to area *j*). How firms respond along these margins (if they respond at all), depends on their reliance on property and capital in their production process, their mobility and the tax rates across geography. Thus, we expect that the responses may vary across firms, but the magnitude of responses is an empirical question.

The identification problem is that T_{jt} is endogenously determined with X_{jt}, not all of which are observed by the researcher. Therefore, standard regression estimates of the relationship between T_{jt} and Y_{jt} will tend to be biased by omitted variables.[5] We attempt to solve this identification problem by using information on the votes for local property tax levies for schools in a regression discontinuity design (RDD).[6] For illustration, suppose that voters are choosing between having school property tax $T_j = T$ or $T_j = 0$ (for simplicity, we drop the time subscripts). The levy will pass if at least 50% of voters plus one person vote in favor of the levy ($z > 0.5$, where z is the share of votes in favor of the levy).[7] The probability of location *j* having property tax T jumps discontinuously at $z = 0.5$, which we can use to identify the effect of the tax on our measures of business activity. In particular, we can investigate whether there is a

[5] With panel data, such as used in this paper, one could attempt to overcome this problem with the inclusion of location specific fixed effects but that would fail to capture any time-varying characteristics that very likely could affect both the level of business activity and the local tax rate.
[6] See Imbens and Lemieux (2008) for a detailed discussion of this technique.
[7] It is important to note that local business people may not be local voters, since they could reside in other districts.

discontinuous change in $E(Y_j|z)$ at $z = 0.5$. For example, if taxes negatively affect business activity then we would expect a discontinuous drop in business activity at $z = 0.5$. The key identifying assumption is that $E(X_j|z)$ is continuous at $z = 0.5$, meaning that there is no discontinuous jump in the underlying characteristics of location j at that point. Under that assumption, any discontinuous change in in $E(Y_j|z)$ at $z = 0.5$ should be due to the additional property tax. We have no reason to suppose that our identifying assumption fails in our case. Furthermore, the use of election results is common in the RDD literature, including Cellini, Ferreira, and Rothstein (2010) in the context of school bond issues (other examples can be found in Cellini (2009), DiNardo and Lee (2004), Lee, Moretti, and Butler (2004), Ferreira and Gyourko (2009) among others). The RDD estimates will produce local average treatment effects (LATE) that plausibly provide the causal effect of taxes on business activity for districts that are near the discontinuity border.

To implement our identification strategy, we gather data on local school-related property tax levy referenda in Ohio from 2003-2016 from the website of the Ohio Secretary of State. Ohio provides a useful focus for several reasons. First, there are a large number of observations, which is important since RDD methods (particularly the nonparametric methods) require a density of observations near the discontinuity point. The Ohio school levy data is available over a long panel and there are approximately 600 school districts in Ohio, providing approximately 3,700 referenda during our sample period. The average vote share in favor of the school levies is 52.6 percent (see Table 1). However, approximately 35 percent of the sample is between vote shares of 45 and 55 percent (see the histogram of vote shares in Figure 1). Thus, there are many observations near the discontinuity at 50 percent vote share.

Second, Ohio school districts rely heavily on local property taxes for funding, despite the Ohio Supreme Court ruling in *DeRolph v. State* in 1997 that such reliance was unconstitutional.[8] Furthermore, school property taxes account for approximately 65 percent of local property taxes in 2014 (authors' calculations from Ohio property tax data), and are applied to both residential and commercial properties.

Partly because of these advantages, Ohio school referenda have been previously used in RDD papers in other topics (e.g. Isen (2014) and Enami (2018)). However, there are several important aspects of the property tax system in Ohio that need to be understood for our study. Most importantly, voters are asked to vote on levies expressed in millages (or mills), which is the amount of tax due per $1,000 in taxable property. However, with the passage of Ohio HB 920 in 1976, local millage rates are adjusted over the lifetime of the levy to keep the revenue generated constant. So, if voters approve a new levy of T mills (called the gross rate), it will generate revenue of $R = T * V$, where V is the taxable value of local property. If there is local appreciation in property (V) then the effective tax rate T^* is adjusted to keep R constant.[9] Note that this adjustment is made in nominal terms; school districts do not benefit from local property appreciation and do not receive any inflation adjustment. Thus, schools are forced to go back to voters over time to ask for new millage to account for inflation.[10]

Partly because of the tax reduction factor, schools can go to voters with different types of referenda, which have different implications for local taxes. Additional referenda are new levies

[8] Despite this ruling, no major changes to the school funding system were ever enacted, and the Ohio Supreme Court later gave up jurisdiction.
[9] A separate adjustment factor is calculated for residential and commercial properties, based on the local appreciation of each class of property. On average, residential properties have tended to appreciate more during our sample so the effective tax rate is lowered faster for residential properties.
[10] Technically, schools are guaranteed a minimum of 20 mills so districts can capture local property appreciation if they are willing to only minimally fund their schools. Some districts choose to do this, and therefore do not go to the voters for additional levies.

that raise local tax rates. However, existing levies passed by previous referenda can also be extended for more years. A renewal would extend the levy and keep the effective tax rate, which means it does not increase local taxes. A replacement would extend the levy but reset the effective tax rate to the original gross rate, thus it typically increases local taxes. Firms may respond differently to these situations, so we will estimate the effects of passing any referenda as well as the effect of a tax increase.

School districts may have multiple referenda on the ballot in a given year. This is mostly because a number of different levies supports each district in each year (due to renewals of prior levies). However, it could also be due to referenda that do not pass, since a failed referendum means that district must either cut costs in the school district or put the tax levy back on the ballot. Failed levies could represent manipulation of the running variable, which would violate the assumptions of the RDD strategy. However, manipulation does not appear to be a serious problem in our data as 95% of referenda are put to voters a single time. Furthermore, there is no evidence of a higher density of observations just beyond the 50% threshold for referenda passage (Figure 1). To further limit any problems from multiple referenda, we only use the first referenda in a year in our estimation. Finally, our estimation strategy will specifically account for the dynamics of referenda over time.

3.2 Establishment Data

In order to measure how local businesses respond to property tax changes, we need detailed establishment-level data on all businesses in Ohio including precise location information to determine which school district each firm resides. We utilize Infogroup's Historical Business Database, which includes characteristics of the universe of all establishments in the entire United States, approximately 35 million establishments each year. For each year, we know the exact location and address of each establishment, age of the establishment, number of employees, sales volume, detailed industry code, and corporate linkages.[11] We also have a unique identifier that lets us track changes to these characteristics for each establishment. From this data, we calculate the total number of establishments in a district in a year to measure the stock of firms. To measure the flows of firms, we construct measures of firm births and deaths. Firm births are calculated as the number of new firms in a district in a year (defined as firms that are less than one year old). Firm deaths are constructed by counting the number of firms in a district that do not appear in the Infogroup data (anywhere in the United States) in the following year. We create measures for all industries, and then separately for different industry classes.

In our estimation, we transform these measures to help with interpretation. Our preferred method is to divide the number of firms in the district in each year by the average number of firms in the district in the 5 years prior to the start of our referenda (1998-2002). This allows us to interpret the point estimates of these scaled outcomes as percentage changes, relative to a district baseline. The number of new firms can be interpreted as an entry rate and the number of dying firms as a death rate, relative to the baseline size of the district. We prefer this specification because it allows us to easily compare the magnitudes across the stock and flow outcomes, since all outcomes in a district are relative to the same baseline. It also helps to account for the heterogeneous nature of business activity across space. As a robustness check, we also considered a natural log transformation, where the outcome is the natural log of the number of firms (plus 1 because of 0 new firms in some districts in some years). We demonstrate that our substantive results are unchanged using this transformation.

[11] The data is similar in many respects to the National Establishment Time Series dataset and its usage has increased (e.g. Serrato and Zidar 2016).

The bottom of Table 1 presents basic summary statistics of these outcome measures. The average school district has around 800 establishments, but that is skewed by the few large urban school districts (the median district has 372 establishments and the standard deviation is approximately 1837). The skewness of the data will be accounted for both by the scaling of outcomes (see Table 1) and the use of fixed effects in our estimation strategy. The average district experienced 80 new firm births and 91 firm deaths in a year (29 new firms and 36 firm deaths in the median district). So approximately 10 percent of firms in a district have been born and another 11 percent are about to die.

3.3. Empirical specification

As discussed by Cellini et al. (2010), a simple RDD estimator ignores the dynamics of referenda voting over time. A school district in the control group, which has failed to increase property taxes by a few votes, may place another referendum on the ballot in the next year. If such a referendum passes, then the difference 5 years later between the initial treatment and control districts is simply one more year of taxation in the treated district. The dynamics can be more complicated. Because of the tax adjustment factor, districts must keep returning to voters with referenda. Passing a school referendum in one year could affect the possibility of passing another school referendum in the future. Furthermore, it could affect the passage of a non-school referendum, such as police or fire support (although, as previously noted, these account for a much smaller share of property tax collections). Estimating the effect of a school property tax referendum on business activity several years in the future, ignoring these dynamics, represents an intent to treat (ITT) estimate. In addition to the ITT effect we prefer to estimate the treatment on the treated (TOT) effect, which accounts for these dynamics. To do so, we adopt the recursive dynamic estimation strategy of Cellini et al. (2010).

Consider a referendum in district *j* at time *t*. Let τ index the time since the referendum, and $R_{t-\tau}$ being an indicator for whether the referendum passed τ years prior. The intent-to-treat (ITT) estimate of a referendum passage on some outcome Y_{jt} is $\theta_\tau^{ITT} = \frac{dY_{jt}}{dR_{j,t-\tau}}$ which can be estimated as

$$Y_{jt\tau} = R_{jt}\theta_\tau^{ITT} + P_\tau(v) + \alpha_\tau + \kappa_t + \lambda_{jt} + \epsilon_{jt\tau}. \tag{1}$$

$P_\tau(v)$ is a polynomial in the vote share (flexibly defined by interacting with indicators for different values of τ), α_τ represents a fixed effect relative to the referenda year (i.e. relative year fixed effect), κ_t represents a calendar year fixed effect, and λ_{jt} represents a referenda-specific fixed effect. Thus, we are controlling for changes over time (κ_t), time since referenda passage (α_τ) and variation across referenda and district (λ_{jt}).

The ITT estimates ignore the dynamics of referenda passage on future referenda, and changes in the treatment and control status of districts over time. The TOT estimates that we want are defined as $\theta_\tau^{TOT} = \frac{\partial Y_{jt}}{\partial R_{j,t-\tau}}$, the effect of referenda passage on the future outcome, holding all else constant. Cellini et al. (2010) demonstrate that the ITT and TOT estimates are related as:

$$\theta_\tau^{ITT} = \theta_\tau^{TOT} + \sum_{h=1}^{\tau} (\theta_{\tau-h}^{TOT} \pi_h) \tag{2}$$

where π_h is the effect of referenda passage at time $h - \tau$ on referenda passage at time h ($\pi_h = \frac{dR_h}{dR_0}$). Thus, the ITT at any point τ since the referenda at time $\tau - h$ is a combination of: 1) the TOT estimate at time τ, 2) the TOT effects of other referenda that were passed since $\tau - h$, and 3) the effect that passing the levy at time $\tau - h$ had on the likelihood of passing other referenda in the meantime. Using this relationship, Cellini et al. (2010) propose a dynamic recursive estimation of the TOT effects by estimating the ITT estimates and the effect of referenda passage on future referenda passages. In particular,

$$\theta_0^{TOT} = \theta_0^{ITT} \tag{3}$$

$$\theta_1^{TOT} = \theta_1^{ITT} - \pi_1\theta_0^{TOT} \tag{4}$$

$$\theta_2^{TOT} = \theta_2^{ITT} - \pi_1\theta_1^{TOT} - \pi_2\theta_0^{TOT} \tag{5}$$

More generally,

$$\theta_\tau^{TOT} = \theta_\tau^{ITT} - \sum_{h=1}^{\tau} \pi_h\theta_{\tau-h}^{TOT} \tag{6}$$

So the TOT at some point in the future is a combination of the ITT estimates of the effect of the referenda passage on the outcome (θ^{ITT}), and the estimated effects of the referenda passage on future referendas (π). θ_τ^{ITT} is estimated by equation (1), and π_τ is estimated similarly by replacing Y_{jt} with R_{jt} in equation (1). Following Cellini et al. (2010), we stack the two equations to obtain the covariances and estimate standard errors for the TOT estimates using the delta method. We use $\tau = \{-3,5\}$, a cubic polynomial function in equation 1, and cluster the standard errors by school district.[12, 13]

We begin with the ITT and TOT estimates of school tax referenda passage on businesses. However, there are two limitations with this approach. First, the estimates do not separate the effects of school referenda passage from the effects of property tax changes: the estimates incorporate both the effect of the continued taxation, from renewal levies, and increases in taxes from additional and replacement levies. We would expect firms to respond to a change in the tax burden, but firms could respond to the referenda passage, regardless of tax change, either

[12] Following Cellini et al (2010), we constrain the coefficients R_{jt} to be 0 when $\tau < 0$.

[13] RDD estimates can be sensitive to the choice of polynomial, but we find similar effects ITT estimates for polynomials of order 1 to 4. For example, see Appendix Figure A-1 for growing showing the 1 year after referenda ITT estimates.

because it continues the current tax burden or because it signals a local support for taxation. Isolating the effect of tax changes would be useful for informing policy decisions. Second, the dynamic TOT estimates account for school referenda but passage of a school levy could affect the likelihood of passing tax referenda for other purposes, such as police or libraries. The estimates described above would miss these spillover effects to other referenda that would affect the tax level in the area. This is likely not a large effect, because school taxes are such a large share of local taxes, but it is a potential limitation.

To account for both limitations, we extend our analysis by considering the effect of changes in effective tax rates on businesses. The future effective tax rate in a district is due to the history of tax referenda in the district. That includes different types of levies (renewal, replacement, additional) which have different effects on local taxes. It also includes referenda on taxes for other local public goods, such as police and fire protection or local libraries. By estimating the effect of a referendum on future effective tax rates, we account for how voting behavior may change in terms of the types of referenda (renewal, replacement, additional) and the purpose (police, fire, etc.).[14] Note that at $\tau = 0$, the outcome of interest (Y_0) is a function of the effective tax rate (T_0), which is itself a function of a school referenda in that year (R_0). Thus, we can write $Y_0 = F[T_0(R_0)]$ and the effect of the referenda on the outcome is then $\frac{dY_0}{dR_0} = \frac{\partial F}{\partial T_0} * \frac{dT_0}{dR_0}$. The TOT estimate of the tax *change* on the outcome (ρ_0^{TOT}) is then

$$\rho_0^{TOT} = \frac{\partial F}{\partial T_0} = \frac{\frac{dY_0}{dR_0}}{\frac{dT_0}{dR_0}} \tag{7}$$

[14] It would also account for referenda that happen later in the calendar year in the same district. In a sense, we are using the referenda passage as an instrument for the change in local taxes. This allows us to isolate the tax change from the other dynamics of local tax financing that would otherwise confound our estimates.

So the TOT estimate of the effect of the tax rate change on the outcome is simply the ratio of the ITT estimate of the referenda passage on the outcome ($\frac{dY_0}{dR_0} = \theta_0^{ITT}$) to the ITT estimated effect of referenda passage on the local effective tax rate ($\frac{dT_0}{dR_0}$). More generally, we can estimate the TOT of the tax rate on the outcome at time τ as

$$\rho_\tau^{TOT} = \frac{\theta_\tau^{ITT} - \sum_{h=1}^{\tau} \rho_{\tau-h}^{TOT} * \frac{dT_h}{dR_0}}{\frac{dT_0}{dR_0}} \tag{8}$$

Thus, we can form a dynamic estimate of the TOT effect of the tax rate on the outcome using the recursive logic of Cellini et al. (2010). Specifically, we estimate θ_τ^{ITT} as before and then estimate $\frac{dT_\tau}{dR_0}$ by using the local effective tax rate, from all tax sources, as the dependent variable in the specification of equation (1). We continue to stack the regressions to account for the covariances and estimate standard errors using the delta method.

4. Results

4.1 Effects of Property Taxes on the Number of Establishments

We begin by presenting the ITT estimates of the effect of school referenda passage on the number of establishments (stock) in the district in the top panel of Table 2. Each point estimate represents the ITT estimate at some year (τ) following the passage of referenda, estimated using equation 1. We include fixed effects for specific referenda (and thus variation across districts as well), calendar year, and years since referenda passage. Standard errors clustered at the district level and estimated using the delta method are presented in parentheses below point estimates. The coefficient for $\tau = 0$ is -0.008, interpreted as a 0.8% decrease in the number of firms relative to the district baseline, although the estimate is not statistically significant. The estimates for $\tau > 0$ suggest that the number of firms falls by a statistically significant 1.5 to 1.9 percent relative to baseline in years 1 to 3 after the passage of a school referendum. The ITT estimates decrease in later years, suggesting that the effect of the tax on the number of establishments in a district eventually dissipates over time. However, these estimates do not include the dynamics of referenda passage over time.

The middle panel presents the TOT estimates of the effect of referenda passage on the number of establishments using the dynamic recursive estimator of Cellini et. al (2010). The point estimates indicate the accounting for the dynamics of referenda passage is important. The point estimates are consistently negative for the number of establishments, and are larger in magnitude. This is consistent with the fact that passage of a referendum in one year decreases the likelihood of passing a referendum in later years.[15] Thus, the ITT estimates are confounded by a decrease in the likelihood of future levies. The estimated TOT effects are on the order of a 3 to 5 percent decrease in the number of establishments 1 to 3 years following a successful referendum. The estimated effects in year 0 and years 4 and 5 are also negative, but smaller in magnitude (-1.4 to -4 percent) and not statistically significant. The overall pattern suggests that the stock of firms may begin falling immediately, but is substantively lower 1 to 3 years following the referenda, at which the effect may dissipate.

In the bottom panel of Table 2, we present our TOT estimates of the effect of the change in the effective tax rate on business outcomes, using the method described in equation 8. These estimates isolate the effect of the change in the effective tax rate from the effect of passing any tax referenda for schools. The estimates also further account for the effects of any other

[15] This is partly because successful passage of a levy means that the issue does not have to go back to voters the next year. It is also due to the fact that districts have multiple levies over time but are unlikely to put levies on the ballot in successive years.

unobserved levies, for schools or other public goods, whose passage might be affected by the school referenda.

The pattern of the point estimates in the bottom panel generally follows the pattern over time seen in the top two panels. However, the interpretation is different because the denominator is the change in the effective tax rate (not the passage of a levy). For example, the point estimate in the year after a referendum is -0.006, which is statistically significant at the 10 percent level. This means that a 1 mill increase in effective property taxes (a $1 increase per $1,000 in taxable property) decreases the number of establishments by 0.6 percent relative to baseline. We can put this into perspective a couple of ways. First, the average school district in our sample has an effective tax rate of 56.57 mills, so a 1 mill increase represents a $\frac{1}{56.65} * 100 = 1.77$ percent increase in local taxes for the average district. This suggests an implied elasticity of the stock of firms to the effective tax rate of $-\frac{0.006}{0.0177} = -0.339$. Alternatively, the average number of mills requested in additional levies, for which the effective tax rate increases by the requested millage, is 4.52. This suggests that the average additional levy is responsible for a $4.52 * (-0.006 * 100) = -2.7$ percent decrease in the number of firms in the district. The point estimates are similar, but not statistically significant, for 2 to 3 years following the passage of a referendum for the number establishments. There is no substantive effect 4 to 5 years following a tax change.

Overall, the estimates in Table 2 suggest a significant, but inelastic, effect of property taxes on the number of local businesses. They also appear to suggest that just the passage of a referenda has a negative effect on the number of establishments, independent of any change in the effective tax rates. First, referenda passage has a negative, although statistically insignificant, effect on the number of firms through 5 years after the referenda. There is no evidence that a change in effective tax rate has a negative effect beyond 3 years following a referendum (and not statistically significant effect beyond 1 year). Second, using the logic above about magnitudes, the average additional levy only causes a -2.7% to -3.2% decrease in the number of firms in years 1 to 3 following the levy. That is smaller than the estimated effect of referenda passage in each of those years in Panel B. Moreover, Finally, only some levies increase effective tax rates, but such additional levies only account for about half the referenda (Table 1). Thus, there seems to be a role for passage of other levy types, such as renewal levies which do not actually change the effective tax rate.[16]

4.2 The Effect of Property Taxes on Establishment Births and Deaths

We now consider how property taxes actually affect the stock of establishments in a district. As discussed previously, the number of establishments changes based on new firm entry (births), existing firms exiting the market (deaths), and firm relocation in and out of the district. In Table 3, we present the ITT and TOT estimates of the effect of property taxes on firm births and deaths. The ITT estimates on the birth of new firms (top row, panel A) suggests that the entry of new firms decreases in the year following a referendum. The point estimate suggests a 0.9 percent decrease in the number of new firms relative to the district baseline. The remaining estimates in the second row of panel A suggest that entry rate largely returns to the original level two or more years after the referenda passes. The bottom row of panel A present the estimated ITT effects of referenda on the death rate of firms. The estimates are generally small in magnitude and never statistically significant. Furthermore, the negative sign would suggest a *decrease* in the death rate.

[16] Replacement levies make up about 6% of the sample and usually do raise taxes. However, they usually increase taxes by less than additional levies.

Panel B presents the TOT estimates of the effect of referenda passage on births and deaths. As in Table 2, the TOT effects are generally larger in magnitude than the ITT estimates but the pattern is similar to the ITT estimates. Panel C presents the TOT estimates of the effect of the change in the effective tax rate on births and deaths. The estimates are quite small and not statistically significant, except for the entry of new firms following a tax increase.

Because the stock and flow outcomes are scaled by the same value (the number of establishments in the pre-period), we can easily compare the magnitudes. Thus we can determine how much of the change in the number of firms at any point in time (stock) can be explained by the sum of the changes in flows overtime. For example, the decreased entry rate in the year following a referendum can explain approximately half of the decrease in the number of establishments in that year (-0.009 compared to -0.015 for ITT estimates, -0.014 compared to -0.031 for TOT estimates). However, the birth rate stabilizes in years following referenda passage in panel B. Thus, even if the TOT effects on the birth rate were statistically significant, only some of the overall decline in establishments several years following the passage of a referendum can be explained by a decrease in the births over time.[17] A decline of firm births can explain much of the decrease in the number of firms caused by a change in the effective tax rate. A 1 mill increase in taxes lowers the number of new firms by -0.005 the year following a tax (and has no effect in later years) which is similar to the -0.006 to -0.007 decline in number of establishments in Panel C of Table 2. Finally, changes in the death rate of firms does not appear to explain any of the changes in the stock of establishments.

[17] For example, ignoring statistical significance, the TOT estimates on the birth rate in Panel B of Table 3 suggest that the number of firms 2 years after the referenda would be lower by 0.003 – 0.014 – 0.011 = -0.022 due only to changes in the birth rate. The estimates in Panel B of Table 2 suggest that the actual effect on the number of establishments is -0.043.

The estimates suggest that an important driver of the change in establishments is due to relocation of firms. Either firms are leaving the district to change their tax burden, firms are not moving to the district to avoid the taxes, or a combination of both. This explanation is quite plausible when considering the geography of our sample. There is a great deal of geographic variation because of the large number of school districts; the median district is 49 square miles and 27 percent of districts are less than 25 square miles. So firms have the option of making relatively small location decisions to change their tax burden. Note that Isen (2014) finds no evidence of tax competition across school districts in Ohio in terms of tax decisions by local governments, and also finds no evidence of mobility of households in response to tax changes. Our evidence suggests that there is mobility of *businesses* in response to tax changes.

In fact, location decisions likely play a role in the birth and death estimates. It is unlikely that a higher tax in a specific school district prevents a potential new firm from entering any market. Instead, they may simply choose to create their firm in a different district. Additionally, location decisions could potentially explain the small negative signs on the death rate (although we should be cautious since these estimates are never statistically significant). Changes in property taxes could induce marginally profitable firms to relocate in a way that prevents them from exiting the overall market. This could occur if such firms face high enough fixed costs associated with moving that they do not relocate until the higher marginal tax rate induces them to.[18]

Tables 2 and 3 use our preferred transformation of the outcomes, scaling by the pre-period average number of firms in a district because it allows an easy comparison of the point estimates across the stock and flow outcomes. However, the substance of the results is not

[18] Alternatively, such marginal firms could be hoping that a referendum fails and the tax rate falls. Once the referendum passes (regardless of type) then they are induced to move.

driven by how we transform the outcomes. The results in Appendix Table A-1 use the natural log transformation. The ITT and TOT estimates for all establishments are very similar to the estimates in Table 2, which we would expect since both represent an approximation of a percentage change in the number of firms. The estimates for births and deaths are larger in magnitude than Table 2. That is because they represent the percent change in the number of births (deaths), which are relatively few compared to the number of all firms (Table 1). However, the substantive effects are similar: the ITT and TOT estimates are negative in the years following the passage of a referenda, consistent with a lower birth and death rates, although the estimates are only sometimes statistically significant, and only for births.

Overall, we interpret the findings in Tables 2 and 3 as suggesting that local property taxes likely reallocate economic activity across space instead of lowering overall economic activity. That is because there does not appear to be any evidence of firms leaving the overall market, the clearest sign of decreased overall economic activity. Additionally, the evidence point to a role for reallocation. Such reallocation is not costless, there is a deadweight loss to inducing firms to move from district to district, but it is probably not on the same order of magnitude as if property taxes led to firms leaving the market. That being said, there is clear evidence of a negative effect on the local (district) economy. This could feedback into lower resources for the local schools that such taxes are supposed to be supporting. This could happen directly through a decrease in the local property tax base. It could also happen indirectly through spillovers, such as fewer people employed in businesses in the district, which would decrease local income tax revenue (if such a tax exists) or less consumption at local establishments (retail shops, restaurants, etc.).

4.3 Effects for Manufacturing Firms

The estimates from Tables 2 and 3 present the average effects across all firms. However, there are reasons to believe that the effects may vary across industry. For example, manufacturing firms are likely to be disproportionately affected by property taxes as taxes are placed on real property (property and capital), the values of which are likely higher than non-manufacturing firms. In contrast, manufacturing firms may be more likely to receive tax abatements that limit their exposure to local property taxes. Thus, the effect on the manufacturing sector in our sample is inherently an empirical question.

In Table 4, we present estimates of the effect of property taxes on manufacturing establishments. We present the same outcomes (stock, births, deaths) but measured only for manufacturing firms. Here we scale by the mean number of establishments in the pre-period, but in this case use only manufacturing establishments. The ITT estimates on the number of manufacturing establishments are presented in the first row of the top panel. The ITT estimates show a large, negative effect on the number of manufacturing firms in the district. The effect is only statistically significant in the second year following a successful referendum, but the magnitudes suggest a 2 to 4 percent decrease. Unlike the estimates for all firms, the effect does not appear to decrease over time. The estimates on the birth and death rate are never statistically significant. However, the point estimate is negative for births in the year following a referendum, similar to the estimate for all firms. Additionally, the point estimates are positive for the death rate in several years.

Panel B presents the TOT effects of referenda passage. As in Table 2, the TOT effects are larger in magnitude for the stock of establishments, suggesting decreases of 4 to almost 10 percent, which generally increase over time. The estimates for the birth and death rate continue to be smaller in magnitude and statistically insignificant, although it may be worth noting that the death rate estimates are fairly large and positive in the year of a referendum passage and one year later. The estimates in Panel C present the TOT effects of the change in the effective property tax rate. Using the previous logic, the estimates suggest an elasticity of manufacturing firms to the effective property tax rate of $-\frac{0.013}{0.0177} = -0.73$ in the year following a tax increase and $-\frac{0.016}{0.0177} = -0.9$. The estimates continue to be negative, but not statistically significant, in later years. Averaging the point estimates for $\tau = 1$ to 5, we have an implied elasticity of approximately -0.61.

4.3 Effects for Non-manufacturing Firms

We now present estimates for non-manufacturing firms. While, in general, these firms may face a lower burden of property taxes, they may have higher mobility. Thus, it is possible that non-manufacturing firms are more able to avoid taxes through relocation which would have effects on the number of firms in a district. In our analysis, we choose to focus on retail and service establishments. Non-manufacturing firms account for approximately 95% of establishments in districts, thus the estimates for all non-manufacturing firms essentially mirror the 'all industry' results presented in Tables 2 and 3.[19] Retail and service are the two largest components of non-manufacturing and account for approximately 19% and 39% of all establishments, respectively, in the average district during our sample.

For ease of presentation, we present our two sets of TOT estimates for retail and service establishments in Table 5 (the ITT estimates are presented in Appendix Table A-3). The estimates suggest that the effects of property taxes are particularly large for the service sector. The point estimates for the TOT effects of referenda passage in the top panel for the retail sector

[19] The only substantive difference is that non-manufacturing firms show a statistically significant decrease in the year of a referenda passage. This is consistent with these firms being more mobile than manufacturing firms, and therefore able to relocate quicker. Full estimates are presented in Appendix Table A-2.

generally follows the pattern for all establishments in Table 2, but the effects are imprecisely estimated. In contrast, the point estimates for service sector firms are large in magnitude and frequently statistically significant. The passage of a property tax referenda decreases service firms by 2.9 percent in the year of a referendum, and the number of service firms continues to be approximately 5 to 7 percent lower in the following years. The entry of new firms falls by 1.9 percent in the year following the referenda passage, and the coefficients remain large and negative in later years, although not statistically significant. Results also suggest that firms in the service industry are less likely to close. A possible explanation is that service firms have lower moving costs making them more likely to move instead of closing, lowering the death rate in the district.

Panel B presents the estimated TOT effects of the change in the effective property tax rate. The point estimate for the birth rate of retail firms one year after a referendum is -0.005, which matches the estimate for the number of retail firms, although the latter is not statistically significant. The implied elasticity in the number of firms 1 year following the referenda would be $-\frac{0.005}{0.0177} = -0.28$. In contrast, service sector firms have point estimates of -0.008 in the year of and year after referenda passage. This would be an implied elasticity of $-\frac{0.008}{0.0177} = -0.45$.

5. Conclusion

This paper investigates the effect of property taxation on the local business activity. Property taxes are used to fund local public goods, such as schools, but raise the costs of operating in the area for firms. Higher property taxes in a location could therefore decrease the number of local businesses by increasing firm deaths, discouraging firm births or by increasing net migration out of the area. While the potential effects of property taxes on businesses are clear from basic theory, the magnitudes of the potential effects are an empirical question that are difficult to answer due to the endogenous nature of property taxation.

We attempt to overcome the issue of endogeneity by employing a dynamic regression discontinuity design using voting data on property tax referenda for local schools across 600 districts in Ohio from 2003-2016. We construct measures of local businesses using a unique longitudinal database of all establishments in Ohio during our sample period. Our method compares what happens to the number of businesses in school districts that barely pass a property tax increase to the number of businesses who reside in school districts that barely fail to pass an increase. We estimate treatment-on-the-treated effects that account for the dynamics of how passage of a referendum in one year affects passage of future referenda, and we separately identify the effects of passing any referendum from the effects of the change in local taxes.

We find evidence that a property tax referendum lowers the number of establishments in the district for several years following its passage. The magnitudes suggest a 3-5 percent decline in the stock of local establishments up to 3 years following the referenda passage, after which the effect appears to decrease and loses statistically significance. Our estimates suggest an inelastic response with respect to the change in the local tax rate, with an implied elasticity of approximately -0.34. Further evidence suggests that new firm entry to the area drops temporarily following referenda passage, suggesting that local taxes deter new business formation in the area. The magnitude of this effect indicates that decreased firm entry can only explain a small share of the overall decrease in the number of firms, and we find no evidence that property taxes lead to an increase in firm deaths, suggesting that firm relocations are driving most of the effects. The evidence therefore suggests that variation in local taxes serve more to reallocate economic activity instead of reducing overall economic activity.

These results provide local policymakers with information about the potential costs of higher property taxes for the business community. The results also add to the literature on school funding, showing that while higher school funding may in fact raise local residential property values, higher property taxes appear to deter business activity. Given our estimates, this could lead to an erosion in the local tax base used to fund schools, potentially both the commercial property tax base as well as local income tax base. Thus, our results raise further questions about the economic efficiency and equity of relying on local property taxes to fund schools.

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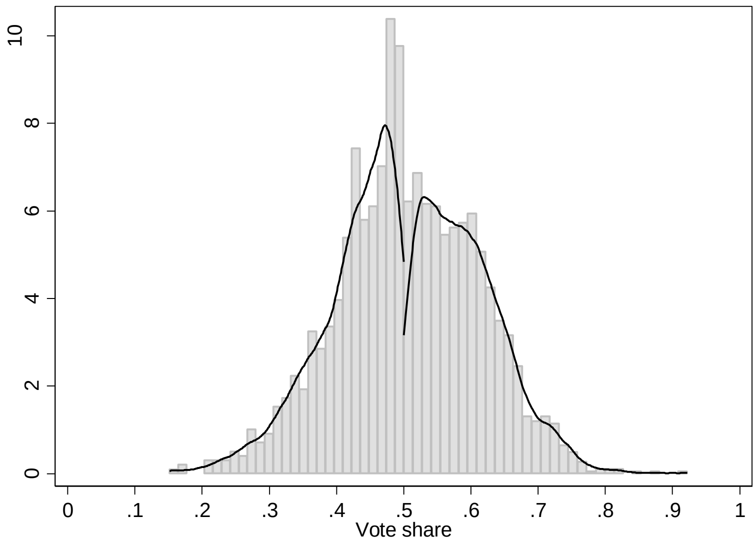
Figure 1: Density of Vote Shares in School Property Tax Referenda



Notes:
1) The graph shows the distribution of share of votes in favor of passing a tax levy in our data. The grey bars show the histogram and the black lines represent kernel density estimates, estimated separately on either side of the 50% threshold for passage of a tax levy.

Table 1: Summary Statistics

Number of school property tax votes	3,734	
	Mean	St. Dev.
Vote share	0.526	0.105
Passage rate	0.603	0.489
Additional	0.494	0.500
Renewal	0.436	0.496
Replacement	0.058	0.233
Total mills	4.979	3.105
Raw outcomes		
Establishments, all industries	802.168	1,837.478
Births all industries	79.730	214.840
Deaths, all industries	90.757	239.719
Scaled outcomes		
Establishments, all industries	1.105	0.166
Births all industries	0.096	0.058
Deaths, all industries	0.114	0.053
Logged outcomes		
Establishments, all industries	5.987	1.113
Births all industries	3.447	1.316
Deaths, all industries	3.674	1.222

Notes:
1) Vote share refers to the proportion of total votes for a tax levy that are in favor of the levy.
2) Scaled outcomes are divided by the number of total firms in the district in the 5 years before the sample (1998-2002). Logged outcomes are the natural log of the number of establishments + 1.

Table 2: ITT and TOT Effects of Property Tax Referenda on the Number of Establishments, All Industries

	Years since the tax passage					
	0	1	2	3	4	5
	Panel A: ITT Effects (of passing a ref on the number of estab.)					
Establishments	-0.008	-0.015**	-0.017*	-0.019*	-0.007	0.000
	(0.005)	(0.007)	(0.009)	(0.010)	(0.012)	(0.014)
	Panel B: TOT Effects (of passing a ref on the number of estab.)					
Establishments	-0.014	-0.031**	-0.043**	-0.052*	-0.038	-0.018
	(0.009)	(0.015)	(0.021)	(0.027)	(0.033)	(0.039)
	Panel C: TOT Estimates of Effective Tax Rate Change					
Establishments	-0.004	-0.006*	-0.006	-0.007	0.000	0.002
	(0.003)	(0.003)	(0.004)	(0.005)	(0.006)	(0.007)

Notes:
1) Standard errors are presented in parentheses below point estimates. Standard errors are clustered by school district in the estimation of the ITT effects. Standard errors for the TOT estimates are derived using the ITT standard errors and the delta method. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
2) The left-hand side is the number of establishments in the district divided by the average number of all establishments in the district in the pre-period 1998-2002.

Table 3: ITT and TOT Effects of Property Tax Referenda on Establishment Births and Deaths, All Industries

	Years since the tax passage					
	0	1	2	3	4	5
	Panel A: ITT Effects (of passing a ref on the number of estab.)					
Births	0.002	-0.009**	-0.003	-0.001	-0.003	0.001
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
Deaths	-0.002	-0.003	0.000	-0.005	-0.001	0.000
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
	Panel B: TOT Effects (of passing a ref on the number of estab.)					
Births	0.003	-0.014	-0.011	-0.006	-0.008	-0.004
	(0.006)	(0.009)	(0.010)	(0.012)	(0.013)	(0.013)
Deaths	-0.003	-0.006	-0.002	-0.009	-0.007	-0.002
	(0.006)	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)
	Panel C: TOT Estimates of Effective Tax Rate Change					
Births	0.001	-0.005**	0.000	0.000	-0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Deaths	-0.001	-0.001	0.001	-0.002	0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)

Notes:
1) Standard errors are presented in parentheses below point estimates. Standard errors are clustered by school district in the estimation of the ITT effects. Standard errors for the TOT estimates are derived using the ITT standard errors and the delta method. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
2) The left-hand side is number of establishments in the district divided by the average number of all establishments in the district in the pre-period 1998-2002.

Table 4: Estimated Effects of Property Taxes on Manufacturing Establishments

	Years since the tax passage					
	0	1	2	3	4	5
	Panel A: ITT Effects (of passing a ref on the number of estab.)					
Establishments	0.004	-0.026	-0.040*	-0.029	-0.020	-0.029
	(0.014)	(0.017)	(0.022)	(0.023)	(0.025)	(0.025)
Births	0.007	-0.006	-0.006	0.004	-0.004	0.000
	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Deaths	0.012	0.004	-0.005	0.003	-0.001	-0.003
	(0.009)	(0.009)	(0.008)	(0.011)	(0.010)	(0.011)
	Panel B: TOT Effects (of passing a ref on the number of estab.)					
Establishments	0.007	-0.040	-0.086*	-0.088	-0.076	-0.090
	(0.023)	(0.036)	(0.050)	(0.060)	(0.069)	(0.072)
Births	0.012	-0.004	-0.013	0.001	-0.006	-0.004
	(0.009)	(0.014)	(0.014)	(0.015)	(0.016)	(0.016)
Deaths	0.020	0.016	0.000	0.006	0.002	-0.006
	(0.015)	(0.018)	(0.019)	(0.023)	(0.025)	(0.024)
	Panel C: TOT Estimates of Effective Tax Rate Change					
Establishments	0.002	-0.013*	-0.016*	-0.007	-0.007	-0.011
	(0.007)	(0.008)	(0.009)	(0.010)	(0.011)	(0.012)
Births	0.003	-0.004	-0.002	0.004	-0.004	0.001
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Deaths	0.006	-0.000	-0.003	0.003	-0.002	-0.003
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)

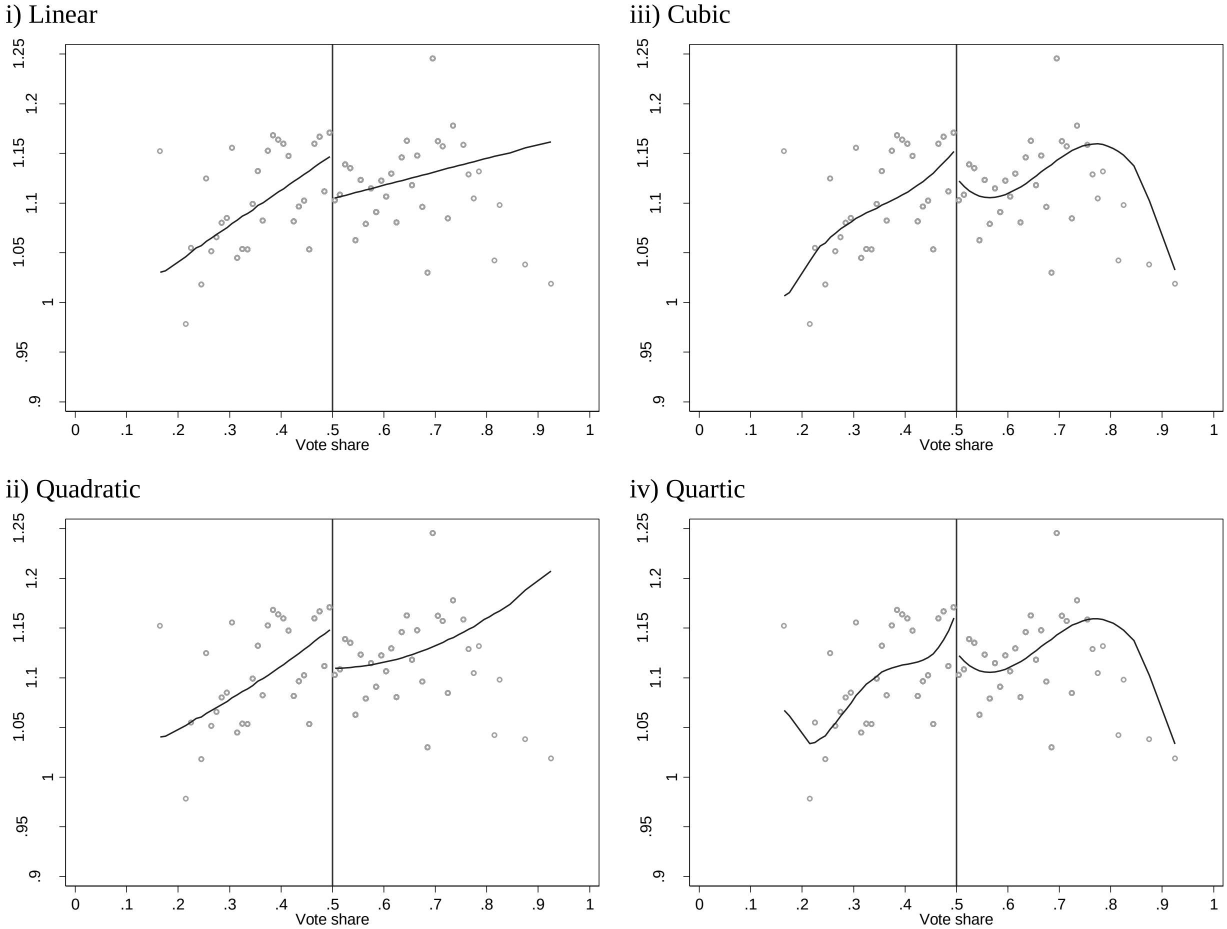
Notes:
1) Standard errors are presented in parentheses below point estimates. Standard errors are clustered by school district in the estimation of the ITT effects. Standard errors for the TOT estimates are derived using the ITT standard errors and the delta method. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
2) The left-hand side is number of establishments in the district divided by the average number of manufacturing establishments in the district in the pre-period 1998-2002.

Table 5: TOT Effects of Property Taxes on Retail and Service Establishments

	Years since the tax passage					
	0	1	2	3	4	5
	Panel A: TOT Effects (of passing a ref on the number of estab.)					
Establishments, retail	0.003	-0.015	-0.021	-0.011	-0.001	0.026
	(0.015)	(0.023)	(0.028)	(0.036)	(0.041)	(0.047)
Births, retail	0.013	-0.008	-0.002	0.014	0.003	0.013
	(0.008)	(0.011)	(0.012)	(0.015)	(0.016)	(0.017)
Deaths, retail	0.004	0.002	0.005	0.011	-0.002	0.018
	(0.009)	(0.011)	(0.012)	(0.013)	(0.014)	(0.016)
Establishments, service	-0.029**	-0.051**	-0.051*	-0.065	-0.066	-0.049
	(0.014)	(0.023)	(0.031)	(0.040)	(0.049)	(0.058)
Births, service	-0.003	-0.019*	-0.017	-0.008	-0.023	-0.013
	(0.008)	(0.010)	(0.011)	(0.013)	(0.015)	(0.016)
Deaths, service	-0.002	-0.018*	-0.005	-0.008	-0.001	-0.002
	(0.008)	(0.010)	(0.011)	(0.011)	(0.013)	(0.014)
	Panel B: TOT Estimates of Effective Tax Rate Change					
Establishments, retail	0.001	-0.005	-0.002	0.001	0.001	0.008
	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)
Births, retail	0.004	-0.005*	0.002	0.004	-0.004	0.005
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Deaths, retail	0.001	-0.000	0.001	0.002	-0.003	0.006
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Establishments, service	-0.008*	-0.008	-0.004	-0.010	-0.005	0.000
	(0.004)	(0.005)	(0.006)	(0.008)	(0.009)	(0.010)
Births, service	-0.001	-0.005*	0.000	0.001	-0.006*	0.002
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Deaths, service	-0.001	-0.005*	0.003	-0.002	0.001	0.000
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)

Notes:
1) Standard errors are presented in parentheses below point estimates. Standard errors are clustered by school district in the estimation of the ITT effects. Standard errors for the TOT estimates are derived using the ITT standard errors and the delta method. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
2) The left-hand side is number of establishments in the district divided by the average number of similar establishments in the district in the pre-period 1998-2002.

Appendix Figure A-1: ITT Estimates of the Effect of Property Tax Levies on Number of Firms 3 Years After Passage



Notes:

1) Dots represent the average change in the business activity for all levies that fall within a specific range of passage rates (percent of total votes in favor of the levy). The lines represent predicted outcome from each specification. The vertical difference between the lines on either side of the 50% vote share needed to pass a levy represents the estimated effect of property taxes on business activity in our regression discontinuity design.

Appendix Table A-1: ITT and TOT Effects of Property Taxes on Establishments, All Industries, logged estimates

	Years since the tax passage					
	0	1	2	3	4	5
	Panel A: ITT Effects (of passing a ref on the number of estab.)					
Establishments	-0.008*	-0.012**	-0.013*	-0.014*	-0.005	-0.001
	(0.005)	(0.006)	(0.007)	(0.008)	(0.010)	(0.011)
Births	0.011	-0.085*	-0.059	-0.005	-0.040	-0.031
	(0.040)	(0.045)	(0.049)	(0.054)	(0.058)	(0.059)
Deaths	-0.017	-0.007	-0.005	-0.026	-0.018	0.015
	(0.035)	(0.035)	(0.032)	(0.035)	(0.036)	(0.045)
	Panel B: TOT Effects (of passing a ref on the number of estab.)					
Establishments	-0.014*	-0.027**	-0.034*	-0.040*	-0.029	-0.016
	(0.008)	(0.013)	(0.018)	(0.022)	(0.027)	(0.031)
Births	0.018	-0.132	-0.163	-0.083	-0.110	-0.115
	(0.066)	(0.093)	(0.111)	(0.132)	(0.149)	(0.158)
Deaths	-0.029	-0.026	-0.020	-0.054	-0.057	0.000
	(0.057)	(0.070)	(0.067)	(0.071)	(0.076)	(0.090)
	Panel C: TOT Estimates of Effective Tax Rate Change					
Establishments	-0.004*	-0.005*	-0.004	-0.005	0.000	0.001
	(0.002)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)
Births	0.005	-0.043**	-0.016	0.009	-0.024	-0.005
	(0.019)	(0.021)	(0.023)	(0.026)	(0.027)	(0.026)
Deaths	-0.008	-0.001	-0.001	-0.013	-0.003	0.012
	(0.017)	(0.017)	(0.016)	(0.018)	(0.018)	(0.022)

Notes:
1) Standard errors are presented in parentheses below point estimates. Standard errors are clustered by school district in the estimation of the ITT effects. Standard errors for the TOT estimates are derived using the ITT standard errors and the delta method. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
2) The left-hand side is the ln(N+1) where N is the number of establishments.

Table A-2: Estimated Effects of Property Taxes on All Non-Manufacturing Establishments

	Years since the tax passage					
	0	1	2	3	4	5
	Panel A: ITT Effects (of passing a ref on the number of estab.)					
Establishments	-0.010*	-0.015**	-0.016*	-0.018*	-0.006	0.002
	(0.006)	(0.007)	(0.009)	(0.011)	(0.013)	(0.015)
Births	0.007	-0.006	-0.006	0.004	-0.004	0.000
	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Deaths	-0.002	-0.003	0.000	-0.005	-0.002	0.001
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)
	Panel B: TOT Effects (of passing a ref on the number of estab.)					
Establishments	-0.016*	-0.034**	-0.042**	-0.051*	-0.036	-0.014
	(0.009)	(0.015)	(0.021)	(0.028)	(0.034)	(0.040)
Births	0.003	-0.014	-0.012	-0.007	-0.008	-0.003
	(0.007)	(0.009)	(0.010)	(0.012)	(0.013)	(0.014)
Deaths	-0.004	-0.008	-0.003	-0.010	-0.008	-0.002
	(0.007)	(0.008)	(0.008)	(0.010)	(0.009)	(0.010)
	Panel C: TOT Estimates of Effective Tax Rate Change					
Establishments	-0.005	-0.006*	-0.005	-0.007	0.000	0.003
	(0.003)	(0.003)	(0.004)	(0.006)	(0.006)	(0.007)
Births	0.001	-0.005**	0.000	0.000	-0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)
Deaths	-0.001	-0.001	0.001	-0.003	-0.000	0.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)

Notes:
1) Standard errors are presented in parentheses below point estimates. Standard errors are clustered by school district in the estimation of the ITT effects. Standard errors for the TOT estimates are derived using the ITT standard errors and the delta method. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
2) The left-hand side is number of establishments in the district divided by the average number of all non-manufacturing establishments in the district in the pre-period 1998-2002.

Appendix Table A-3: ITT Effects of Property Taxes on Retail and Service Establishments

	Years since the tax passage					
	0	1	2	3	4	5
Establishments, retail	0.002	-0.010	-0.008	-0.001	0.003	0.016
	(0.009)	(0.011)	(0.012)	(0.014)	(0.015)	(0.018)
Births, retail	0.008	-0.008	0.001	0.008	-0.002	0.008
	(0.005)	(0.006)	(0.005)	(0.007)	(0.007)	(0.007)
Deaths, retail	0.002	0.000	0.002	0.005	-0.005	0.011
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Establishments, service	-0.017**	-0.022**	-0.017	-0.024	-0.020	-0.010
	(0.008)	(0.010)	(0.012)	(0.015)	(0.018)	(0.021)
Births, service	-0.002	-0.011**	-0.004	0.000	-0.011*	-0.001
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
Deaths, service	-0.001	-0.010**	0.002	-0.004	0.003	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)

Notes:
1) Standard errors are presented in parentheses below point estimates. Standard errors are clustered by school district in the estimation of the ITT effects. Standard errors for the TOT estimates are derived using the ITT standard errors and the delta method. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
2) The left-hand side is number of establishments in the district divided by the average number of similar establishments in the district in the pre-period 1998-2002.