Abstract:
The endogenous nature of property taxation makes it difficult to properly understand the effects of property taxation on businesses. We employ a regression discontinuity design comparing business outcomes in areas that barely passed school property tax increases to business outcomes in areas that barely failed to pass the tax increase. The findings suggest that property tax increases have an immediate adverse effect on new business formation while more established business are adversely affected three years after passing the tax increase.

Acknowledgements: The authors gratefully acknowledge financial support of this project from the Ewing M. Kauffman foundation. All errors and omissions are our own.
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 investment and location decisions, the 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 of 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 renewals or changes in 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, the property tax levy 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. 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 negative 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 little much less literature on the negative consequences.

We gather election data on approximately 2,100 school property tax levy issues in Ohio from 2004-2013. The data includes information about size and type of tax levy as well as the votes for and against. We then gather data on local business activity from Infogroup data

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).
covering a near universe of establishments. We combine information about the industry and age of the establishments, as well as their employment, with detailed location information that allows us to construct annual measures of business activity for each of the approximately 600 school districts in our sample. We measure both a short-term effect, defined as one year following the tax levy vote, and a longer-term effect, defined as three years following the tax levy vote.

We find that property taxes lower the number of existing establishments by approximately 1.5 percentage points one year following the levy vote. Three years after the vote, the number of establishments are lowered by approximately 2.5 percentage points. We find evidence that the short-term effect is driven by a reduction in the rate of new business entry into the district following the levy passage. The longer-term effect is due to both the decreased rate of business entry several years earlier as well as a decreased survival rate of existing firms. However, we find that the entry rate of new firms is unaffected by property in the longer term, suggesting that the entry rate of new businesses drops immediately following the tax increase but then returns to steady rate after a few years. We further demonstrate that these estimates are robust to a variety of parametric and non-parametric specifications.

We provide some evidence about how property taxes affect businesses across sectors. There is some evidence of negative effects on manufacturing firms, particularly in terms of employment, but the estimates are imprecisely estimated. We do find large negative responses by non-manufacturing firms in general, particularly in the retail and service sector. New firm creation decreases substantially in these sectors following school property tax levy passage compared to manufacturing, and this helps to contribute to a reduction in the total number of existing firms several years after passage of the levy. We also provide some evidence that employment in non-manufacturing sectors, particularly retail, is negatively affected by property
taxes. These point estimates provide a preliminary look at how property taxes may affect business activity, but the heterogeneity of the response is an important avenue for future research.

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 literature related to the effect of property taxation on business that are worth noting. 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 the 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.

---

\(^3\) 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.
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 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 business 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. The only evidence of a negative relationship between property taxation and businesses is Walker and Greenstreet (1991) who find 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 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

---

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

Let $Y_j$ be different measures of entrepreneurial activity in location $j$ at time $t$. We can then express the level of business activity as $Y_{jt} = f(\tau_{jt}, X_{jt})$ where $\tau_{jt}$ the local property tax rate at time $t$ and $X_{jt}$ is a vector of local characteristics that can include business amenities (or disamenities) such as local productivity or agglomeration effects. As discussed previously, we expect that higher local business amenities, in the form of local productivity or positive agglomeration effects, are positively correlated with $\tau_{jt}$.

The identification problem is that $\tau_{jt}$ is endogenously determined with $X_{jt}$, not all of which are observed by the researcher. Therefore, standard regression estimates of the relationship between $\tau_{jt}$ and $Y_{jt}$ will tend to be biased by omitted variables. 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.

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). To illustrate, suppose that voters are choosing between having school property tax $\tau_j = r'$ or $\tau_j = 0$ (for simplicity, we drop the time subscripts), and the levy will pass if at least 50% of voters vote in favor of the levy. Suppose also that the proportion of voters supporting the levy is expressed as $z = \frac{n_s}{n_s + n_o}$ where $n_s$ and $n_o$ are the number of supporters and opponents, respectively. While not necessarily critical for our design, it is important to note that the local voters in the election may

---

5 See Imbens and Lemieux (2008) for a detailed discussion of this technique.
not include local business people affected by the tax, since business owners could reside in other locations.\footnote{Even if all local businesses are owned by individuals living in the district, and therefore in the pool of voters, our identification strategy will be successful as long as the pool of business owners is small relative to the pool of local voters, which is likely true in all districts in our data.}

We expect that $z$ may be correlated with $X_t$. For example, property taxes may be more likely to be supported in locations with high income or productivity where taxes are less likely to be damaging to businesses. In this case, we would expect to find a positive relationship between $z$ and $X_t$. However, the probability of location $j$ having property tax $\tau'$ jumps discontinuously at $z = 0.5$ so that

$$
\tau = \begin{cases} 
0 & \text{if } z < 0.5 \\
\tau' & \text{if } z \geq 0.5
\end{cases}
$$

We can use the jump in the probability of having $\tau'$ at $z = 0.5$ to identify the effect of the tax on our measures of business activity. In particular, we can investigate whether there is a 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 $z = 0.5$. If taxes have no effect on local business activity, then we would expect to find no discontinuous change 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 $E(Y_j | z)$ at $z = 0.5$ should be due to the tax. We have no reason to suppose that our identifying assumption fails, and will present evidence supporting our assumption later. 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 ballot issues in Ohio from 2004-2013 from the Ohio Secretary of State website (prior years are not available). 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 2,100 observations. The average vote share in favor of the school levies is 53.2 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 that the Ohio Supreme Court ruled in DeRolph v. State in 1997 that such reliance was unconstitutional.\(^7\) Furthermore, school property taxes account for approximately 65 percent of local property taxes in 2014 (author’s calculations from Ohio property tax data), and are applied to both residential and commercial properties. Finally, 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 tax rates can vary substantially

\(^7\) Despite this ruling, no major changes to the school funding system were ever enacted, and the Ohio Supreme Court later gave up jurisdiction.
across relatively small levels of geography, potentially allowing firms the option of making relatively small location decisions to change their tax burden.

There are several important aspects of the property tax system in Ohio that need to be understood. 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 $\tau$ mills (called the gross rate), it will generate revenue of $R = \tau \cdot V$, where $V$ is the taxable value of local property. If there is local appreciation in property ($V$) then the effective tax rate $\tau^*$ is adjusted to keep $R$ constant.\(^8\) Note that this adjustment is made in nominal terms; school districts not only do not benefit from local property appreciation but 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.\(^9\)

Partly because of the tax reduction factor, schools can go to voters with different types of levies. Tax renewals renew the current effective rate for another set of years, additional levies add new millage to existing rates and replacement levies reset effective rates back to their initial gross rate, thus raising local taxes. We later explore differences in the effect of school levies that raise local millages, which clearly raises the tax burden of local firms, to those that extend current effective rates, which still may be problematic to firms with losses or thin margins. If a school tax levy does not pass, then districts either must cut costs in the school district or they can put the tax levy back on the ballot. The latter could cause problems with our identification if it allows districts to game the discontinuity (keep attempting levies until they finally pass).

---

\(^8\) 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.

\(^9\) 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.
However, it does not appear this is a concern in our data. Table 1 demonstrates that the average number of attempts at a levy is 1.14, but 95% of levy issues are put to voters a single time. Furthermore, Figure 1 shows that there is a higher density of vote shares that fall just below the discontinuity, even when the data is restricted to levies that are only attempted once, suggesting that many issues that just barely fail are not put back to voters. While this does not appear to be a problem in the data, we will restrict our estimation to the first attempt at each levy. This means that any attempt that fails on the first attempt but then succeeds on a second attempt will be treated as ‘not passed’ in our estimation, which will tend to bias the estimates towards finding no effect.

In order to measure how local business 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.\(^{10}\) We also have a unique identifier that lets us track changes to these characteristics for each establishment.

From this data, we construct several measures of business activity for each school district. We calculate the number of new establishments, defined as those that have been in service one year or less than , and established establishments, defined as establishments with four or more years of service. We create measures for all industries, and then separately for different industry classes. We create all measures at two different points in time. We define the short-

\(^{10}\) 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).
term as the year following the tax levy vote ($Y_{t+1}$ where the vote is taken in time $t$). We then define a longer-term outcome as three years following the tax levy vote ($Y_{t+3}$). These two measures allow us to consider the very near-term effect of property taxes compared to a longer time-frame.

In our estimation, we scale these measures to help interpretation and to account for large differences in sizes of school districts. For establishment counts, we divide the measure in each district in each year by the mean number of firms in the district during our sample. This allows us to interpret point estimates for all firms and established firms as percentage changes, relative to the district baseline. New firms then can be interpreted as an entry rate relative to the baseline size of the district. We similarly construct and scale measures of total employment in the district. The bottom panel of Table 1 presents basic summary statistics showing the mean of our variables around 1 for all firms (as expected based on our scaling), the number of established firms averaging around 75 percent of all firms, and the entry rate of new firms around 10 percent (1 new firm per 10 existing firms).

In practice, RDD estimates can be sensitive to the empirical specification so we use a variety of specifications in our estimates. A common approach in the literature is to estimate a regression of the outcome on an indicator for whether $z \geq 0.5$, a polynomial in $z$, and the interaction of the indicator with the polynomial. In our case we estimate:

$$Y_{j t+c} = \alpha + \delta I(z_{jt} \geq 0.5) + \beta f(z_{jt}) + \gamma \left(f(z_{jt}) * I(z_{jt} \geq 0.5)\right) + \phi_t + \epsilon_{jt}$$

where $\phi_t$ is a year fixed effect to account for trends over time, $t = 0$ indicates the year of a property tax vote and $t + c$ indicates the business activity $c$ years after the vote. In the specification above, $\delta$ measures the discontinuous jump in $Y_{jt}$ at $z = 0.5$, which can be interpreted as the causal impact of property taxes on local businesses. Under our identifying
assumption, there is no need to include observed measures of $X_{jt}$, although doing so can improve precision (see Imbens and Lemieux (2008)). We do not include variables, despite the potential gains in precision, because we lack measures of economic conditions at the district level that vary over time.\footnote{One option would be to include information about the school district itself. Data on enrollment, staffing and expenditures is available from the Department of Education for each year. These measures do not really capture information about local conditions that change over time, but would potentially help to improve precision.}

There is little guidance in the literature about what order polynomial should be used, although higher order polynomials add flexibility to the functional form and therefore may provide more accurate estimates of $\delta$. It is common, therefore, to check the robustness of the estimates by using different order polynomials. In our main results, we focus on cubic and quartic specifications, but we demonstrate that our results are insensitive to functional form specifications, including linear and quadratic polynomials of $z$. We estimate all specifications clustering the standard errors by school district.

One potential concern with the parametric specification above is that it utilizes the full range of data to estimate the effect of taxes. The idea of RDD estimates is that treatment status is exogenously determined in a narrow window around $z = 0.5$; that while there are likely large differences in characteristics (observed and unobserved) between districts that vote 10\% in favor of taxes and districts that vote 90\% in favor, there are likely little differences for districts that vote 49\% versus 50\%. The parametric specification uses data from all districts, relying on the polynomial of $z$ to estimate the discontinuity in $Y_{jt}$ at $z = 0.5$. Given that we our results are insensitive to the choice of polynomial, this may not be a concern. However, we chose to also estimate our results using a non-parametric approach based on estimated local linear regressions on either side of $z = 0.5$ with a triangle kernel and a bandwidth chosen to minimize the mean square error of the estimates (see Nichols, 2007). To account for the time effects captured by the
year fixed effects in our parametric specification, we first demeaned the data to remove annual averages. Standard errors are produced by bootstrapping the procedure with 1000 replications.

4. Results

4.1 Effects of Property Taxes on Firms in All Industries

We begin by investigating the effect of local property taxes to fund schools on the number of establishments in the local district across all industries. Figure 2 shows the graphical representation of the RDD estimates for the one-year effect in the first column and for the three-year effect in the second column, produced using a cubic parametric specification, a quartic parametric specification, and the nonparametric Wald estimate. All of the graphs show a decrease in the number of firms at the 50% vote share required to implement a tax, with larger effects in the longer-term compared to the shorter-term. This suggests that local property taxes are inhibiting business activity.

Exact estimates are provided in the top panel of Table 2. The estimated one-year effect is a decrease in the number of firms of -1 percentage point in the quartic estimate and -1.6 percentage points in the cubic and Wald specifications, although only the cubic specification is statistically significant. The three-year estimates suggest a -2.4 percentage point decrease in the number of firms in the cubic and Wald specifications and a -2.9 percentage point decrease in the quartic specification, all of which are statistically significant at the 10% level or higher. The estimates are fairly consistent across specifications, which can also be seen in Figure 2, suggesting that the estimates are robust to specification choice. Given this robustness, for simplicity, in later tables we only present the results from the quartic and non-parametric specifications (all other estimates are available upon request to the authors).

\[12\] Appendix Figure 1 shows the graphs for the lower-polynomial specifications: linear and quadratic. The graphs and estimates also suggest a negative effect of property taxes on establishments with estimates of \(-0.014^{**} (0.006)\) for the linear model and \(-0.021^{***} (0.007)\) for the quadratic model.
The bottom two sections of Table 2 break the estimates into those for new and established firms. Doing so reveals that short-term and longer-term effects are driven by different impacts for new and established firms. There is little evidence that established firms are affected by property taxes in the short-term, but instead, much of the overall effect is driven by a decrease entry rate of new firms in school districts following passage of a tax levy. In the longer-term, it appears that the entry rate of new establishments is unaffected by property taxes, while there is a substantial decline in existing establishments. The latter effect is partly due to the short-term decrease in new firms: all else held constant, fewer firms entering the market following the tax approval would lead to fewer older, established firms when measured three years later. However, a comparison of the magnitudes suggests that property taxes are also reducing established firms regardless of a change in entry rate of new businesses. The overall pattern in Table 2 suggests that property taxes reduce the rate of new business formation in the school district in the short-term but the entry-rate recovers. Established firms, on average, are not affected immediately following the passage of the tax levy, but there are substantially fewer existing establishments several years later.

In our estimates above, we treated the passage of all tax levies equally. However, as previously discussed, some types of tax levies actually increase the tax rate on businesses while other tax levies only extend the current rate of taxation. The former has a clear prediction of lower business activity, both the entry of new firms and the survival of existing firms, because it raises the tax burden of firms. However, it is less clear how firms would respond to the continuation of a tax. It is possible that firms will not respond much because the tax burden has not increased. However, it is also possible that some businesses respond because they prefer the lower taxes that would have occurred if the renewal failed. This is likely more true for existing
firms who are experiencing thin or negative profit margins, for whom a decrease in taxes would be necessary to maintain operation in the school district. Soon-to-be new firms that planned to operate with the existing tax levels are unlikely to respond to a three- or five-year continuation of those taxes.

In Table 3, we explore the differences in tax increases and tax renewals. We re-estimate our specifications separately for levies that would only renew existing tax rates and levies that would increase tax rates. The top panel presents the short-term effects while the bottom panel displays the longer-term effects. For all firms, tax increases show larger negative effects than tax renewals, although none of the estimates are statistically significant primarily due to the reduced sample size by cutting the sample by levy type. However, the other estimates in the top panel suggest that new firms are substantially affected by new taxes in the short-term, with an approximately 2 percentage point decrease in entry rate, and there is no evidence of a negative effect for tax renewals. For established firms, the point estimates suggest negative effects for renewals but not for tax increases, although none of the estimates are statistically significant.

In the longer-term, tax increases substantially reduce the number of firms, by around 4.2 percentage points, with large effects for established firms, around 2-2.4 percentage points. These estimates are generally larger in magnitude than the estimates for tax renewals, none of which are statistically significant. There is little evidence of any response by new firms to either tax renewals or increases, consistent with the evidence in Table 3 that the entry rate of new businesses is not affected several years after passage of the tax levy.

The estimates in Table 3 generally follow a pattern we might expect, larger effects of tax increases than renewals, although the evidence should be interpreted carefully, as it is possible that school districts strategically make different decisions about whether to ask for tax renewals.
versus tax increases. For example, we might expect that school districts in areas experiencing economic insecurity may be less likely to put a levy to voters asking for additional millage. In general, we do not think this is much of a problem in our data because school districts are generally forced to ask for increased taxes to meet inflation because of the tax adjustment factor. Thus, at some point, many districts need to ask for tax increases because of the unique rules of property taxation in Ohio. Furthermore, if districts do change their behavior as hypothesized, it will likely bias our estimates towards finding similar effects of renewals and new millages. In this case, renewals disproportionately represent economics conditions where firms may be more likely to go out of business regardless of changes in taxes. Thus, we may be getting a somewhat more negative effect for renewals, and a somewhat smaller negative effect for new taxes (since the worst cases have been avoided by using a renewal) than if renewals and additional levies were chosen randomly. Overall, we think it is still valuable to consider the role of tax renewals versus increases, but hesitate to draw too strong of conclusions on these estimates.

4.2 Effects of Property Taxes on Firms by Industry

We next consider how property taxes may affect firms across different industries. It is not fully clear how we might anticipate business activity in different industries to respond to local property taxes. Capital-intensive manufacturing firms are likely to see a larger burden from the taxation of real property, and thus would be most impacted. However, compared to non-manufacturing firms, they may be more likely to receive tax abatements (which we do not observe in our data), are less likely to be able to respond quickly to the change in tax environment, and are likely less mobile so they cannot easily and quickly switch to a lower-tax school district nearby. Even within categories of manufacturing or non-manufacturing there are likely to be differences in how firms respond to property taxes due to differences in tax
treatment, capital-intensity, and mobility. Unfortunately, we are not able to fully explore these questions related to capital-intensity and mobility in this paper, although this is an area for future research. Instead, we present preliminary evidence across large categories of industry.

Table 4 presents estimates within industry categories for the short-term in the top panel and longer-term in the bottom panel. The estimates in columns (i) and (ii) show large, negative, but imprecise effects of property taxes on all manufacturing firms in the short-run. The effects appear to be driven by established manufacturing firms, which may be consistent with large start-up costs for capital-intensive firms that prevent them from deciding to not enter the district at the last moment. The lack of precision may indicate substantial heterogeneity in the response, possibly due to differences in tax abatements and capital-intensity across manufacturing firms.

In contrast, there is little evidence of large, longer-term effects on manufacturing firms in the bottom panel.

In contrast, the pattern of short-term effects on new firms and longer-term effects on established firms seen in Table 2 is clearly observed for non-manufacturing firms. The estimates in column (iii) and (iv) suggest the entry rate of new non-manufacturing firms falls by approximately 1.3 percentage points in the short term, with no effect seen for established firms. In the longer-term, the number of all non-manufacturing firms decreases by 2 to 3 percentage points, driven entirely to a reduction in the number of established firms three years after passage of the tax levy. This reduced number of established firms appears to be due both to the decreased entry rate of new firms immediately following the passage of the tax levy and the exit of established firms from the district. Similar to Table 2, the entry rate of new non-manufacturing firms has stabilized three years after passage of the tax levy.
To try to learn a bit more about how local property taxes affect different firms, we separate out retail and service sector firms from within non-manufacturing and present estimates for these smaller, though still broad, industry categories in columns (v) to (viii). The estimates generally show a similar pattern as observed for non-manufacturing, for example, large decreases in the entry rate of new firms in the short-term for both retail and service. However, the longer-term effects on established firms seems to be more concentrated in service sector firms compared to the retail sector. However, while the point estimates are larger for service sector firms, they are negative for both retail and service and do not appear to be statistically different from each other.

4.3 Effects of Property Taxes on Employment

Firms may respond to local property taxes by not entering the market, shutting down or moving to another district, all of which would affect the count of firms in the school district. However, firms could respond instead by making other adjustments, including lower costs from other sources or changing planning an investment activity. While we do not have data to explore all of these channels, we do have data on total employment at firms in the district. This is not a perfect measure of the employment response since we do not know anything about compensation or hours worked (including part-time vs. full-time status). Thus, we cannot detect if firms are reducing compensation or reducing hours, but we can measure if firms are reducing the total amount of their workforce.

We construct measures of employment in each district, similar to our construction of firm counts. We then estimate our specifications, measuring both the short-term and longer-term effects, of property taxes on total employment. Figure 3 presents the graphical representation of these estimates. The figure shows reductions in employment at the 50% vote share needed for
passage of the property tax levy. The point estimates in columns (i) and (ii) Table 5 suggest that there is no effect of property taxes on the size of new firms (which is true throughout the table), but the point estimates for established firms are large in both the short-term and the longer-term. The longer-term effect is consistent with the reduction in the number of established firms after three years found in Table 2, but the negative short-term effect on employment is in contrast to the lack of any effect of property taxes on the number of established firms in the same time period found in Table 2. That could suggest that established firms respond in the short-term by cutting employment instead of moving or exiting the market. However, the estimates in columns (i) and (ii) of Table 5 are imprecisely measured, with large standard errors, and none are statistically significant from zero.

Some of the lack of precision appears to be due to differences across industries. Estimates in columns (iii) and (iv) show some differences in point estimates between the quartic and nonparametric estimates for manufacturing firms. Furthermore, the standard errors are quite large. Why the standard errors are so large is unclear; it could represent a high degree of heterogeneity in the response of firms within the broad category of manufacturing. Some firms may not have responded due to tax abatements that limit tax liability, some firms may be limited in their ability to respond because of union contracts, or some firms may have chosen to cut compensation or hours, which is not observed in our data, instead of employment. In comparison, the estimates for non-manufacturing firms in columns (v) and (vi) are more precisely estimated. The short-term estimates in the top panel present no clear evidence of a negative employment response, but the bottom panel suggests a large longer term effect of an approximately 6 percentage point decrease in employment. This result is not driven by the size of entering firms but by reduced employment at established non-manufacturing firms,
presumably partly due to the reduction in the number of non-manufacturing firms found in Table 4.

Finally, we estimate the employment effects for retail firms in columns (vii) and (viii) and then for service firms in columns (ix) and (x). While both sectors showed a significant decrease in the entry rate of new firms in the short-run in Table 4, there is no difference in the size of the entering firms in Table 5 (employment at new firms is unchanged). However, while there was not much evidence that the retail sector experienced a decline in the number of firms following passage of property tax levies in Table 4, there is evidence in Table 5 that retail sector employment may have experienced large decreases. The point estimates suggest that employment in the retail sector falls, on the order of 6 to 9 percentage points, in both the short-term and longer-term. The point estimates for service sector employment are generally negative, somewhat smaller than the retail estimates, and not statistically significant.

5. Conclusion

This paper investigates the importance of property taxation in business decisions of where to startup, whether or not to shut down or move and how many workers to employ. These questions are difficult to answer due to the endogenous nature of property taxation. We attempt to overcome the issue of endogeneity by employing a regression discontinuity design approach comparing what happens to businesses in school districts that barely pass a property tax increase and compare their outcomes to businesses who reside in school districts that barely fail to pass an increase. We analyze over 2,100 school property tax votes in 600 school districts in Ohio and find that property taxes do negatively impact local businesses. There seems to be evidence that new firm creation decreases in the year following a property tax levy passage, but that the rate of new entry stabilizes afterwards. However, the number of existing establishments is lower three
years following the tax levy passage, partly due to the decreased entry rate immediately following the tax passage. The effects seem to be particularly large in non-manufacturing industries. We also find negative, but imprecisely estimated, effects on employment.

These results provide local policymakers with information about the potential costs to the business community of higher property taxes. 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.
References


Figure 1: Density of Vote Shares in Property Tax Vote Attempts

i) All vote attempts

[Diagram showing density distribution of vote shares for all vote attempts]

ii) Single attempts only

[Diagram showing density distribution of vote shares for single attempts only]

Notes:
1) The graphs show 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.
Figure 2: Estimates of the Effect of Property Tax Levies on Number of Firms

1-year effect
i) Cubic

ii) Quartic

iii) Wald

3-year effect
iv) Cubic

v) Quartic

vi) Wald

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.
Figure 3: Estimates of the Effect of Property Tax Levies on Employment

1-year effect

i) Cubic

![Graph](image)

ii) Quartic

![Graph](image)

iii) Wald

![Graph](image)

3-year effect

iv) Cubic

![Graph](image)

v) Quartic

![Graph](image)

vi) Wald

![Graph](image)

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.
### Table 1: Summary Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean</th>
<th>St. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of school property tax votes</td>
<td>2113</td>
<td></td>
</tr>
<tr>
<td>Vote share</td>
<td>0.528</td>
<td>0.104</td>
</tr>
<tr>
<td>Passage rate</td>
<td>0.633</td>
<td>0.482</td>
</tr>
<tr>
<td>Vote attempts</td>
<td>1.142</td>
<td>0.402</td>
</tr>
<tr>
<td>Establishments, all industries</td>
<td>1.033</td>
<td>0.085</td>
</tr>
<tr>
<td>New establishments, all industries</td>
<td>0.093</td>
<td>0.052</td>
</tr>
<tr>
<td>Existing establishments, all industries</td>
<td>0.753</td>
<td>0.073</td>
</tr>
<tr>
<td>Employment, all industries</td>
<td>1.047</td>
<td>0.274</td>
</tr>
<tr>
<td>New employment, all industries</td>
<td>0.049</td>
<td>0.063</td>
</tr>
<tr>
<td>Existing employment, all industries</td>
<td>0.877</td>
<td>0.260</td>
</tr>
</tbody>
</table>

Notes:
1) Vote share refers to the proportion of total votes for a tax levy that are in favor of the levy.
2) All outcomes are scaled relative to the average level of existing establishments or existing level or employment in the school district during the sample.
Table 2: RDD Estimates of the Effect of Property Taxes on Firms

<table>
<thead>
<tr>
<th></th>
<th>1-year effect</th>
<th>3-year effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cubic (i)</td>
<td>Quartic (ii)</td>
</tr>
<tr>
<td>All firms</td>
<td>-0.016*</td>
<td>-0.010</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>New firms</td>
<td>-0.008</td>
<td>-0.014*</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Established firms</td>
<td>-0.007</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.009)</td>
</tr>
</tbody>
</table>

Notes:
1) All data are measured at the school district level. The outcomes are divided by the average number of existing establishments in the district during the sample. Thus, the point estimates on total number of firms and established firms represent percentage changes relative to a baseline for each district. The point estimates on new firms represent a change in the entry rate, relative to the number of existing establishments.
2) Point estimates represent the estimated discontinuous change in the outcomes at the 50% vote share threshold needed to pass a tax levy.
3) Standard errors are presented in parentheses below point estimates. In the parametric models, standard errors are clustered at the district level. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
<table>
<thead>
<tr>
<th></th>
<th>Tax renewal</th>
<th>Tax increase</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quartic</td>
<td>Wald</td>
<td>Quartic</td>
<td>Wald</td>
</tr>
<tr>
<td></td>
<td>(i)</td>
<td>(ii)</td>
<td>(iii)</td>
<td>(iv)</td>
</tr>
<tr>
<td>1 year effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All firms</td>
<td>0.015</td>
<td>0.006</td>
<td>-0.015</td>
<td>-0.021</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.019)</td>
<td>(0.014)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>New firms</td>
<td>0.003</td>
<td>0.011</td>
<td>-0.021**</td>
<td>-0.020**</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.013)</td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Established firms</td>
<td>-0.011</td>
<td>-0.018</td>
<td>0.010</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.016)</td>
<td>(0.011)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>3 year effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All firms</td>
<td>-0.020</td>
<td>-0.020</td>
<td>-0.042**</td>
<td>-0.042*</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.021)</td>
<td>(0.018)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>New firms</td>
<td>-0.009</td>
<td>0.007</td>
<td>-0.006</td>
<td>-0.008</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.012)</td>
<td>(0.011)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>Established firms</td>
<td>-0.013</td>
<td>-0.034</td>
<td>-0.024*</td>
<td>-0.020*</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td>(0.022)</td>
<td>(0.013)</td>
<td>(0.012)</td>
</tr>
</tbody>
</table>

Notes:
1) All data are measured at the school district level. The outcomes are divided by the average number of existing establishments in the district during the sample. Thus, the point estimates on total number of firms and established firms represent percentage changes relative to a baseline for each district. The point estimates on new firms represent a change in the entry rate, relative to the number of existing establishments.
2) Point estimates represent the estimated discontinuous change in the outcomes at the 50% vote share threshold needed to pass a tax levy.
3) Standard errors are presented in parentheses below point estimates. In the parametric models, standard errors are clustered at the district level. Asterisks denote statistical significance at the 10% (*), 5% (**), and 1% (***).
Table 4: RDD Estimates of the Effect of Property Taxes on Firms, by Age of Firm and Industry

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing</th>
<th>All Non-manufacturing</th>
<th>Retail</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quartic (i)</td>
<td>Wald (ii)</td>
<td>Quartic (iii)</td>
<td>Wald (iv)</td>
</tr>
<tr>
<td>1 year effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All firms</td>
<td>-0.027</td>
<td>-0.025</td>
<td>-0.010</td>
<td>-0.017</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.027)</td>
<td>(0.011)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>New firms</td>
<td>-0.002</td>
<td>-0.005</td>
<td>-0.013*</td>
<td>-0.012*</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.008)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Established firms</td>
<td>-0.040</td>
<td>-0.037</td>
<td>0.000</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.024)</td>
<td>(0.009)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>3 year effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All firms</td>
<td>0.001</td>
<td>-0.012</td>
<td>-0.029*</td>
<td>-0.022*</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.028)</td>
<td>(0.015)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>New firms</td>
<td>0.011</td>
<td>0.007</td>
<td>0.001</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.009)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Established firms</td>
<td>-0.011</td>
<td>-0.002</td>
<td>-0.032***</td>
<td>-0.024**</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td>(0.026)</td>
<td>(0.011)</td>
<td>(0.009)</td>
</tr>
</tbody>
</table>

Notes:
1) All data are measured at the school district level. The outcomes are divided by the average number of existing establishments in the district during the sample. Thus, the point estimates on total number of firms and established firms represent percentage changes relative to a baseline for each district. The point estimates on new firms represent a change in the entry rate, relative to the number of existing establishments.
2) Point estimates represent the estimated discontinuous change in the outcomes at the 50% vote share threshold needed to pass a tax levy.
3) Standard errors are presented in parentheses below point estimates. In the parametric models, standard errors are clustered at the district level. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
### Table 5: RDD Estimates of the Effect of Property Taxes on Employment, by Age of Firm and Industry

<table>
<thead>
<tr>
<th></th>
<th>All industries</th>
<th>Manufacturing</th>
<th>All Non-manufacturing</th>
<th>Retail</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quartic (i)</td>
<td>Wald (ii)</td>
<td>Quartic (iii)</td>
<td>Wald (iv)</td>
<td>Quartic (v)</td>
</tr>
<tr>
<td>1 year effect</td>
<td>-0.010</td>
<td>-0.029</td>
<td>-0.005</td>
<td>-0.025</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>(0.041)</td>
<td>(0.033)</td>
<td>(0.073)</td>
<td>(0.064)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>New firms</td>
<td>0.001</td>
<td>0.002</td>
<td>-0.009</td>
<td>-0.000</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.013)</td>
<td>(0.010)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Established firms</td>
<td>-0.026</td>
<td>-0.035</td>
<td>-0.038</td>
<td>-0.038</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.036)</td>
<td>(0.072)</td>
<td>(0.060)</td>
<td>(0.042)</td>
</tr>
<tr>
<td>3 year effect</td>
<td>-0.058</td>
<td>-0.058</td>
<td>-0.019</td>
<td>-0.036</td>
<td>-0.063*</td>
</tr>
<tr>
<td></td>
<td>(0.044)</td>
<td>(0.039)</td>
<td>(0.119)</td>
<td>(0.123)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>New firms</td>
<td>0.002</td>
<td>0.002</td>
<td>0.014</td>
<td>0.007</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.008)</td>
<td>(0.009)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Established firms</td>
<td>-0.047</td>
<td>-0.046</td>
<td>-0.057</td>
<td>-0.044</td>
<td>-0.045</td>
</tr>
<tr>
<td></td>
<td>(0.044)</td>
<td>(0.038)</td>
<td>(0.119)</td>
<td>(0.104)</td>
<td>(0.036)</td>
</tr>
</tbody>
</table>

Notes:
1) All data are measured at the school district level. The outcomes are divided by the average number of employment in the district during the sample. Thus, the point estimates on total number of firms and established firms represent percentage changes in employment relative to a baseline for each district. The point estimates on new firms represent a change in the size of district employment due to new establishments, relative to the average amount of existing employment.
2) Point estimates represent the estimated discontinuous change in the outcomes at the 50% vote share threshold needed to pass a tax levy.
3) Standard errors are presented in parentheses below point estimates. In the parametric models, standard errors are clustered at the district level. Asterisks denote statistical significance at the 10% (*), 5% (**) and 1% (***) levels.
Appendix Figure 1: Estimates of the Effect of Property Tax Levies on Number of Firms, Linear and Quadratic Models

1-year effect
i) Linear

ii) Quadratic

3-year effect
iii) Linear

iv) Quadratic

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 Figure 2: Estimates of the Effect of Property Tax Levies on Employment, Linear and Quadratic Models

1-year effect
i) Linear

iii) Linear

ii) Quadratic

iv) Quadratic

3-year effect

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.