Federal Tax Deductions and the Demand for Local Public Goods*

Brent W. Ambrose† Maxence Valentin‡

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Abstract

The United States tax system allows taxpayers to deduct state and local taxes from their taxable incomes. Using local referendum results, we document a positive relation between the demand for public goods and the share of residents deducting taxes. Based on this evidence, we develop a theoretical model of local public goods capitalization that accounts for this federal tax provision. We provide empirical support for the model using cross-sectional and temporal variation in local tax deductions, thereby confirming that federal tax deductions increase local public goods demand. The results provide new insights into the equity of the current tax system.

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Keywords: Local Public Finance, Fiscal Federalism, Fiscal Deductions, Capitalization of Public Goods.

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†Institute for Real Estate Studies, Penn State University, bwa10@psu.edu
‡SC Johnson College of Business, Cornell University, maxence.valentin@cornell.edu

In 2017, United States (U.S.) cities, townships, counties, school districts, and special districts spent $1.64 trillion delivering public goods. These local governments must balance the benefits of those public goods with the tax burden they impose. In financing public goods, local governments rely on a variety of taxes, that the federal government partially subsidizes via their deductibility from federal taxable income.[1] The federal tax deductions effectively reduce the cost associated with local public goods for the taxpayers who itemize their expenses. Because these taxpayers are primarily concentrated in wealthier and high cost of living urban areas, this provision in the federal tax code introduces a spatially heterogeneous subsidy (Figure A1 maps the heterogeneous incidence of the property tax deductions). Furthermore, the variation in the rate of taxpayer itemization suggests that revisions to the federal tax code can have profound effects on the value of this subsidy, and as a result, on the demand for local public goods. For example, changes in the federal tax code introduced in the Tax Cut and Jobs Act (TCJA) resulted in a 61% decline in residents deducting taxes from 2017 to 2018 – in effect increasing the net cost and reducing the demand for local public goods for those residents.[2] As evidence of this effect, Figure 1 shows that the approval rate for bond referendums in California school districts plummeted following the TCJA. This decrease in the approval rate for expenditures predominately funded with property taxes stands in contrast to

[1]In the United States, taxpayers can deduct from their taxable incomes a lump-sum amount (called the standard deduction) or the sum of allowable deductions, including state and local taxes (SALT), which are itemized on Schedule A of their income tax returns.

[2]The TCJA increased the standard deduction from $12,700 in 2017 to $24,000 in 2018 for married taxpayers filing jointly and from $6,500 to $12,000 for single taxpayers. In addition, the TCJA imposed a $10,000 limit on the amount of state and local taxes (SALT) that can be deducted. See Ambrose et al. (2022) for an in-depth discussion of the TCJA changes in the federal tax treatment of housing expenses.

the approval rate for other local tax referendums, such as sales taxes, that are more difficult to deduct.[3] In this paper, we use both cross-sectional and temporal variation in the incidence of property tax deductions to demonstrate that the demand for local public goods increases with the share of residents benefiting from the deductions of local taxes.

To motivate our analysis, we begin by showing a causal link between California referendum approval rates and the share of residents who deduct local taxes. Specifically, using a within-school district identification strategy and the exogenous shock to the rate of itemization introduced by the TCJA, we show that a 10 percentage point decline in the share of residents who deduct their property taxes is associated with a 5.1 percentage point decline in "Yes" votes. Thus, our analysis provides direct link between federal tax policy and the demand for local public goods.

We then construct a theoretical framework to demonstrate the causal connection between the demand for local public goods and federal tax deductions. Our theory draws on models showing the capitalization of public goods into property values (Brueckner, 1979; Cellini et al., 2010; Hilber and Turner, 2014; Lang, 2018). A community becomes more attractive if the benefits of additional public spending are greater than the consumption forgone by the property tax increase. Because both effects are reflected in house prices, it implies that local governments should provide goods up to the point where the marginal increase of spending has zero effect on local housing prices. By contrast, under-provision (over-provision) of local public goods may occur if housing values increase (de-

[3]In California, only 15% of residents who itemize their deductions deduct state and local general sales taxes.

crease) with marginal increases in local spending. The innovative prediction of our model is that, regardless of the current level of local public goods, capitalization of public goods into housing values should be systematically greater in jurisdictions with a higher share of residents who deduct their property taxes.

We provide three tests of the model's predictions. Our primary test relies on cross-sectional variation in educational spending in the school year 2016-2017: pre-TCJA. We focus on education because property taxes are the largest revenue source for U.S. public schools. Combining data from a variety of sources on income taxes, housing prices, school district budgets, test scores, and demographic data, we show that before the TCJA, public goods were on average provided efficiently as the marginal effect of school spending on housing values is not different from zero. However, this result is not spatially uniform. The marginal effect is negative in school districts with few or no residents who deduct their property taxes, suggesting that property taxes outweigh the benefits of additional public goods in these jurisdictions. But the marginal effect is positive in school districts where more than 18% of the residents deduct property taxes. Specifically, we find that a one standard deviation increase in educational spending corresponds to a 2.7% decrease in house values in school districts where almost no resident deducts property taxes but with a 0.7% increase in property values in school districts where 25% of the residents take advantage of the property tax deduction. Hence, the traditional capitalization model, which does not factor in federal tax deductions, fails to capture the heterogeneity created by the ability of residents to deduct their property taxes. We additionally show that our primary results are robust to the inclusion of county fixed effects, different measures of educational spending, and also to other public goods, such as policing.

Second, we verify our results using a school district panel data setting that exploits the exogenous shock to the incentive to itemize expenses that was introduced by the TCJA. By computing the change in capitalization of school test scores pre- and post-TCJA, we show that as the share of residents deducting property taxes declines, the capitalized value of school test scores also declines. Third, we triangulate the primary findings using an alternative dataset comprising house-level transactions. To achieve identification, we exploit temporal variation in federal tax deduction subsidies (pre- and post-TCJA), and spatial variation in school quality by using housing transactions along school district borders. This analysis confirms that in states where residents stopped deducting property taxes the most, the capitalized value of local public goods declined.

Finally, we examine possible channels that could either magnify or dampen the capitalization effect. We show that the capitalization parameter in school districts with a higher share of residents who deduct property taxes is greater in school districts that (1) have a greater reliance on property taxes to fund expenses, (2) have a higher percentage of residents with high federal tax rates, (3) have a large share of pupils enrolled in public schools, and (4) have a lower share of commercial properties. These results are consistent with the predictions of the theoretical model.

Our study contributes novel insights concerning the efficient allocation of local public goods (Samuelson, 1954; Tiebout, 1956; Oates, 1969). Following the proposed capitalization test of Brueckner (1979), which relies on the co-determination of property tax rates and level of public goods, the literature reports mixed findings on whether public goods are provided efficiently. For instance, Brueckner (1979) and Heintzelman (2010) show that local public goods are over provided, Barrow and Rouse (2004), Cellini et al. (2010), and Lang (2018) show they are under provided, while Brueckner (1982), Bradbury et al. (2001), and Bayer et al. (2020b) find no evidence of under or over provision. Our model provides a mechanism to reconcile these conflicting results.

We also provide new evidence describing the real effects of federal tax policy regarding the itemization of expenses. Many research papers have investigated the effects of mortgage interest deductions on both the mortgage (Hanson, 2012a; Rappoport, 2016; Valentin, 2021) and housing markets (Poterba et al., 1991; Hanson, 2012b; Sommer and Sullivan, 2018), establishing demand and price responses. Likewise, a lengthy literature focuses on the positive effects of deducting charitable contributions on both the extensive and intensive margins (Taussig, 1967; Feldstein, 1975; Feldstein and Taylor, 1976; Reece and Zieschang, 1985; Randolph, 1995; Auten et al., 2002; Almunia et al., 2020; Meer and Priday, 2020). Despite the volume of work in this field, to our knowledge, no paper links demand for local public goods to local tax deductibility.

Finally, we provide new insights into the debate about the equity of the property tax system (Oates and Fischel, 2016; Brueckner, 2021). In theory, the valued-based property tax is a mechanism to collect taxes as a percent of residents' resources. However, many recent studies cast doubt on the progressivity of the property tax system specifically because of assessments regressivity and the non-homothetic preferences over housing consumption (McMillen and

Singh, 2020; Amornsiripanitch, 2020; Berry, 2021; Fleck et al., 2021; Avenancio-León and Howard, 2022). We suggest that the property tax deduction is another key aspect of the property tax system that also leads to regressivity. Because itemizers are generally wealthier, the federal tax deductions break the proportionality between tax obligations and resources. Thus, we enrich the scholarly and public debate on the suitability of property taxation by shedding light on the unintended consequences of property tax deductibility.

1 Institutional Background and Motivating Evidence

In this section, we provide evidence that property tax deductions reduce residents' demand for local public goods. Our empirical analysis uses approval rates on local referendums in California as a proxy for residents' demand for local public goods. To achieve identification, we rely on changes in the income tax code introduced by the TCJA that reduced by 61% the number of taxpayers deducting local taxes on their federal income tax returns. California is an excellent empirical setting because residents were highly impacted by the change in the tax deductions subsidy and many jurisdictions hold annual referendums.[4]

1.1 Empirical framework

We use the School District Ballot Measure Election Results data that contains results on local referendums in California School districts from 2008 to 2020 that we merged with school district demographic data from the American

[4]Appendix B contains material supporting this section, including further description of the data, the methodology, and robustness analyses.

Community Survey (ACS), and data on the share of residents who deduct property taxes from the Internal Revenue Service (IRS) Statistics of Income (SOI).

To test whether a decrease in federal tax deductions changes the support for local public goods, we estimate the following regression:

$$WinningMargin_{j,t} = \alpha_j + \alpha_t + \gamma(ChangeDed_j \times Post_t) + X'_{j,t}\beta + \epsilon_{j,t} \quad (1)$$

where $WinningMargin_{j,t}$ is the ratio of *Yes* votes over the number of cast votes in school district j at election t, $ChangeDed_j$ measures the extent to which residents of a school district were impacted by the loss of tax deductions subsidies following the enactment of the TCJA, α_j and α_t are school district and election fixed effects, $X_{j,t}$ are additional controls (election turnout, referendum type, and a dummy for recently rejected referendum), and $Post_t = 1$ for elections after 2019 inclusive.[5] We define $ChangeDed_j$ as:

$$ChangeDed_j = DedShare_{j,2017} - DedShare_{j,2018} \quad (2)$$

where $DedShare_{j,t}$ is the share of property tax deducters in the school district j in fiscal year t. Hence, a greater $ChangeDed_j$ is associated with a larger reduction in the property tax deduction subsidy in a school district.

The inclusion of spatial and temporal fixed effects removes endogeneity concerns regarding the timing of elections and the composition of the school district proposing referendums (Romer and Rosenthal, 1979; DeBartolo and Fortune, 1982; Cellini et al., 2010). The underlying identification assumption is that,

[5] 2019 was the first year that changes introduced by the TCJA took effect.

absent the tax code change, residents' voting patterns would be similar pre- and post-TCJA. Thus, the coefficient of interest, γ, captures the marginal change in approval rate resulting from a marginal decrease in the share of residents benefiting from federal tax deductions holding the school district constant.

1.2 Results

The results are presented in Table 1. In column (1), the regression excludes the interaction term and election fixed effects. The negative coefficient on $Post_t$ indicates that the winning margin decreased in recent elections conditional on the school districts that proposed a referendum. Thus, the decrease in approval rates is not driven by differences in the set of school districts. In column (2), we add the interaction term. The coefficient γ is negative and significant at the 5% level while the coefficient on $Post_t$ becomes insignificant. These results indicate that the observed decrease in approved referendums is therefore driven by the loss in property tax deductions subsidy. In column (3), we add election fixed effects to control for potential timing endogeneity that may influence election outcomes (Kogan et al., 2018). The coefficient γ is negative and remains significant at the 5% significance level. In column (4), we show the preferred specification in which the sample is restricted to close elections (within 25 percentage points to the passing thresholds) to remove referendums that had strong or weak a priori support. The results are robust to this selection. The coefficient $\gamma = -51.0$ suggests that a 10 percentage points decrease in the number of residents deducting property taxes is associated with a 5.1 percentage points reduction in approval rates. The magnitude is quite substantial given the usually narrow margins of wins. Because the average $ChangeDed_j$ in California is 14 percentage points, the loss of property tax deductibility alone can explain most of the defeated referendums. In column (5), we only keep bond referendums allowing us to control for the proposed cost of the initiative by dividing the bond amount by the number of housing units. The coefficient γ remains negative and significant at the 10% significance level.

Over the last 20 years, U.S. public school capital expenditures have decreased, especially in high-income school districts (Biasi et al., 2021). Hence, a pre-trend could explain our results as the share of property tax deducters is positively correlated with income. In order to rule out this possibility, we run placebo tests using different years for *Post*. The coefficient γ on the interaction between $Post_t$ and $ChangeDed_j$ is non-significant for all placebo years as shown in Table B2. Thus, we find no evidence of a prior diverging trend.

The results presented in Table 1 may reflect an endogenous change in the number or nature of the referendums proposed in those schools districts impacted by the decrease in the tax deduction subsidy. Thus, we present in Table B3 a series of regressions that use as the dependent variable the number of referendums proposed each year, the value of the proposed bond, the proposed parcel levy amount, and the voter turnout. The results indicate that our inference is robust to this alternative explanation. In Table B4, we consider the intensive versus extensive effect by estimating a series of regressions with a triple interaction term in equation (1) that captures various measures of the amount of lost deductions following the TCJA. The non-significant coefficients on the triple interaction indicate that the decrease in approval rates is due to the extensive margin loss of deductibility benefits rather than the intensive margin. Finally, since the analysis covers referendums that occur after the unfolding of the Covid-19 pandemic, in Figure B3 we provide evidence, using data from the Public Policy Institute of California (PPIC) Statewide Survey (Brunner and Sonstelie, 2003), that resident support for bond referendums has declined since 2019. Thus, our conclusions are robust to the effects of the pandemic.

2 Theoretical Framework

In this section, we present a theoretical model to establish a causal connection between federal tax deductions and the demand for local public goods, focusing on local public goods financed by property taxes. Following the framework developed in Brueckner (1979, 1982), Barrow and Rouse (2004), and Cellini et al. (2010), we assume that a resident's utility depends on the level of local public goods ($g_{i(j)}$), housing consumption (h_i), and consumption of a numeraire good (x_i) such that $u(g_{i(j)}, h_i, x_i)$ is quasi-concave, where i denotes the individual's house in jurisdiction j. All residents in j consume the same level of public goods $g_{i(j)}$, and housing service flow is a function of housing characteristics X_i and neighborhood attributes $Z_{i(j)}$ such that $h_i = h(X_i, Z_{i(j)})$. Residents are fully mobile so that those with the same income y achieve the same utility level $f(y)$. Through urban sorting, house rents, denoted as R_i, adjust to ensure that residents are indifferent between houses.

To finance public goods, local governments collect ad-valorem property taxes at rate τ_j.[6] Because the property tax rate is commonly applied to both land

[6]We assume that local public goods are exclusively financed by ad-valorem residential prop-

and improvements at market value (Glaeser, 2013), housing rent and property tax payments are capitalized into house i's value (v_i):

$$v_i = \frac{1}{\theta}\left[R(g_{i(j)}, h_i; y) - \tau_j v_i + \mathbb{I}_i(\tau_j v_i \cdot mtr)\right] \tag{3}$$

where θ is the discount rate, and $\mathbb{I}_i$ equals 1 if the resident owns house i and takes advantage of the property tax deductions and 0 if the resident rents or uses the standard deduction. Assuming that j comprises n houses, the aggregate housing value of j is $V_j = \sum_{i=1}^{n} v_i$, which serves as the jurisdiction's tax base. Since local governments must balance their budgets (Glaeser, 2013), the local government's budget constraint is

$$V_j \cdot \tau_j = C(g_j), \tag{4}$$

where $C(g_j)$, the cost function for providing g_j, is assumed to be convex. Since local jurisdictions comprise a combination of residents who deduct property taxes and others who use the standard deduction, we note that the aggregate housing value is a function of public goods (g_j), the stock and quality of houses ($\mathcal{H}_j$), and the share of residents who deduct their property taxes ($DedShare_j$):

$$V(g_j, \mathcal{H}_j, DedShare_j) \approx \frac{1}{\theta}\Bigg[\sum_{i=1}^{n} R(g_{i(j)}, h_i; y) - C(g_j) + DedShare_j \cdot C(g_j) \cdot \text{mtr}\Bigg]. \tag{5}$$

erty taxes. In the empirical section, we relax this assumption and consider other funding sources including grant transfers from higher-level governments, and commercial property taxation.

In order to conceptualize the impact of the federal property tax deductions, we consider two extreme cases characterizing the extent that residents deduct their property taxes. We first examine the case where no residents deduct property taxes from their taxable income ($DedShare_j = 0$). In this scenario, we can rewrite the tax base for a jurisdiction with no deducters (V^{ND}) as:

$$V^{ND}(g_j, \mathcal{H}_j) \quad = \quad \frac{1}{\theta}\Bigg[\sum_{i=1}^{n} R(g_{i(j)}, h_i; y) - C(g_j)\Bigg]. \tag{6}$$

Equation (6) shows that housing value depends on rents and the cost of providing local public goods. Because both increase in g, the net effect of an increase in public goods on housing value is uncertain. Differentiating (6) with respect to the level of public goods (g) yields the capitalization parameter:

$$\begin{aligned}\frac{\partial V^{ND}}{\partial g} \quad &= \quad \frac{1}{\theta}\Bigg[\sum_{i=1}^{n} \frac{\partial R_i}{\partial g} - \frac{\partial C(g)}{\partial g}\Bigg] \\ &= \quad \frac{1}{\theta}\Bigg[\sum_{i=1}^{n} \frac{u_g(g, h_i, y - R)}{u_x(g, h_i, y - R)} - \frac{\partial C(g)}{\partial g}\Bigg].\end{aligned} \tag{7}$$

If $\frac{\partial V^{ND}}{\partial g} = 0$, the sum of the marginal rate of substitution between public goods and the numeraire equals the marginal cost of providing the public goods indicating that public goods are provided efficiently (Samuelson, 1954). Hence, for any $\frac{V^{ND}}{\partial g} \neq 0$, the level of public goods provision is not efficiently provided.[7] Given the concavity of $R(g_{i(j)}, h_i; y)$ and the convexity of $C(g_j)$, we note that $V^{ND}(g_j, \mathcal{H}_j)$ is concave in g with a maximum value at g^*, which is the Samuelson's efficient level of public goods provision. Panel A of Figure 2 illustrates

[7]Note that the under- or over-provision of public goods may result either from productive or allocative inefficiencies. We only consider the extent to which local governments deviate from the efficient level.

this trade-off. For any level of g below g^*, public goods are under-provided ($\frac{\partial V^{ND}}{\partial g} > 0$) while values above g^* imply that public goods are over-provided ($\frac{\partial V^{ND}}{\partial g} < 0$).

We now consider the opposite case where all residents take full advantage of the property tax deduction. With full deductibility, the net-of-tax housing cost for individual i becomes $R_i - v_i\tau_j(1 - \text{mtr})$, where mtr is the marginal tax rate on federal income. Thus, the tax base for a jurisdiction where all residents deduct their property taxes (V^D) is:

$$V^D(g_j, \mathcal{H}_j) = \frac{1}{\theta}\left[\sum_{i=1}^{n} R(g_{i(j)}, h_i; y) - C(g_j)(1 - \text{mtr})\right]. \tag{8}$$

Equation (8) shows that the trade-off between the benefits of additional public goods (through higher rents) and property taxation is attenuated by the property tax deduction subsidy. As a result, the capitalization of public goods into aggregate house values when all residents deduct their property taxes is:

$$\frac{\partial V^D}{\partial g} = \frac{1}{\theta}\left[\sum_{i=1}^{n} \frac{u_g(g, h_i, y - R)}{u_x(g, h_i, y - R)} - \frac{\partial C}{\partial g}(1 - \text{mtr})\right]. \tag{9}$$

Thus, regardless of the level of public goods provision and as long as local governments finance a share of their budget through property taxation, we note that $\frac{\partial V^D}{\partial g} > \frac{\partial V^{ND}}{\partial g}$. Panel B of Figure 2 shows the relation between public goods provision and housing value for the two extreme cases. Since federal property tax deductions provide a subsidy for the costs of providing public goods, V^D lies above V^{ND} for all positive levels of public goods.

We now consider the case of jurisdictions comprising a combination of residents who do and do not take advantage of the federal deduction for property taxes. In doing so, we develop a series of testable hypotheses that capture the cross-sectional heterogeneity in the share of residents who deduct federal taxes on their federal tax returns. Because $0 \leq DedShare_j \leq 1$, V from equation (5) lies within the curves of the extreme cases shown in panel B of Figure 2. Since property tax deductibility is capitalized into house values through a reduction in the cost of providing public goods, we expect housing values to increase with the share of residents who deduct their property taxes: $\frac{\partial V}{\partial DedShare} > 0$.

Taking the partial derivative of (5) with respect to g leads to insights into whether local public goods are on average efficiently provided:

$$\frac{\partial V}{\partial g} \begin{cases} > 0 & \text{if g is under-provided} \\ = 0 & \text{if g is efficiently provided} \\ < 0 & \text{if g is over-provided} \end{cases} \tag{10}$$

Given the longstanding debate regarding whether local public goods are efficiently allocated (Tiebout, 1956; Samuelson, 1954; Brueckner, 1979; Arnott and Stiglitz, 1979) and the mixed empirical findings (Barrow and Rouse, 2004; Cellini et al., 2010; Lang, 2018; Bayer et al., 2020b), the sign on this derivative (10) is an empirical question.

Finally, we test whether the capitalization of local public goods varies based on the share of residents who deduct property taxes by looking at:

$$\frac{\partial^2 V}{\partial g \, \partial DedShare} > 0 \tag{11}$$

which is positive. In contrast to models that do not consider the ability of residents to deduct property taxes, our model predicts that a higher share of residents who deduct their property taxes corresponds to a higher capitalization parameter regardless of the efficiency conclusion drawn from the sign of $\frac{\partial V}{\partial g}$.

3 Data

For our primary cross-sectional analysis, we collect housing statistics from Zillow's home value index (ZHVI) for January 2017 provided at the zip code level. Zillow estimates the median value of single-family houses based on recent sales applying hedonic adjustments for property characteristics. Thus, we use median housing value as a proxy for aggregate housing value because it approximates mean value, which is proportional to aggregate value (Brueckner, 1979; Lang, 2018). The series are seasonally adjusted and averaged using a 6-month moving average, which removes endogeneity concerns regarding the timing of sales. We then match the zip code level ZHVI to school districts using the 2014 School District Geographic Reference Files developed by the U.S. Census Bureau's Education Demographic and Geographic Estimates program. For the subsequent analysis based on a border discontinuity approach, we rely on individual house transaction data collected from CoreLogic for 2017 and 2019.

We use the SOI of the IRS to collect the number of residents who deduct their property taxes from their taxable income available for each zip code with more than 100 tax returns:

$$DedShare = \frac{\text{\# of tax returns with property tax deductions}}{\text{\# of tax returns}}. \tag{12}$$

We then cross-walk $DedShare$ to the school district level using the School District Geographic Reference Files to calculate the share of residents in school district j that deduct their property taxes.[8]

We obtain school district spending information from the Census Annual Survey of School System Finances (ASSSF). For each public school district, we collect the revenue source (federal, state, local, or property taxes) and expense items (such as educational expenses, support services expenses, or library expenses). We adjust the ASSSF monetary statistics using the ACS Comparable Wage Index for Teachers (CWIFT) to facilitate comparison of educational spending across school districts.[9] Adjusting the school district spending for the local cost of living is necessary because we analyze the capitalization of local public good spending $C(g)$ as opposed to local public goods g. We keep school districts that provide elementary education to have non-overlapping school districts and comparable per-pupil spending.

We collect demographic information including income, racial composition, level of school attainment of the population, and the age distribution from the ACS at the school district level. We additionally compute the share of residents that fall within each income group defined by the SOI. We obtain school districts' employment data from the Annual Survey of Public Employment and Payroll - School Systems. We measure school performance by the

[8]To illustrate the significant heterogeneity in $DedShare_j$, Figure A2 shows the spatial distribution of *DedShare* for Pennsylvania school districts. We note significant variation across urban and rural areas, with inner-city areas having lower $DedShare_j$ values.

[9]CWIFT is a measure of the regional variation in the wages and salaries of college graduates who are not PK-12 educators. A dollar spent in schools with a score of one (e.g. Boulder Valley School District, CO or New Bedford School District, MA) is therefore worth the same as $1.40 spent in San Francisco Unified School districts (highest CWIFT) and $0.65 spent in Vaughn Municipal Schools, NM (lowest CWIFT).

pooled across subjects test-based achievement score of The Stanford Education Data Archive. Lastly, we collect land use data from the National Land Cover Database computed at the school district level.

Table 2 shows the summary statistics of the cross-sectional study. We separate school districts into high property tax deducting areas and low property tax deducting areas (those with $DedShare$ greater or less than the median share [23.0%], respectively). We note that school districts with a greater share of property tax deducters have higher housing values, incomes, and home-ownership rates. Additionally, the summary statistics show that the adjusted school expenses per pupil are larger for school districts with higher shares of deducters (about $1,230 more per pupil). Despite obvious correlations between $DedShare$ and other variables (Table A1 shows the correlation statistics), our econometric framework relies on equilibrium relations conditional on demographic variables, which alleviates endogeneity concerns.

4 Empirical Analysis

4.1 A cross-sectional test of heterogeneous capitalization

Our primary identification strategy relies on cross-sectional variation in housing values, public goods, and the share of tax deducters. Because the theoretical predictions are derived in a comparative statics framework, cross-sectional regression analysis is ideal since it allows for the isolation of ceteris paribus effects (Brueckner, 1979, 1982; Barrow and Rouse, 2004). Additionally, cross-sectional regressions alleviate sorting issues that can emerge from time-series identification (Kuminoff and Pope, 2014), endogenous jurisdiction formation (Hoxby, 2000), or variation in discount rates (Koster and Pinchbeck, 2022).

We specifically test the theoretical model's predictions using data at the school district level. We focus on educational spending because it represents the largest local spending (policing being second), and property taxes are the largest revenue source supporting it.[10] In addition, the relation between residential choice and school quality is well-documented (Black, 1999; Barrow and Rouse, 2004; Bayer et al., 2007; Avery and Pathak, 2021; Lafortune and Schönholzer, 2022), which reinforces the link between local spending and housing values.

We estimate the following equations:

$$log(V_j) \quad = \quad \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j \tag{13}$$

and

$$\begin{aligned} log(V_j) \quad = \quad & \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^{D}(Exp_j \times DedShare_j) \\ & + \phi DedShare_j + X_j'\beta + \epsilon_j \end{aligned} \tag{14}$$

where V_j is median house value in school district j, $\alpha_{m(j)}$ are Core-Based Statistical Area (CBSA) fixed effects, Exp_j is the educational spending per pupil, $DedShare_j$ is the share of residents in school district j who deduct property taxes, and X_j are demographics controls (income, education, age distribution, etc.).[11] We control for school district average test scores in X_j, which alleviates

[10] According to the ASSSF, in the school year 2016-2017, 45.6% of public school revenues came from local taxation, out of which 64.5% came from property taxes.

[11] We use public goods spending $C(g)$ as a proxy for public goods output g which offers the

concerns regarding the use of input versus output level variables when discussing residents' preferences for schools (Turnbull and Zheng, 2019; Downes and Zabel, 2002). Thus, all the results are conditional on school district pupils' performance. We estimate equations (13) and (14) in parallel to show the impact of introducing heterogeneity in the share of residents who deduct their property taxes. Figure 2 intuitively shows the empirical strategy where each point depicts a jurisdiction for which we observe its conditional median house value and current level of public goods.

From the theoretical model, we expect ϕ to be positive because the property tax deduction subsidy is capitalized into housing values (Poterba et al., 1991). In equation (13), $\bar{\delta}$ is the average capitalization parameter and its sign provides information about the average efficiency of public goods provision (Brueckner, 1979). In equation (14), the coefficient δ^{ND} depicts the capitalization parameter for school districts with hypothetically no residents deducting property taxes while δ^{D} depicts the capitalization heterogeneity for school districts with higher shares of residents who deduct their property taxes. The theoretical model predicts the latter parameter (δ^{D}) to be positive.

We present the estimated coefficients from equations (13) and (14) in Table 3.[12] Consistent with the theoretical predictions and the housing user-cost literature (Poterba et al., 1991), the estimated coefficient for the share of residents who deduct their property taxes ($DedShare$) from equation (13) is positive and significant at the 10% level, regardless of the spatial fixed effects included. The

same efficiency interpretations (Brueckner, 1979).

[12]The full set of coefficients are presented in Table A2. We also present, in Table A3, the results using the log of expenses per pupil. The results are qualitatively and quantitatively similar.

estimated coefficient indicates that a 10 percentage points increase in the share of residents who deduct property taxes corresponds to an approximate 6.0% increase in house values, an economically meaningful impact. Considering that the top federal marginal tax rate in 2017 was 39.6%, the estimate coefficient implies that a full capitalization of housing expense deductibility would result in a 65.5% housing value premium.[13]

The estimated coefficient for $\bar{\delta}$ in equation (13), the average capitalization parameter, is not significant in columns (1a) or (2a) indicating that the provision of public goods is on average provided efficiently across school districts. However, when we allow for heterogeneity in the share of residents who itemize deductions, the coefficient on the capitalization parameter δ^D is positive and significant at the 1% level (column [1b]). This estimate indicates that in areas with higher shares of residents taking advantage of the property tax deduction, the capitalization of public goods into housing values increases. However, we note that the estimated coefficient for δ^{ND} is negative and significant, suggesting that the cost of providing local public goods outweighs their benefits in school districts that have a low share of residents deducting property taxes (less than 18%). Specifically, the coefficients of column (1b) imply that a one standard deviation increase in per-pupil spending is associated with a 2.7% reduction in housing values in a school district where residents do not deduct their property taxes. However, property values increase by 0.67% in school districts having the median share of residents that deduct their property taxes (23.0%).

In columns (2a) and (2b), we further add state fixed effects to mitigate en-

[13]Under complete and perfect pass-through of housing expenses deductibility, $\phi = \frac{1}{1-mtr} - 1$.

dogeneity concerns that can arise within CBSAs that span different states. Although the magnitude of the estimated coefficients are smaller, the results are qualitatively and quantitatively unchanged. In columns (3a) and (3b), we set the spatial fixed effects to counties. Identification is thus reduced to counties with multiple school districts which further increases the fit of the regressions (Adjusted R^2 is 0.93). In this specification, the estimated coefficient for $\bar{\delta}$ is positive and significant at the 5% level (column [3a]), indicating under-provision of public goods on average. Nevertheless, the results in column (3b) confirm that the positive capitalization is driven by school districts with residents deducting property taxes as δ^D is positive and statistically significant (at the 1% level) while δ^{ND} is negative (statistically significant at the 10% level).

The main results have implications regarding the efficient provision of local public goods.[14] They show that, on average, public goods are provided efficiently as the marginal effect of public goods spending on housing values is not statistically different from zero. However, consistent with our theoretical model, introducing heterogeneity in the share of residents who take advantage of the federal property tax deduction changes this inference. To provide greater clarity on this trade-off, Figure 3 shows the effects of including heterogeneity vis-à-vis deductibility benefits. In districts where residents do not deduct their property taxes, the property tax burden marginally outweighs the utility from local public goods. However, as the share of the residents who deduct their property taxes increases, the benefits of public goods outweigh the associated

[14]Since tax deductibility subsidizes local public goods, it could be argued that it leads to provision above the level where the Samuelson condition is satisfied. We therefore refer to efficiency as "efficiency conditional on the Federal tax system and its deductibility rules", which in its current state encourages greater provision.

tax burden. Hence, local public goods appear to be under-provided in communities where residents benefit from the federal tax subsidy but they appear over-provided for school districts with few residents who deduct property taxes.

Although the advantage of the cross-sectional empirical model is that it flows directly from the theoretical model and directly tests the equilibrium relations, one disadvantage is that it does not exploit exogenous shocks (either temporal or spatial) to achieve identification. Thus, in the following sections, we present two additional tests that rely on the changes in the incentive to itemize induced by the TCJA enactment.

4.2 School district panel data identification

Our second test of the theoretical predictions exploits the exogenous decrease in the share of property tax deducters due to changes in the standard deduction introduced in the TCJA. For this analysis, we convert the cross-sectional data into a two-period panel data setting and compute the change in capitalization of local public goods for each state. Since the theoretical model predicts that jurisdictions that experienced a decline in the share of residents taking advantage of the ability to deduct local taxes should have had a corresponding decline in the capitalized value of local public goods, this analysis should provide confirmation of the cross-sectional results. The advantage of this analysis is that it exploits the exogenous shock associated with TCJA for identification and it relies on simpler identification (without interaction) to measure the capitalization of local public goods. The disadvantage of this method is the subjectivity in the choice of aggregation level to compute the capitalization estimates, the time-invariant school test score variable, and the possibility that resident sorting over the two-time periods could bias the results.

Using median house values in January 2017 and 2020 merged with school district mean test scores, we compute the rate of capitalization ($\frac{\partial V}{\partial g}$) before and after the TCJA for each state. We aggregate $ChgDed$, the share of residents in a school district that stopped deducting their property taxes, to the state level. We plot in Figure 4 the change in the rate of capitalization due to the TCJA for each state against the state aggregate $ChgDed$. The result of this analysis shows the expected negative relation (significant at the 1% level) between the change in the rate of capitalization and $ChgDed$. In other words, we observe that as the share of residents deducting property taxes declines, the value they place in local school quality declines too.

4.3 House-level identification using border discontinuities

To further triangulate our findings and help establish a causal connection, we use house level transactions to identify the change in the rate of capitalization of school test scores exploiting discontinuities along bordering school districts.[15] This method has the advantage of achieving identification by directly exploiting the spatial exogeneity of local jurisdictions (borders) as well as the exogenous shock caused by the TCJA. However, because housing characteristics are not consistent across states, school test scores are time-invariant, and the bandwidth along school district borders must be large to accommodate all

[15] As opposed to the traditional border discontinuity literature (Black, 1999; Bayer et al., 2007; Collins and Kaplan, 2017), we use school district boundaries rather than school boundaries because our theoretical model relies on the co-determination of public goods and property taxes.

states, this method imposes subjective specification assumptions.

To implement the border discontinuity analysis, we use 8,000,677 housing transactions in 2017 and 2019 obtained from CoreLogic and merged with elementary (or unified) school district test scores and demographic data. We then estimate the following regression for each state separately:

$$\begin{aligned} log(V_{i,j,t,b}) &= \alpha_b + \alpha_t + \delta^{pre} SchoolTest_j + \delta^{change}(SchoolTest_j \times Post_t) \\ &\quad + X_i'\beta + Z_{j,t}'\gamma + \epsilon_{i,j,t,b} \end{aligned} \quad (15)$$

where $V_{i,j,t,b}$ is the transaction price of house i, located in school district j, adjacent to boundary b, and transacted in month t.[16] Consistent with the literature, we include border (α_b) and month (α_t) fixed effects, housing characteristics (lot size, square footage, age and age squared, and dummies for cash buyer and condominiums), and demographic information (minority share, median income, and the share of residents with at least a Bachelor) from the ACS at the school district level. $Post_t$ equals one for 2019 transactions. In our preferred specification, we restrict the sample to transactions located within one mile of a school district border, which reduces the sample size to 2,758,610 observations.[17].

We report in Table A4 the coefficient estimates for California and provide each state coefficients in the Online Repository. We confirm that the inclusion of

[16]To reduce the computational burden of the estimation with circa 10 million transactions and 25,894 border fixed effects, we prefer the state-level regressions. Therefore, houses along school district borders that coincide with state line borders are removed from the analysis. This approach also allows to estimate coefficients that differ by state, which is supported by coefficients results shown in the online Appendix.

[17]Because the number of transactions within one mile of a school district border is 143 in Wyoming, we do not report an estimate for that state in this stricter specification

border fixed effects (columns [2-4]), border bandwidth restriction (columns [3-4]), and demographics variables (column [4]) reduce the coefficient on *Test Score*, consistent with seminal work using similar design (Black, 1999; Bayer et al., 2007). For about two thirds of the states, the capitalization of school quality decreased between the two time periods ($\delta^{change} < 0$).

We then test whether a decrease in the share of residents who itemize is negatively associated with the change in capitalization of school quality in univariate linear regression models. Figure 5 shows the relation between the change in the share of itemizers and the change in the rate of capitalization (δ^{change}). Regardless of the model specification, this house-level identification shows a significant (at the 1% significance level) negative relation between the decrease in the share of residents deducting taxes and the change in the rate of capitalization. Thus, as resident federal tax deduction benefits decrease, the demand for local public goods, which is embedded in equilibrium house prices, decreases. This conclusion holds with school district borders fixed effects (panels B, C, and D), bandwidth restriction (panels C, and D), and the inclusion of demographic control variables (panel D). By exploiting the spatial exogeneity (borders) with temporal exogeneity (pre and post-TCJA), the results shown in Figure 5 further support our theoretical model.

4.4 Placebo tests using years prior to TCJA

In order to confirm the causal connection identified above, we perform placebo tests for the panel data and border discontinuity specifications. We use years prior the TCJA to compute the change in capitalization and relate these changes to the change in itemizers due to the TJCA. Absent any pre-trend, we should observe no statistical relation. First, in Figure A3, we reproduce the panel data test by computing the change in capitalization using median housing prices in years 2015 and 2017. It is evident from Figure A3 that there is no relation between the two variables (p-value = 0.232), further affirming the causal relationship. Second, in Figure A4, we reproduce the house-level analysis using housing transactions in 2015 and 2017. We plot the relations between the change in the share of itemizers due to the TCJA on the x-axis, and the change in capitalization computed with our placebo sample on the y-axis. Regardless of the model specification, we do not find a significant relation between the two variables. These tests further support the causal effect of deducting local taxes on the demand for local public goods.

4.5 Robustness and external validity

As a robustness check on our primary results, we report the coefficient estimates for $\bar{\delta}$, δ^{ND} and δ^{D} from equations (13) and (14) using different educational spending measures in Table 4. We observe that δ^{D} is positive and significant for all variables except one, ranging from 0.074 to 0.261.[18] Thus, regardless of how the school district spends educational funds, residents value that spending more as the ability to deduct property taxes increases.

We also examine the external validity of our main findings addressing the concern that the value residents place in public schools is different than other

[18]The non-significant coefficient of column (2b), indicates that additional *Instructional Expenses* are not capitalized in housing value. Because we control for test score, the results suggest that spending in instruction is not valued except through the effects on test scores.

local public goods. In Table 5, we show that the qualitative pattern of results is robust to spending on police. Interestingly, the negative coefficient $\bar{\delta}$ suggests that a marginal increase in taxes for police spending, on average outweighs its marginal benefits. This result contrasts with the findings in Brasington (2021) showing that cities where residents vote to cut police funding become less attractive for residents with children. However, Figlio and O'Sullivan (2001) provide evidence that local governments may manipulate police service levels in response to cuts in funding.

5 Channels magnifying or mitigating capitalization

Having established a relation between public goods capitalization and the benefits associated with the deductibility of property taxes, we now investigate potential channels that could magnify or mitigate the effect. Specifically, we focus on differences in school districts across (1) their dependency on local revenue, (2) their residents average income tax rates, (3) their share of children enrolled in public schools, (4) their land available for housing development, (5) their share of commercial property, and (6) whether their state engaged in a school equalization reform.

School districts reliance on local taxation and capitalization.

The way school districts are financed varies significantly across the United States. For example, in eight states, school districts do not directly levy taxes and rely entirely on state and federal funding. Thus, a larger share of higher-level government transfers should reduce the school spending capitalization because the link between property taxation and housing value is lessened. We test this hypothesis by splitting the sample into school districts with property taxes above and below the median of 41% of revenue funded by local taxation and report the results in Figure 6, panel A.[19] The results show that the theoretical predictions only hold in school districts that rely heavily on local taxation. In school districts that have a low reliance on property tax revenue, the capitalization of public goods is non-significant. Thus, the mechanism shown in the theoretical framework holds only in school districts that have autonomy in taxing residents.

Mean federal income tax rate

All the predictions of the theoretical model are enhanced by the tax rate on income because residents with higher tax rates benefit more from the deductions of local taxes. We compute the mean federal income tax rate on in each school district by dividing the federal tax revenues by the total adjusted gross income using data from the SOI. In panel B of Figure 6, we show the effects of splitting school districts based on residents mean federal tax rates (above and below the median of 16.20%). As expected, the capitalization of local public goods for property tax deducters is prevalent only in the subset of school districts where residents have a high mean federal tax rate. In the other districts, δ^D is non-significant.

[19] Coefficient estimates for the tests discussed in this section are provided in details from Table A5 to Table A10.

Does private schools enrollment reduce capitalization?

Since the availability of private schools likely affects residential and educational choices (Cheshire and Sheppard, 2004; Fack and Grenet, 2010; Schwartz et al., 2014), we examine whether the marginal effect of public educational spending on housing values is lower in areas with greater public/private school choice. To test this hypothesis, we split the sample between school districts with high and low levels of public school penetration. Because we can only calculate this measure for unified school districts, we remove elementary school districts from this analysis. We construct the public school penetration as the ratio of pupils enrolled in the public school districts divided by the number of people less than 19 years of age. Panel C of Figure 6 shows the results. As expected, δ^D is positive and significant in areas with high public school penetration. However, the estimated coefficients are not significant in school districts with lower public school penetration, consistent with the rationale that residents' housing bids incorporate the value they place in local public goods.

Does land supply elasticity mitigate capitalization?

The effects of school spending on housing values may vary depending on the availability of land for development. In jurisdictions where land is scarce, the capitalization of public goods in housing value should be greater than in jurisdictions with high land availability because an increase in housing supply can mitigate the price effect (Cheshire and Sheppard, 2004; Hilber and Mayer, 2009; Lutz, 2015). To test this hypothesis, we split the sample based on the share of land that is available for development in each school district. We rely on the satellite imagery provided by the NLCD, which provides nationwide data on the land cover at a 30-meter resolution. For each school district, we compute the ratio of developed land area over the developable land area as a proxy for land availability.[20] Panel D of Figure 6 presents the results. Consistent with previous studies such as Lutz (2015), the mean capitalization estimates ($\bar{\delta}$) is significantly different from zero only in school districts with high land scarcity. In school districts that are less developed, the coefficient is non-significant. The coefficients δ^D are however not different from each other.

Commercial properties taxation and capitalization.

Local governments collect property taxes on both commercial and residential properties. Thus, the higher the share of commercial properties in the community, the lower the tax burden for residents (Brueckner, 1983). We expect greater rate of capitalization in school districts that contain a larger share of commercial properties compared to school districts solely composed of residential properties. To test this hypothesis, we compute the share of the developed land that is considered as either *medium* or *high intensively developed* as per the NLCD. We use this measure as a proxy for the share of commercial property in a school district and report the results in Figure 6, panel E. The positive and significant difference between the coefficients ($\bar{\delta}$) indicates that, all else equal, the capitalization of school spending is greater in school districts with a larger share of commercial properties. This result suggests that the incidence of taxation is lower for residents of school districts containing large amounts of commercial

[20]In contrast to *The Wharton Residential Land Use Regulatory Index*, this measures is available at the school district level instead of relying on larger and sparser spatial areas.

real estate development. The heterogeneous capitalization coefficient (δ^D) is also greater in the school districts with a larger share of commercial properties, though not statistically different from δ^D computed for school districts with a lower share of commercial properties.

Capitalization in states that reformed their school systems.

Previous studies have investigated the impact of statewide school finance equalization reforms on school spending (Bradbury et al., 2001; Hoxby, 2001), students' achievements (Hoxby, 2001; Lafortune et al., 2018), residents' sorting (Chakrabarti and Roy, 2015), house prices (Bradbury et al., 2001; Hoxby, 2001), zoning (Krimmel, 2021), housing supply (Lutz, 2015), and the capitalization of local public goods (Bayer et al., 2020a,b). In states that have enacted equalization tax reforms, public goods are generally under-provided because of the inability of local residents to raise revenue independently (Bradbury et al., 2001; Bayer et al., 2020b). Thus, we split the sample between reformed and non-reformed states.[21] We present the coefficients in panel F of Figure 6, and also the capitalization effects along the $DedShare$ axis in Figure 7. The similarity between the capitalization function for non-reformed states and the function shown in Figure 3 is evident. The main results are therefore driven by school districts that have fiscal autonomy. For school districts within states that passed an equalization reform, the capitalization function is qualitatively different showing a decreasing relation between $DedShare$ and capitalization. Interestingly, in these states, the capitalization of educational spending in school

[21] As per (Bayer et al., 2020b), states that passed school reforms include AL, AR, AZ, CA, CT, ID, KS, KY, MA, MI, MO, MT, NJ, NH, NY, OH, OR, SC, TN, TX, VT, WA, WI, WV, and WY.

districts with a high level of property tax deducters is negative; suggesting that deducters would pay for a reduction of local public goods. The mechanism depicted in the theoretical model is therefore broken when more affluent school districts must compensate less affluent districts through recapture (Hoxby, 2001; Bayer et al., 2020b; Giertz et al., 2021).

To summarize, the analyses in this section show that the capitalization of school spending into house value is greater for school districts that have greater fiscal independence, have residents facing higher federal tax rates, have a large share of pupils enrolled in public schools, have lower land available for development, and have a larger share of commercial properties. These results confirm that net local public goods that are financed by property taxes are less valued by residents that pay the full costs compared to the residents who deduct part of the costs on their federal taxable income.

6 Conclusion

This paper explores the relation between residents ability to deduct local taxes on federal income tax returns and the demand for local public goods. We first show that voters' support for increasing local public spending declined following the enactment of the TCJA, which decreased the share of residents who take advantage of the property tax deduction. Then, in a model of public goods capitalization, we establish a causal connection between the demand for local public goods and the deduction of property taxes. We confirm the model's predictions using both cross-sectional variation in tax deductions and educational spending as well as temporal variation emerging from the enactment of the

TCJA. Our findings imply a causal positive link between federal tax deductions and the demand for local public goods. As a result, our analysis suggests that local governments may see a reduction in the demand for public spending in response to the recent changes in the itemization rules embedded in the revised federal tax code. This decrease in educational spending could potentially have sizable negative impacts on test scores and college-going rates (Jackson et al., 2021; Lafortune and Schönholzer, 2022).

Our results have important implications regarding the property tax system. In theory, a valued-based property tax is a mechanism to collect taxes as a percent of the residents' resources, which incentivizes individuals to sort into locations that provide the optimal amount of public goods that maximizes their utility (Tiebout, 1956). Yet, introducing the federal tax deduction creates a discrepancy across residents in the costs of local public goods. Because the incentive to deduct taxes increases with income and wealth, this federal fiscal provision breaks the proportionality between tax obligations and resources. Thus, our results provide an explanation for why wealthier communities expend more resources on public goods than would be indicated if residents had to bear the full costs. In addition, our analysis suggests that the provisions in the TCJA that reduced the incentives for many taxpayers to take advantage of the property tax deduction may potentially help restore the progressivity nature of the property tax system.

References

Almunia, M., I. Guceri, B. Lockwood, and K. Scharf (2020). More giving or more givers? the effects of tax incentives on charitable donations in the uk. *Journal of Public Economics 183*, 104114.

Ambrose, B. W., P. H. Hendershott, D. C. Ling, and G. A. McGill (2022). Homeownership and taxes: How the TCJA altered the tax code's treatment of housing. *Real Estate Economics*.

Amornsiripanitch, N. (2020). Why are residential property tax rates regressive? *Available at SSRN 3729072*.

Arnott, R. J. and J. E. Stiglitz (1979). Aggregate land rents, expenditure on public goods, and optimal city size. *The Quarterly Journal of Economics 93*(4), 471–500.

Auten, G. E., H. Sieg, and C. T. Clotfelter (2002). Charitable giving, income, and taxes: An analysis of panel data. *American Economic Review 92*(1), 371–382.

Avenancio-León, C. F. and T. Howard (2022). The assessment gap: Racial inequalities in property taxation. *The Quarterly Journal of Economics 137*(3), 1383–1434.

Avery, C. and P. A. Pathak (2021). The distributional consequences of public school choice. *American Economic Review 111*(1), 129–52.

Barrow, L. and C. E. Rouse (2004). Using market valuation to assess public school spending. *Journal of Public economics 88*(9-10), 1747–1769.

Bayer, P., P. Q. Blair, and K. Whaley (2020a). The impact of school finance reforms on local tax revenues. In *AEA Papers and Proceedings*, Volume 110, pp. 416–18.

Bayer, P., P. Q. Blair, and K. Whaley (2020b). A national study of school spending and house prices. Technical report, National Bureau of Economic Research.

Bayer, P., F. Ferreira, and R. McMillan (2007). A unified framework for measuring preferences for schools and neighborhoods. *Journal of political economy 115*(4), 588–638.

Berry, C. R. (2021). Reassessing the property tax. *Available at SSRN 3800536*.

Biasi, B., J. Lafortune, and D. Schönholzer (2021). School capital expenditure rules and distribution. In *AEA Papers and Proceedings*, Volume 111, pp. 450–54.

Black, S. E. (1999). Do better schools matter? parental valuation of elementary education. *The quarterly journal of economics 114*(2), 577–599.

Bradbury, K. L., C. J. Mayer, and K. E. Case (2001). Property tax limits, local fiscal behavior, and property values: Evidence from massachusetts under proposition 212. *Journal of Public Economics 80*(2), 287–311.

Brasington, D. M. (2021). Cutting funding for police protection: The consequences for the size of newly-constructed housing. *The Journal of Real Estate Finance and Economics*, 1–23.

Brueckner, J. K. (1979). Property values, local public expenditure and economic efficiency. *Journal of public economics 11*(2), 223–245.

Brueckner, J. K. (1982). A test for allocative efficiency in the local public sector. *Journal of public Economics 19*(3), 311–331.

Brueckner, J. K. (1983). Property value maximization and public sector efficiency. *Journal of urban Economics 14*(1), 1–15.

Brueckner, J. K. (2021). Jue insight: Zoning and property taxation revisited—was hamilton right? *Journal of Urban Economics*, 103393.

Brunner, E. and J. Sonstelie (2003). Homeowners, property values, and the political economy of the school voucher. *Journal of Urban Economics 54*(2), 239–257.

Cellini, S. R., F. Ferreira, and J. Rothstein (2010). The value of school facility investments: Evidence from a dynamic regression discontinuity design. *The Quarterly Journal of Economics 125*(1), 215–261.

Chakrabarti, R. and J. Roy (2015). Housing markets and residential segregation: Impacts of the michigan school finance reform on inter-and intra-district sorting. *Journal of Public Economics 122*, 110–132.

Cheshire, P. and S. Sheppard (2004). Capitalising the value of free schools: the impact of supply characteristics and uncertainty. *The Economic Journal 114*(499), F397–F424.

Collins, C. A. and E. K. Kaplan (2017). Capitalization of school quality in housing prices: Evidence from boundary changes in Shelby county, Tennessee. *American Economic Review 107*(5), 628–32.

DeBartolo, G. and P. Fortune (1982). The demand for public services: inferences from municipal bond referenda. *National Tax Journal 35*(1), 55–67.

Downes, T. A. and J. E. Zabel (2002). The impact of school characteristics on house prices: Chicago 1987–1991. *Journal of urban economics 52*(1), 1–25.

Fack, G. and J. Grenet (2010). When do better schools raise housing prices? evidence from paris public and private schools. *Journal of public Economics 94*(1-2), 59–77.

Feldstein, M. (1975). The income tax and charitable contributions: Part i—aggregate and distributional effects. *National Tax Journal*, 81–100.

Feldstein, M. and A. Taylor (1976). The income tax and charitable contributions. *Econometrica: Journal of the Econometric Society*, 1201–1222.

Figlio, D. N. and A. O'Sullivan (2001). The local response to tax limitation measures: Do local governments manipulate voters to increase revenues? *The Journal of Law and Economics 44*(1), 233–257.

Fleck, J., J. Heathcote, K. Storesletten, and G. L. Violante (2021). Tax and transfer progressivity at the US state level. *Working paper*.

Giertz, S. H., R. Ramezani, and K. J. Beron (2021). Property tax capitalization, a case study of dallas county. *Regional Science and Urban Economics*, 103680.

Glaeser, E. L. (2013). Urban public finance. *Handbook of public Economics 5*, 195–256.

Hanson, A. (2012a). The incidence of the mortgage interest deduction: Evidence from the market for home purchase loans. *Public Finance Review 40*(3), 339–359.

Hanson, A. (2012b). Size of home, homeownership, and the mortgage interest deduction. *Journal of Housing Economics 21*(3), 195–210.

Heintzelman, M. D. (2010). The value of land use patterns and preservation policies. *The BE Journal of Economic Analysis & Policy 10*(1).

Hilber, C. A. and C. Mayer (2009). Why do households without children support local public schools? linking house price capitalization to school spending. *Journal of Urban Economics 65*(1), 74–90.

Hilber, C. A. and T. M. Turner (2014). The mortgage interest deduction and its impact on homeownership decisions. *Review of Economics and Statistics 96*(4), 618–637.

Hoxby, C. M. (2000). Does competition among public schools benefit students and taxpayers? *American Economic Review 90*(5), 1209–1238.

Hoxby, C. M. (2001). All school finance equalizations are not created equal. *The Quarterly Journal of Economics 116*(4), 1189–1231.

Jackson, C. K., C. Wigger, and H. Xiong (2021, May). Do school spending cuts matter? evidence from the great recession. *American Economic Journal: Economic Policy 13*(2), 304–35.

Kogan, V., S. Lavertu, and Z. Peskowitz (2018). Election timing, electorate composition, and policy outcomes: Evidence from school districts. *American Journal of Political Science 62*(3), 637–651.

Koster, H. R. and E. W. Pinchbeck (2022). How do households value the future? evidence from property taxes. *American Economic Journal: Economic Policy 14*(1), 207–39.

Krimmel, J. (2021). Reclaiming local control: School finance reforms and housing supply restrictions. *Working paper*.

Kuminoff, N. V. and J. C. Pope (2014). Do "capitalization effects" for public goods reveal the public's willingness to pay? *International Economic Review 55*(4), 1227–1250.

Lafortune, J., J. Rothstein, and D. W. Schanzenbach (2018). School finance reform and the distribution of student achievement. *American Economic Journal: Applied Economics 10*(2), 1–26.

Lafortune, J. and D. Schönholzer (2022, July). The impact of school facility investments on students and homeowners: Evidence from los angeles. *American Economic Journal: Applied Economics 14*(3), 254–89.

Lang, C. (2018). Assessing the efficiency of local open space provision. *Journal of Public Economics 158*, 12–24.

Li, W. and E. G. Yu (2022). Real estate taxes and home value: Evidence from tcja. *Review of Economic Dynamics 43*, 125–151.

Lutz, B. (2015). Quasi-experimental evidence on the connection between property taxes and residential capital investment. *American Economic Journal: Economic Policy 7*(1), 300–330.

McMillen, D. and R. Singh (2020). Assessment regressivity and property taxation. *The Journal of Real Estate Finance and Economics 60*(1), 155–169.

Meer, J. and B. A. Priday (2020). Tax prices and charitable giving: Projected changes in donations under the 2017 tax cuts and jobs act. *Tax Policy and the Economy 34*(1), 113–138.

Oates, W. E. (1969). The effects of property taxes and local public spending on property values: An empirical study of tax capitalization and the tiebout hypothesis. *Journal of political economy 77*(6), 957–971.

Oates, W. E. and W. A. Fischel (2016). Are local property taxes regressive, progressive, or what? *National Tax Journal 69*(2), 415.

Poterba, J. M., D. N. Weil, and R. Shiller (1991). House price dynamics: The role of tax policy and demography. *Brookings Papers on Economic Activity 1991*(2), 143–203.

Randolph, W. C. (1995). Dynamic income, progressive taxes, and the timing of charitable contributions. *Journal of Political Economy 103*(4), 709–738.

Rappoport, D. E. (2016). Do mortgage subsidies help or hurt borrowers? *Working paper*.

Reece, W. S. and K. D. Zieschang (1985). Consistent estimation of the impact of tax deductibility on the level of charitable contributions. *Econometrica: Journal of the Econometric Society*, 271–293.

Romer, T. and H. Rosenthal (1979). Bureaucrats versus voters: On the political economy of resource allocation by direct democracy. *The Quarterly Journal of Economics 93*(4), 563–587.

Samuelson, P. A. (1954). The pure theory of public expenditure. *The review of economics and statistics 36*(4), 387–389.

Schwartz, A. E., I. Voicu, and K. M. Horn (2014). Do choice schools break the link between public schools and property values? evidence from house prices in new york city. *Regional Science and Urban Economics 49*, 1–10.

Sommer, K. and P. Sullivan (2018). Implications of us tax policy for house prices, rents, and homeownership. *American Economic Review 108*(2), 241–74.

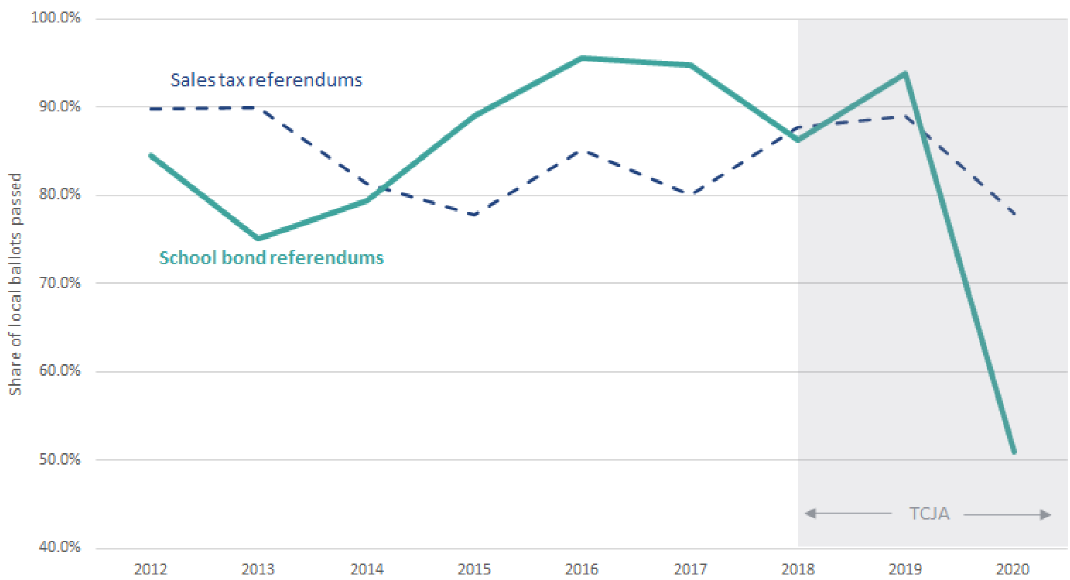
Taussig, M. K. (1967). Economic aspects of the personal income tax treatment of charitable contributions. *National Tax Journal 20*(1), 1–19.

Tiebout, C. M. (1956). A pure theory of local expenditures. *Journal of political economy 64*(5), 416–424.

Turnbull, G. K. and M. Zheng (2019). A meta-analysis of school quality capitalization in us house prices. *Real Estate Economics*.

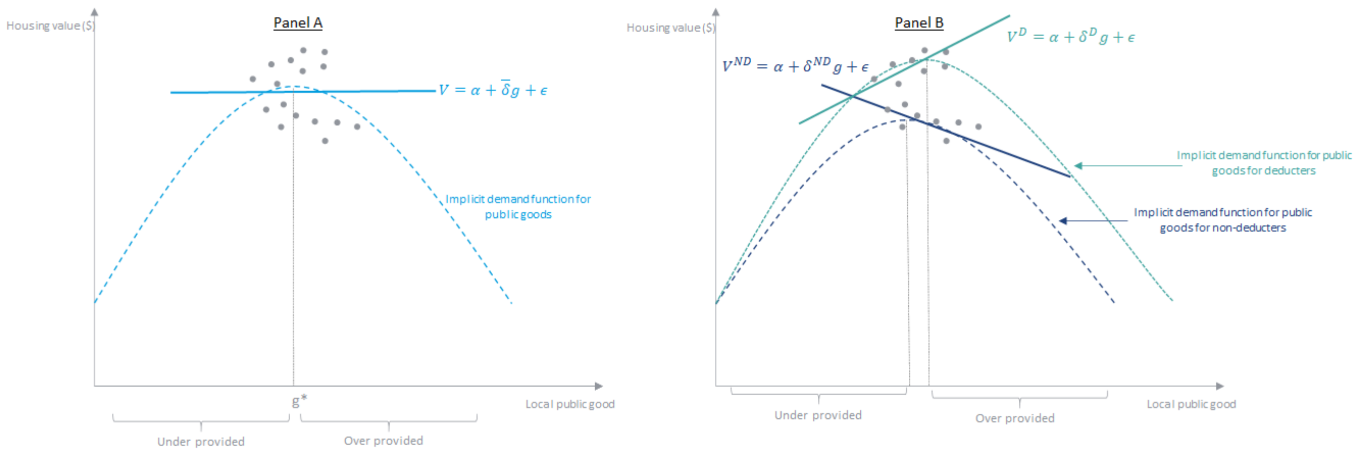
Valentin, M. (2021). Interest deductibility, market frictions and price discrimination. *Working paper*.

Figure 1: California sales tax and school bond referendums approval rates (2012-2020)



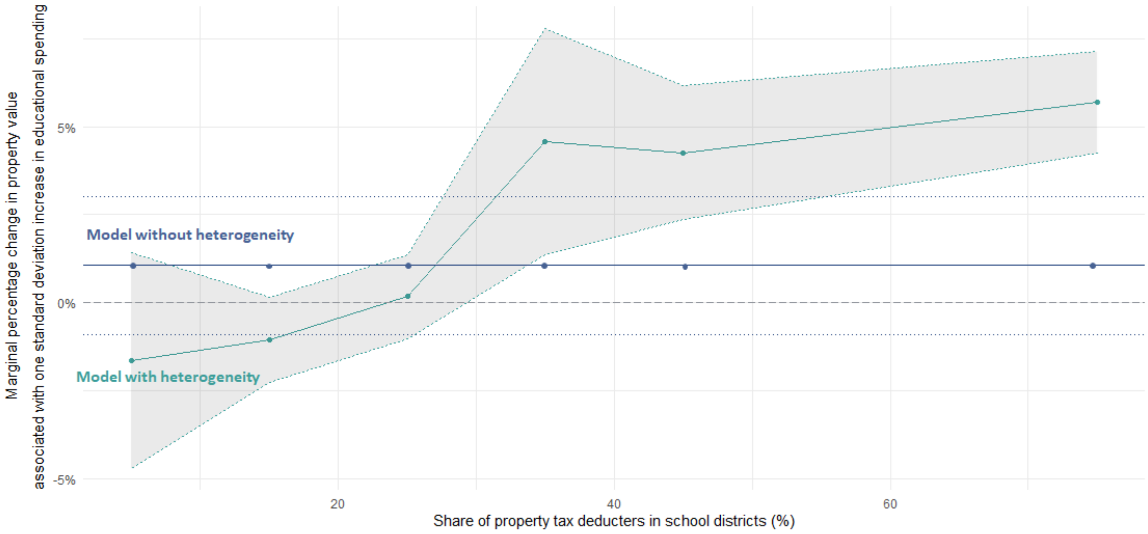
Note: The lines depict the share of approved sales tax (blue) and school district bond (turquoise) referendums in California. Authors' computation using data from the School District Ballot Measure Election Results data and The California Local Government Finance Almanac.

Figure 2: The implicit demand function for local public goods with local tax deductions



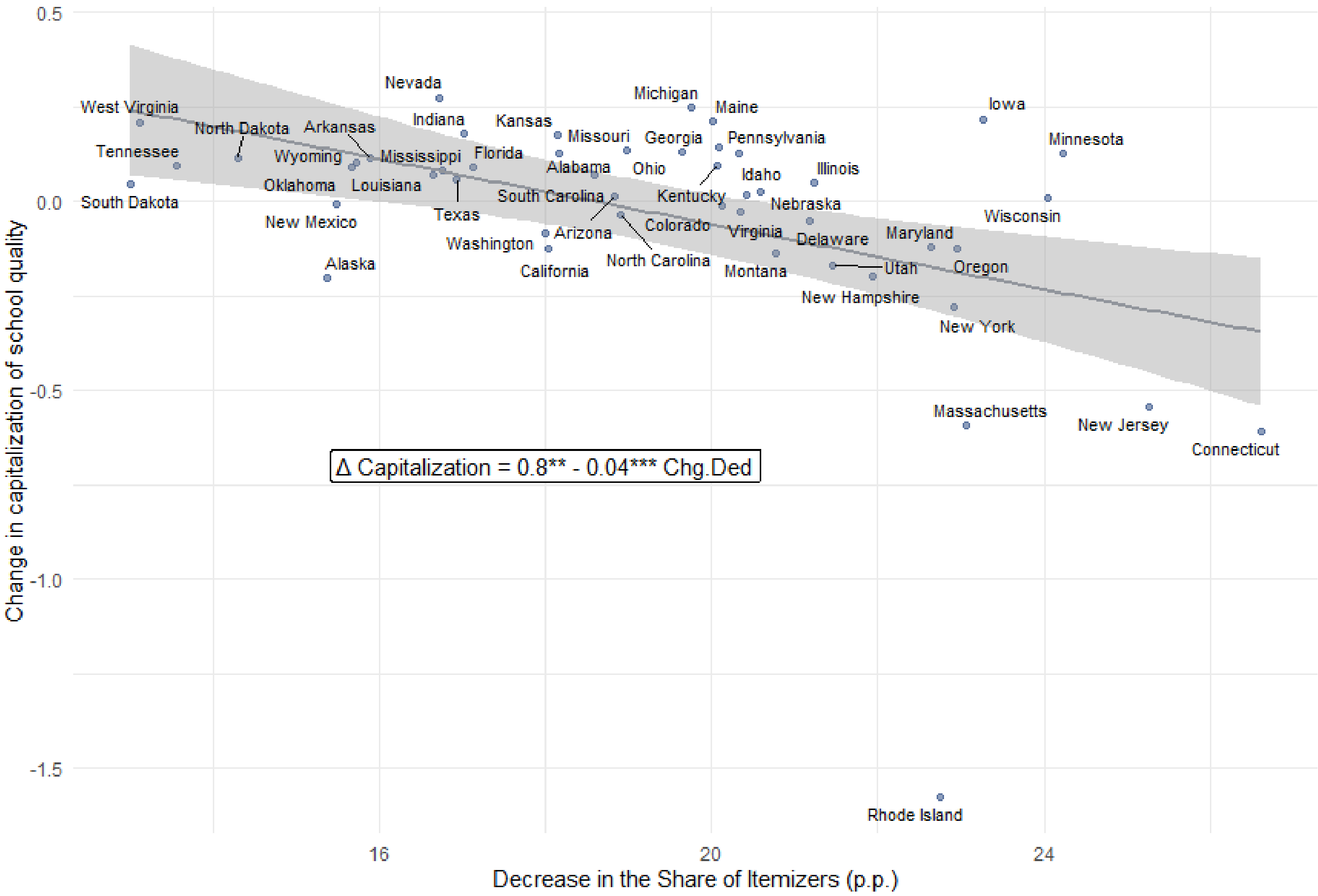
Note: The charts show the relation between the provision of public goods (x-axis) and aggregate house value (y-axis) conditional on housing and neighborhood quality level. Panel A shows the standard model as in Brueckner (1982). Panel B shows the demand function for jurisdictions composed of property tax deducters (green line) and for non-deducters (dashed blue line). The grey dots represent fictional jurisdictions illustrating the empirical strategy to test for the heterogeneous demand for local public goods.

Figure 3: The implied change in housing value to an increase in local public good



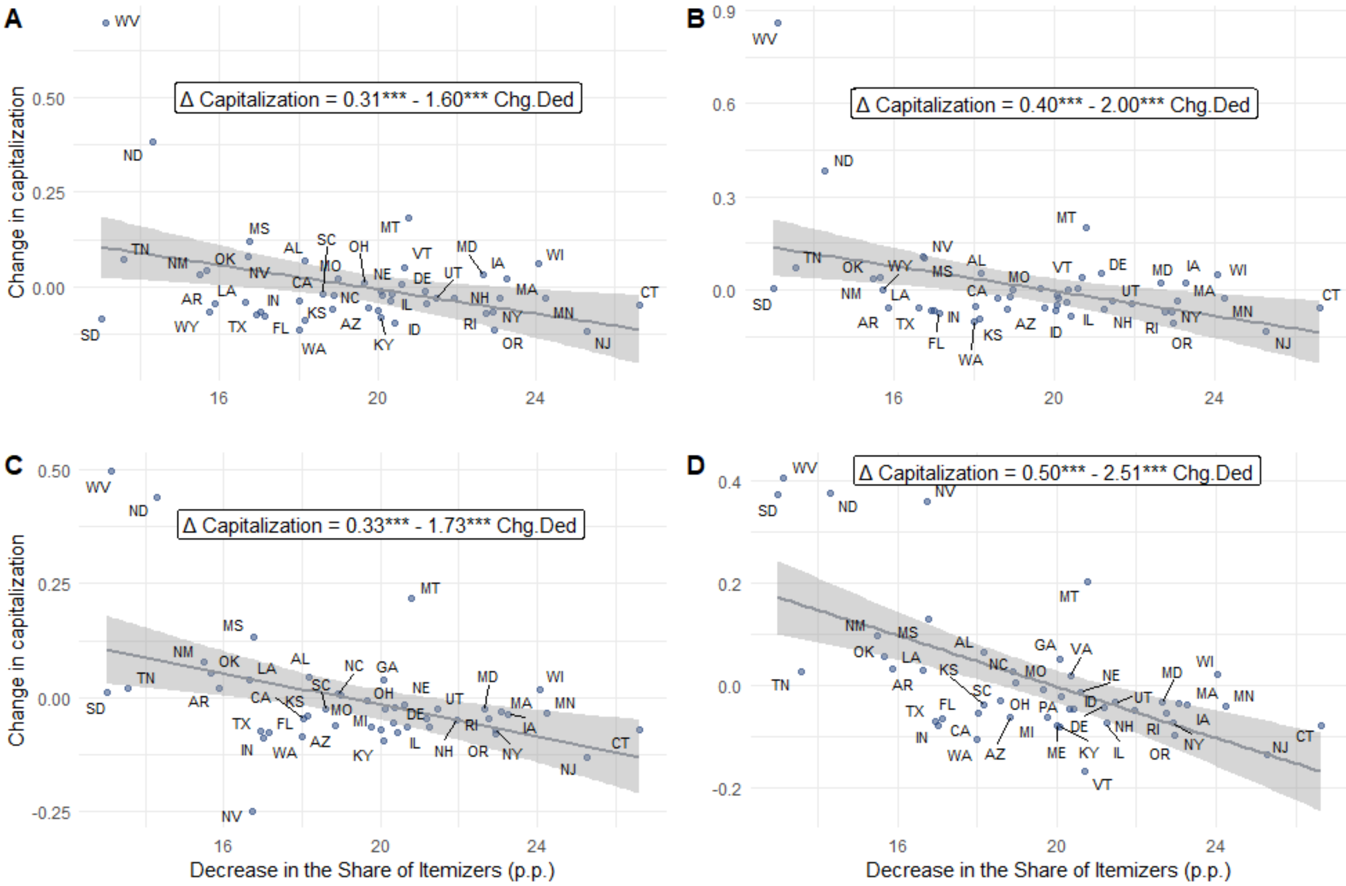
Note: The dotted turquoise line shows the implied marginal change in housing value to a one standard deviation increase in per pupil adjusted educational spending for school districts with heterogeneous share of property tax deducters. The shaded area shows the 90% confidence interval. The horizontal blue line with corresponding dotted confidence interval shows the the coefficient if no heterogeneity is included in the model.

Figure 4: Change in capitalization of local public goods and decrease in local tax deductions



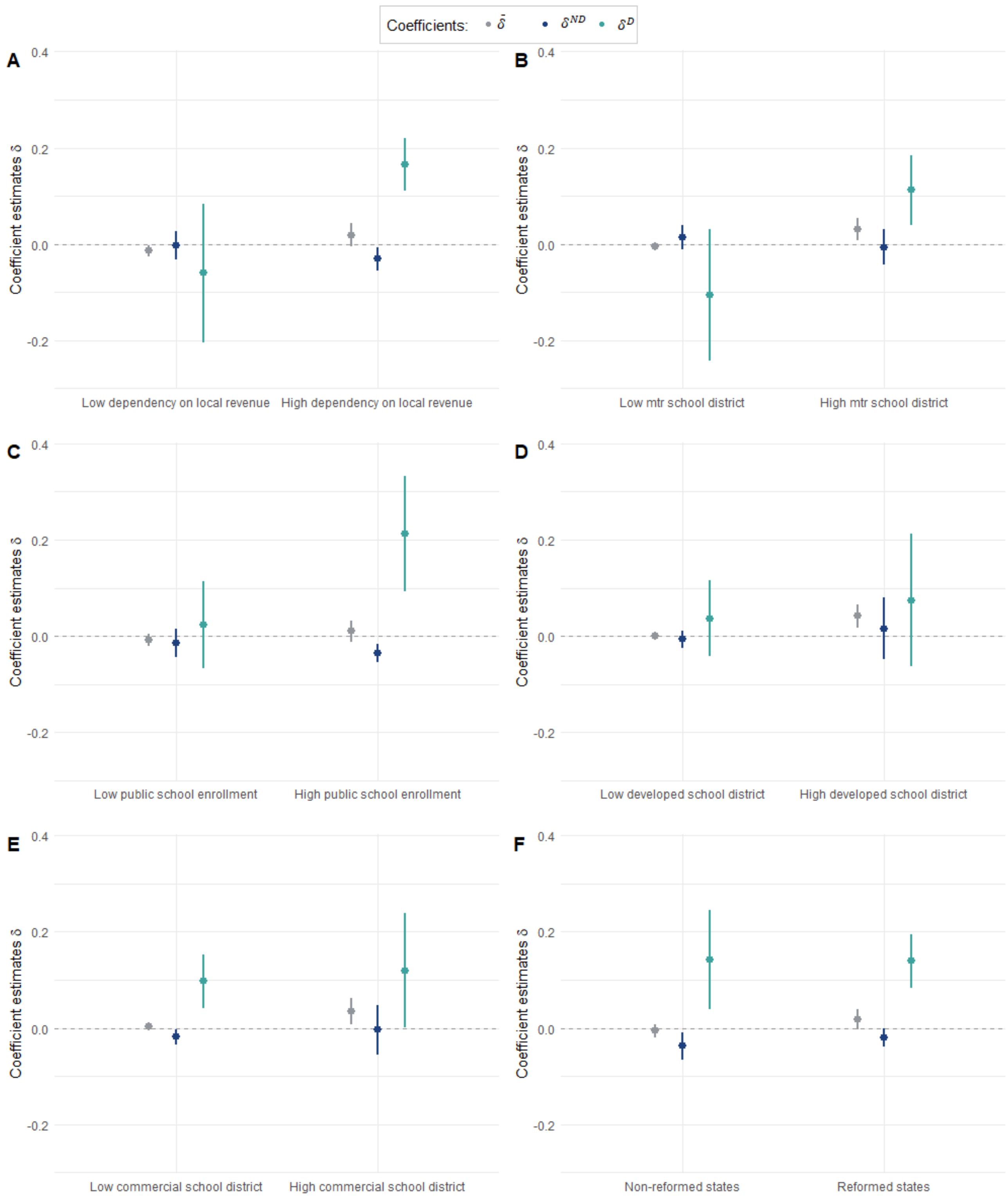
*Note: The scatter plot shows the relation between the decrease in the share of residents deducting property taxes (x-axis), and the change in the rate of capitalization of school test score in house value before and after the TCJA. School test score is measured by the mean pooled test score at the school district level. House prices is the Zillow ZHVI in January 2017 (pre-TCJA) and in January 2020 (post-TCJA). The decrease in the share of deducters is computed from the SOI of the IRS in fiscal year 2017, and 2018. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

Figure 5: A house-level identification approach to compute the change in the rate of capitalization



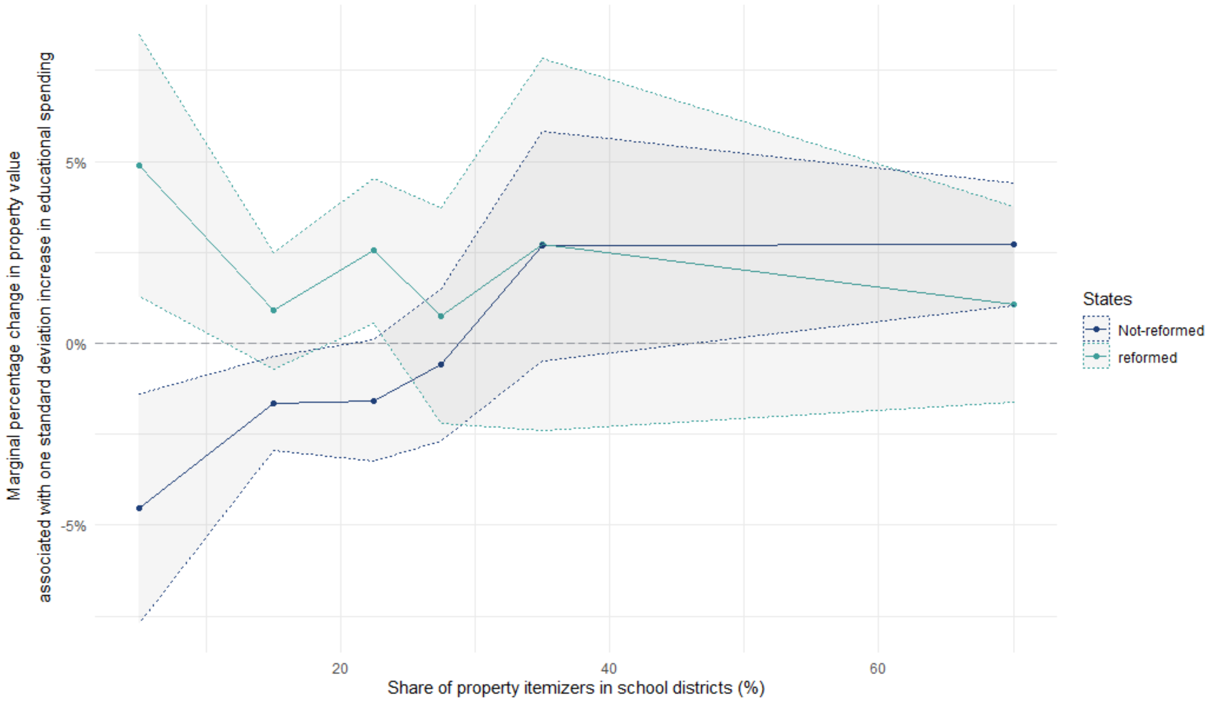
*Note: The scatter plot shows the relation between the decrease in the share of residents deducting property taxes (x-axis), and the change in the rate of capitalization of school test score in house value before and after the TCJA. The change in the rate of capitalization is estimated within each state in a hedonic pricing model using all residential transactions in 2017 and 2019. Panel A shows the results when county fixed effects are used, panel B adds school district border fixed effects, panel C further restricts to transactions within one mile of a school district border, and panel D regressions include demographic variables. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

Figure 6: Testing the intensity of the mechanism



Note: The points, along with their 90% confidence intervals, show the coefficient estimates $\bar{\delta}$ of equation (13), and δ^{ND} and δ^{D} of equation (14) for different sub-samples of school districts. Panel A shows the coefficients for school districts with high and low level of dependency on local property taxes, panel B shows the coefficients for school districts with high and low residents mean federal tax rate on income, panel C shows the coefficients for school districts with high and low level of public school enrollment, panel D shows the coefficients for school districts with high and low level of land available for development, panel E shows the coefficients for school districts with high and low level of highly developed land, and panel F shows the coefficients for school districts within states that passed or did not pass a school equalization reform.

Figure 7: Capitalization of school spending, share of deducters, and state school finance reforms



Note: The dotted lines show the implied marginal change in housing value to a one standard deviation increase in per pupil adjusted educational spending for school districts with heterogeneous level of share of property tax deducters. The estimation is performed separately for school districts in states that passed a school system financial equalization reform (dark blue), and school district in states that did not (turquoise). The shaded area shows the 90% confidence intervals.

Table 1: Local referendums approval rates and property tax deductions subsidy

This table reports the estimates of the regression $WinningMargin_{j,t} = \alpha_j + \alpha_t + \gamma(ChangeDed_j \times Post_t) + X'_{j,t}\beta + \epsilon_{j,t}$. *The sample comprises all California school districts local referendum results from 2008 to 2020.* $WinningMargin_{j,t}$ *is the share of Yes votes minus the threshold for the referendum to be approved,* α_j *are school district fixed effects,* α_t *are election fixed effects,* $Post_t = 1$ *for elections occurring after 2019 inclusive,* $ChangeDed_j$ *is the change between the ratio of property tax deducters before and after the TJCA, and* $X_{j,t}$ *are additional control. In columns (1) and (2), the election fixed effects are omitted and replaced by indicators for presidential elections and odd years elections. In column (4), close elections are used for the estimation (within 25 percentage points of winning/losing). In column (6), only bond referendums are used. Standard errors, presented in parentheses, are clustered at the school district level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable:				
	Winning Margin (%)				
	(1)	(2)	(3)	(4)	(5)
Post	-6.74^{***}	2.14			
	(0.97)	(3.94)			
Post x $ChangeDed$ (γ)		-67.09^{**}	-62.32^{**}	-51.02^{**}	-45.64^{**}
		(31.26)	(30.79)	(21.93)	(22.16)
Presidential election	4.03^{***}	4.01^{***}			
	(0.96)	(0.95)			
Odd year election	-0.51	-0.57			
	(1.06)	(1.06)			
Voters' turnout	6.78^{**}	6.98^{**}	7.64^{**}	5.42^{*}	4.38
	(3.00)	(3.00)	(3.47)	(2.89)	(4.25)
Recently defeated referendum	3.74^{***}	3.74^{***}	3.74^{***}	2.63^{***}	1.95^{***}
	(0.73)	(0.75)	(0.72)	(0.59)	(3.39)
Bond indicator	7.57^{***}	7.52^{***}	7.38^{***}	7.00^{***}	
	(0.83)	(0.83)	(0.84)	(0.80)	
Bond value per housing unit					5.91
					(7.47)
School district fixed effects	X	X	X	X	X
Election fixed effects			X	X	X
Tight election results				X	X
Only bonds referendums					X
Observations	1,525	1,524	1,524	1,476	1,151
R^2	0.66	0.66	0.68	0.71	0.75
Adjusted R^2	0.41	0.41	0.43	0.47	0.42

Table 2: Summary statistics

*This table reports the summary statistics of the variables used in the cross-sectional study. All urban school districts providing elementary education with more than 100 pupils are included (n=8,916). The first three columns show the mean, standard deviation and median of the entire sample. The data is equally split between school districts with high share of property deducters and school districts with low level of deducters. The means for the two groups are presented in columns (4) and (5). The difference in mean is shown along the t-statistics of difference in means. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Mean	Std. dev.	Median	High $DedShare$	Low $DedShare$	Difference	t-statistics
Main variables:							
Median house value (000's)	227.17	228.28	162.69	323.45	130.88	192.57	43.92***
Share of property deducters (%)	25.40	12.12	22.96	35.17	15.63	19.53	128.58***
Adjusted expenses per pupil (000's)	16.56	6.39	14.88	17.18	15.95	1.23	9.16***
Control variables:							
Income median (000's)	62.69	24.38	57.08	76.61	48.76	27.85	65.72***
Home ownership (%)	63.55	13.45	64.63	67.40	59.70	7.71	28.23***
Share of population less than 19 (%)	25.36	4.55	25.16	24.73	25.98	−1.25	-13.10***
Share of population more than 65 (%)	23.40	6.21	23.05	23.59	23.21	0.38	2.87***
Share of minority (%)	12.95	15.51	7.00	11.95	13.96	−2.01	−6.14***
Share population with bachelor degree (%)	28.18	15.64	23.72	37.24	19.13	18.12	67.10***
Poverty rate (%)	1.07	2.50	0.41	0.52	1.62	−1.10	−21.25***
School score (standardized)	0.05	0.34	0.05	0.21	−0.10	0.31	48.32***
Variables used for heterogeneity analyses:							
Public school penetration (%)	63.77	13.34	62.58	63.02	64.42	−1.40	−4.57***
Share of land developed (%)	28.38	31.33	11.39	36.43	20.26	16.17	25.01***
Share of revenue from local sources (%)	44.08	20.28	41.01	52.98	35.19	17.79	46.09***
Reformed dummy	0.66	0.47	1	0.71	0.62	0.09	8.62***
Developed land highly developed (%)	18.85	17.11	13.63	21.57	16.11	5.46	15.12***
Mean federal income tax (%)	16.92	2.90	16.21	18.48	15.36	3.12	60.21***

Table 3: Capitalization of local public goods with heterogeneous deductibility subsidy

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* Exp_j *is the total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts educational score. The coefficients* β *are reported in Table A2. Standard errors, presented in parentheses, are clustered at the CBSA level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.656*	0.589	0.669**	0.610*	0.655**	0.592**
	(0.359)	(0.383)	(0.327)	(0.338)	(0.289)	(0.295)
Expenses per pupil ($\bar{\delta}$)	0.011		0.004		0.013**	
	(0.010)		(0.005)		(0.006)	
Expenses per pupil (δ^{ND})		−0.027***		−0.024**		−0.021*
		(0.010)		(0.011)		(0.013)
Expenses per pupil x DedShare (δ^{D})		0.147***		0.113***		0.134***
		(0.032)		(0.039)		(0.039)
Demographics	X	X	X	X	X	X
Spatial fixed effects	CBSA	CBSA	+ State	+ State	County	County
Observations	8,890	8,890	8,890	8,890	8,890	8,890
R^2	0.923	0.923	0.927	0.927	0.945	0.946
Adjusted R^2	0.914	0.914	0.918	0.919	0.932	0.932

Table 4: Capitalization of school spending and deductibility subsidy by types of school expenses

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta} g_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND} g_j + \delta^{D}(g_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* g_j *are different per-pupil measures of public goods deflated across space by the CWIFT for monetary measures and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts test score. Standard errors, presented in parentheses, are clustered at the CBSA level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)							
	All expenses		Instructional		Support		Others	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Share of property deducters (ϕ)	0.656*	0.589	0.680*	0.653*	0.636*	0.579	0.563	0.509
	(0.359)	(0.383)	(0.358)	(0.366)	(0.362)	(0.375)	(0.383)	(0.372)
Public good ($\bar{\delta}$ or δ^{ND})	0.011	−0.027***	0.027*	0.008	−0.0001	−0.027**	−0.019**	−0.080***
	(0.010)	(0.010)	(0.015)	(0.024)	(0.007)	(0.011)	(0.008)	(0.016)
Public good x DedShare (δ^D)		0.147***		0.066		0.094***		0.261***
		(0.032)		(0.045)		(0.031)		(0.036)
Demographics	X	X	X	X	X	X	X	X
CBSA fixed effects	X	X	X	X	X	X	X	X
Observations	8,890	8,890	8,890	8,890	8,890	8,890	8,890	8,890
R^2	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.925
Adjusted R^2	0.914	0.914	0.914	0.914	0.914	0.914	0.914	0.916

	Non-school		Capital expenditure		Employees		All but non-deflated	
	(5a)	(5b)	(6a)	(6b)	(7a)	(7b)	(8a)	(8b)
Share of property deducters (ϕ)	0.647*	0.655*	0.636*	0.628*	0.870**	0.828**	0.670*	0.637*
	(0.355)	(0.356)	(0.368)	(0.368)	(0.406)	(0.410)	(0.357)	(0.368)
Public good ($\bar{\delta}$ or δ^{ND})	0.014***	−0.005	−0.0002	−0.024***	−0.006	−0.030***	0.021	0.001
	(0.006)	(0.007)	(0.003)	(0.007)	(0.004)	(0.010)	(0.013)	(0.016)
Public good x DedShare (δ^D)		0.077**		0.105***		0.094**		0.074**
		(0.034)		(0.028)		(0.042)		(0.032)
Demographics	X	X	X	X	X	X	X	X
CBSA fixed effects	X	X	X	X	X	X	X	X
Observations	8,890	8,890	8,890	8,890	8,102	8,102	8,890	8,890
R^2	0.923	0.923	0.923	0.923	0.921	0.921	0.923	0.923
Adjusted R^2	0.914	0.914	0.914	0.914	0.912	0.912	0.914	0.914

Table 5: Capitalization of police funding and property deductions subsidy

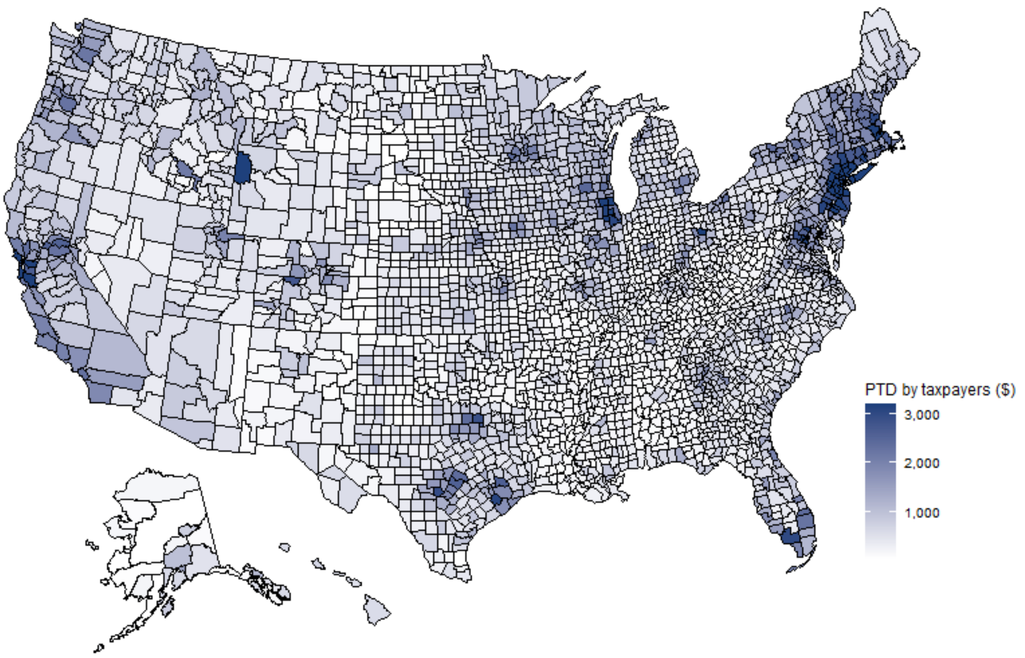
This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban U.S. counties and equivalent.* $DedShare_j$ *is the share of residents deducting property taxes on their federal taxable income in year 2017 in the county from the SOI.* Exp_j *is the standardized total policing expenses per inhabitant for all the entities falling within a county in fiscal year 2017.* X_j *include demographics control (poverty rate, education achievements, homeownership rate, the share of minority, and the population density), income quartile fixed effects, and income distribution share. Standard errors, presented in parentheses, are clustered at the spatial fixed effects level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	2.917***	2.893***	1.447***	1.453***	1.765***	1.772***
	(0.165)	(0.165)	(0.210)	(0.211)	(0.235)	(0.235)
Expenses per resident ($\bar{\delta}$)	−0.027***		−0.024***		−0.029***	
	(0.008)		(0.008)		(0.008)	
Expenses per resident (δ^{ND})		−0.064***		−0.037**		−0.043**
		(0.016)		(0.018)		(0.017)
Expenses per resident x DedShare (δ^{D})		0.181**		0.058		0.068
		(0.072)		(0.073)		(0.072)
Demographics	X	X	X	X	X	X
Spatial fixed effects	State	State	CBSA	CBSA	Both	Both
Observations	1,758	1,758	1,758	1,758	1,758	1,758
R^2	0.886	0.886	0.964	0.965	0.968	0.968
Adjusted R^2	0.881	0.882	0.925	0.925	0.930	0.930

Online APPENDIX

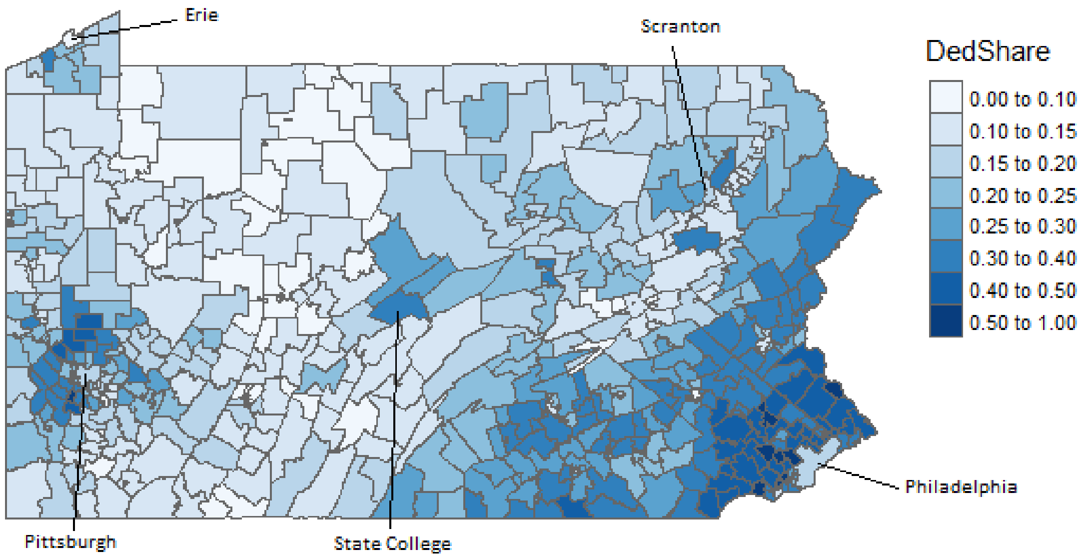
A Additional Figures & Tables

Figure A1: Property tax deductions per taxpayers by U.S. counties in 2017



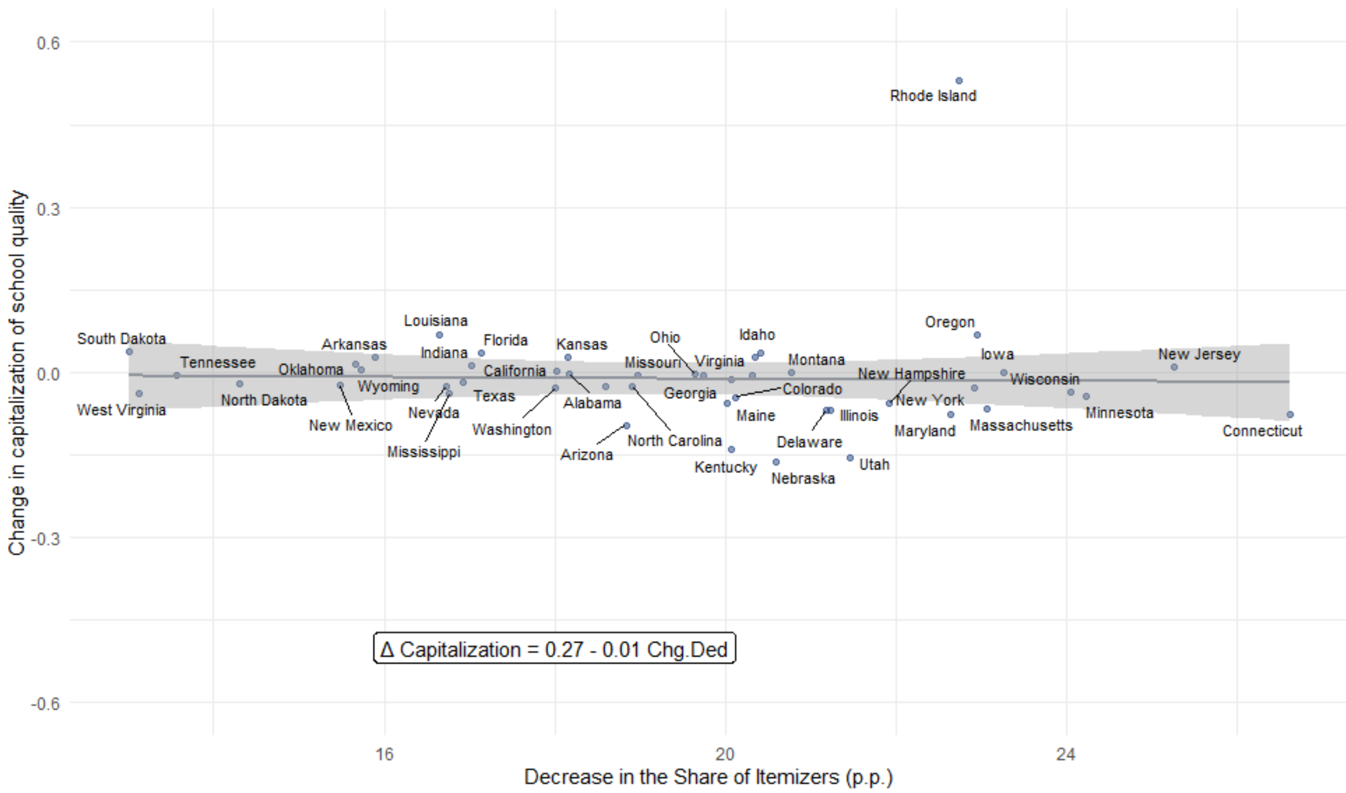
Note: This map shows the sum of the property tax deductions claimed by U.S. taxpayers divided by the number of taxpayers for each U.S. county in 2017. Authors' computations using data from the Statistics of Income of the Internal Revenue Service.

Figure A2: Share of property tax deducters in Pennsylvanian school districts in 2017



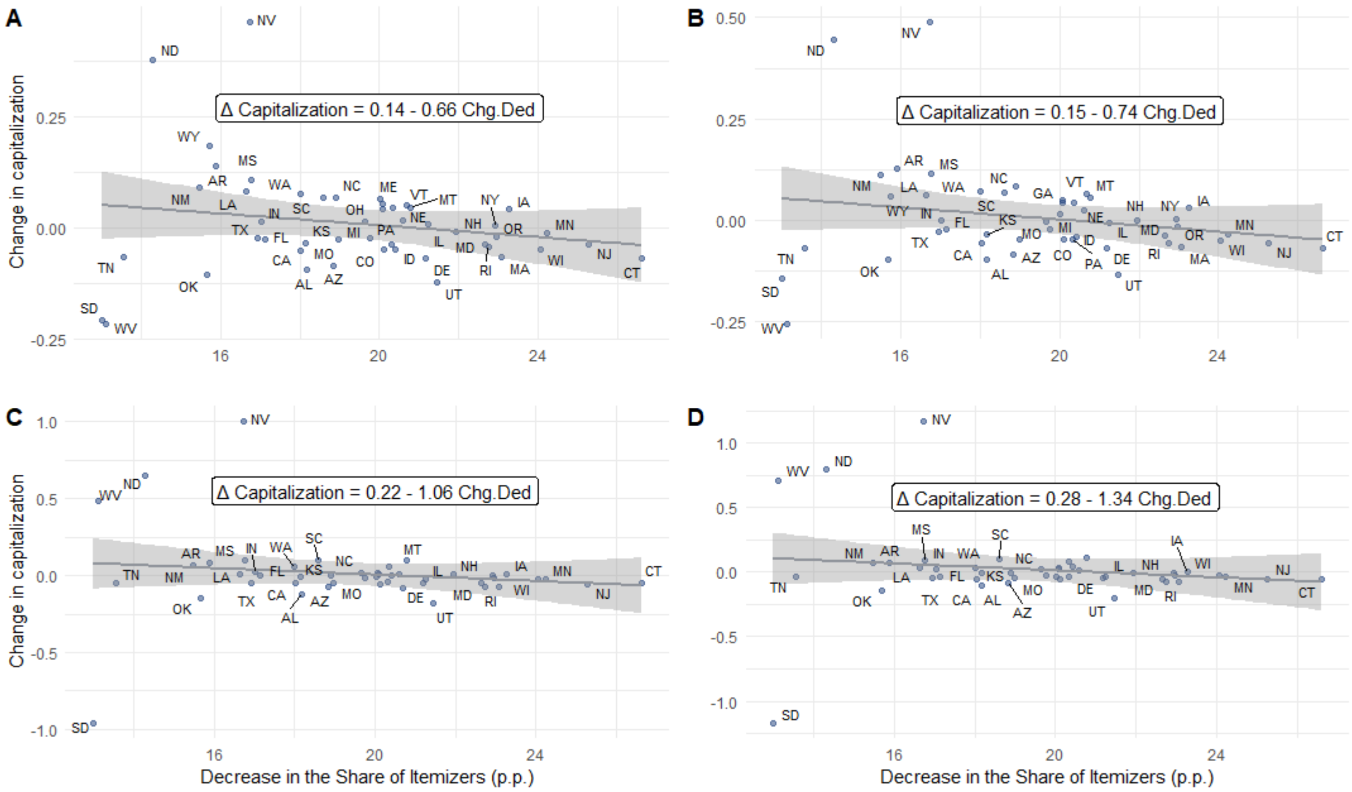
Note: This map shows the share of property tax deducters for Pennsylvanian school districts computed from Statistics of Income of the Internal Revenue Service cross-walked into school district with the School District Geographic Reference Files.

Figure A3: Placebo test: Using 2015 and 2017 capitalization change with panel data



*Note: The scatter plot shows the relation between the decrease in the share of residents deducting property taxes before and after the TCJA (x-axis), and the change in the rate of capitalization of school test score in house value computed for years prior the TCJA. School test score is measured by the mean pooled test score at the school district level. House prices is the Zillow ZHVI in January 2015 and in January 2017. The decrease in the share of deducters is computed from the SOI of the IRS in fiscal year 2017, and 2018. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

Figure A4: Placebo test: Using 2015 and 2017 capitalization change with housing transactions



*Note: The scatter plot shows the relation between the decrease in the share of residents deducting property taxes before and after the TCJA (x-axis), and the change in the rate of capitalization of school test score in house value. The change in the rate of capitalization is estimated within each state in a hedonic pricing model using all residential transactions in 2015 and 2017: the placebo sample. Panel A shows the results when county fixed effects are used, panel B adds school district border fixed effects, panel C further restricts to transactions within one mile of a school district border, and panel D regressions include demographic variables. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

Table A1: Correlation table

This table reports the correlation coefficients of the variables used the cross-sectional analysis. All variables are at the school district level in 2017.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Median house value (000's)	1	0.551	0.081	0.121	0.647	0.022	-0.076	0.029	0.115	0.633	-0.111	0.381	-0.018	0.321	0.418	0.180	0.265	0.693
(2) Share of property deducters - DedShare (%)	0.551	1	0.018	0.154	0.803	0.408	-0.111	0.040	-0.085	0.774	-0.257	0.635	-0.046	0.331	0.580	0.109	0.141	0.752
(3) Number of pupils	0.081	0.018	1	-0.085	0.007	-0.116	0.057	-0.146	0.199	0.096	-0.099	-0.033	-0.075	0.164	-0.001	-0.039	0.208	0.127
(4) Adjusted expenses per pupil (000's)	0.121	0.154	-0.085	1	0.163	-0.060	-0.226	0.210	-0.050	0.176	0.061	0.151	-0.086	0.111	0.305	0.048	0.011	0.157
(5) Income median (000's)	0.647	0.803	0.007	0.163	1	0.515	0.020	-0.043	-0.106	0.809	-0.190	0.708	0.065	0.271	0.595	0.105	0.081	0.770
(6) Home ownership (%)	0.022	0.408	-0.116	-0.060	0.515	1	0.034	0.062	-0.391	0.227	-0.155	0.487	0.155	-0.164	0.207	-0.067	-0.311	0.211
(7) Share of population less than 19 (%)	-0.076	-0.111	0.057	-0.226	0.020	0.034	1	-0.680	0.166	-0.106	0.048	-0.120	-0.136	-0.042	-0.265	-0.012	0.005	-0.087
(8) Share of population more than 65 (%)	0.029	0.040	-0.146	0.210	-0.043	0.062	-0.680	1	-0.321	0.037	0.079	0.133	0.186	-0.184	0.205	-0.005	-0.280	0.047
(9) Share of minority (%)	0.115	-0.085	0.199	-0.050	-0.106	-0.391	0.166	-0.321	1	0.011	-0.033	-0.390	-0.161	0.413	-0.134	-0.018	0.430	0.017
(10) Share population with bachelor degree (%)	0.633	0.774	0.096	0.176	0.809	0.227	-0.106	0.037	0.011	1	-0.225	0.701	-0.066	0.412	0.624	0.083	0.202	0.835
(11) Poverty rate (%)	-0.111	-0.257	-0.099	0.061	-0.190	-0.155	0.048	0.079	-0.033	-0.225	1	-0.182	0.298	-0.217	-0.141	0.009	-0.211	-0.213
(12) School score (standardized)	0.381	0.635	-0.033	0.151	0.708	0.487	-0.120	0.133	-0.390	0.701	-0.182	1	0.094	0.143	0.574	-0.018	-0.053	0.600
(13) Public school penetration (%)	-0.018	-0.046	-0.075	-0.086	0.065	0.155	-0.136	0.186	-0.161	-0.066	0.298	0.094	1	-0.150	-0.065	0.026	-0.162	-0.044
(14) Share of land developed (%)	0.321	0.331	0.164	0.111	0.271	-0.164	-0.042	-0.184	0.413	0.412	-0.217	0.143	-0.150	1	0.281	0.050	0.753	0.372
(15) Share of revenue from local sources (%)	0.418	0.580	-0.001	0.305	0.595	0.207	-0.265	0.205	-0.134	0.624	-0.141	0.574	-0.065	0.281	1	-0.001	0.111	0.615
(16) Reformed dummy	0.180	0.109	-0.039	0.048	0.105	-0.067	-0.012	-0.005	-0.018	0.083	0.009	-0.018	0.026	0.050	-0.001	1	0.074	0.088
(17) Developed land highly developed (%)	0.265	0.141	0.208	0.011	0.081	-0.311	0.005	-0.280	0.430	0.202	-0.211	-0.053	-0.162	0.753	0.111	0.074	1	0.178
(18) Mean federal income tax (%)	0.693	0.752	0.127	0.157	0.770	0.211	-0.087	0.047	0.017	0.835	-0.213	0.600	-0.044	0.372	0.615	0.088	0.178	1

Table A2: Capitalization of local public goods with heterogeneous deductibility subsidy

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X_j' \beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^D (Exp_j \times DedShare_j) + \phi DedShare_j + X_j' \beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* Exp_j *is the total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts educational score. Standard errors, presented in parentheses, are clustered at the CBSA level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.656*	0.589	0.669**	0.610*	0.655**	0.592**
	(0.359)	(0.383)	(0.327)	(0.338)	(0.289)	(0.295)
Expenses per pupil ($\bar{\delta}$)	0.011		0.004		0.013**	
	(0.010)		(0.005)		(0.006)	
Expenses per pupil (δ^{ND})		−0.027***		−0.024**		−0.021*
		(0.010)		(0.011)		(0.013)
Expenses per pupil x DedShare (δ^D)		0.147***		0.113***		0.134***
		(0.032)		(0.039)		(0.039)
Share Bachelor degree	0.391***	0.386***	0.361***	0.358***	0.315***	0.311***
	(0.056)	(0.057)	(0.063)	(0.063)	(0.058)	(0.058)
Share minority	0.005	0.023	0.003	0.016	−0.046	−0.034
	(0.059)	(0.064)	(0.062)	(0.064)	(0.079)	(0.080)
Share young	−0.411***	−0.398***	−0.437***	−0.426***	−0.322**	−0.313**
	(0.128)	(0.128)	(0.122)	(0.121)	(0.136)	(0.135)
Share old	−0.282*	−0.299*	−0.290*	−0.302*	−0.149	−0.164
	(0.161)	(0.156)	(0.160)	(0.159)	(0.165)	(0.162)
Ownership rate	−0.442***	−0.441***	−0.462***	−0.459***	−0.440***	−0.436***
	(0.112)	(0.113)	(0.129)	(0.129)	(0.125)	(0.125)
School test score	0.086***	0.086***	0.109***	0.106***	0.106***	0.102***
	(0.017)	(0.016)	(0.022)	(0.022)	(0.019)	(0.019)
Income - quartile 2	0.124***	0.123***	0.119***	0.119***	0.111***	0.111***
	(0.024)	(0.024)	(0.020)	(0.021)	(0.019)	(0.019)
Income - quartile 3	0.192***	0.192***	0.186***	0.187***	0.166***	0.165***
	(0.042)	(0.043)	(0.038)	(0.038)	(0.034)	(0.034)
Income - quartile 4	0.206***	0.206***	0.196***	0.197***	0.178***	0.180***
	(0.066)	(0.066)	(0.057)	(0.057)	(0.053)	(0.054)
Share household < 25K	2.518***	2.477***	2.407***	2.381***	2.178***	2.143***
	(0.468)	(0.477)	(0.454)	(0.456)	(0.482)	(0.484)
Share households < 50K	1.504***	1.537***	1.508***	1.526***	1.377***	1.391***
	(0.368)	(0.366)	(0.357)	(0.357)	(0.354)	(0.352)
Share households < 75K	1.240***	1.259***	1.307***	1.327***	1.370***	1.373***
	(0.395)	(0.391)	(0.410)	(0.407)	(0.430)	(0.427)
Share households < 100K	1.877***	2.005***	1.813***	1.924***	1.738***	1.861***
	(0.337)	(0.347)	(0.316)	(0.327)	(0.406)	(0.422)
Share households > 100K	4.454***	4.415***	4.357***	4.332***	4.098***	4.051***
	(0.293)	(0.291)	(0.303)	(0.306)	(0.319)	(0.311)
Spatial fixed effects	CBSA	CBSA	+ State	+ State	County	County
Observations	8,890	8,890	8,890	8,890	8,890	8,890
R^2	0.923	0.923	0.927	0.927	0.945	0.946
Adjusted R^2	0.914	0.914	0.918	0.919	0.932	0.932

Table A3: Capitalization of school spending and deductibility benefits - log-log specification

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta} log(Exp_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND} log(Exp_j) + \delta^{D}(log(Exp_j) \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* $log(Exp_j)$ *is the log of total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts educational score. Standard errors, presented in parentheses, are clustered at the CBSA level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.645*	−0.368	0.657**	−0.057	0.650**	−0.296
	(0.361)	(0.544)	(0.327)	(0.509)	(0.292)	(0.525)
log[Expenses per pupil] ($\bar{\delta}$)	0.013		−0.006		0.030*	
	(0.024)		(0.016)		(0.016)	
log[Expenses per pupil] (δ^{ND})		−0.077**		−0.068		−0.053
		(0.039)		(0.045)		(0.049)
log[Expenses per pupil] x DedShare (δ^{D})		0.349***		0.244		0.325*
		(0.121)		(0.190)		(0.181)
Demographics	X	X	X	X	X	X
Spatial fixed effects	CBSA	CBSA	+ State	+ State	County	County
Observations	8,890	8,890	8,890	8,890	8,890	8,890
R^2	0.923	0.923	0.927	0.927	0.945	0.946
Adjusted R^2	0.914	0.914	0.918	0.918	0.931	0.932

Table A4: Computing the change of capitalization from house level transaction data – California

This table reports the estimates of the regression $log(V_{i,j,t,b}) = \alpha_b + \alpha_t + \delta^{pre} SchoolTest_j + \delta^{change}(SchoolTest_j \times Post_t) + X_i'\beta + Z_{j,t}'\gamma + \epsilon_{i,j,t,b}$. $V_{i,j,t,b}$ *is the transaction price of house* i*, located in school district* j*, adjacent to border* b*, and transacted in month* t. α_b *and month* α_t *are spatial and time fixed effects,* $Post_t$ *equals one for 2019 transactions,* X_i *are housing characteristics, and* $Z_{j,t}$ *are demographic information. The sample comprises residential transactions in California in 2017 and 2019. Standard errors, presented in parentheses, are clustered at the county fixed effects level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable:			
	log(Sale.Price)			
	(1)	(2)	(3)	(4)
log(Lot.size)	0.02	0.04***	0.04***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)
log(Sq.footage)	0.81***	0.69***	0.65***	0.65***
	(0.04)	(0.02)	(0.01)	(0.01)
Building_age	−0.001	−0.004***	−0.005***	−0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Building_age_sq	0.0000***	0.0000***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Condo	−0.01	−0.24***	−0.27***	−0.27***
	(0.04)	(0.05)	(0.05)	(0.04)
Cash	−0.03	−0.06***	−0.06***	−0.06***
	(0.02)	(0.01)	(0.01)	(0.01)
Minority.share				0.003
				(0.04)
Bachelor.share				0.20***
				(0.06)
Income_median				0.001***
				(0.0004)
Test.score (δ^{pre})	0.47***	0.29***	0.25***	0.15***
	(0.04)	(0.02)	(0.03)	(0.03)
Test.score x Post (δ^{change})	−0.08***	−0.09***	−0.07***	−0.08***
	(0.02)	(0.02)	(0.02)	(0.02)
Month fixed effects	X	X	X	X
Spatial fixed effects	County	Border	Border	Border
Bandwidth around borders			1 mile	1 mile
Observations	1,433,014	1,433,014	692,597	692,345
R^2	0.71	0.82	0.85	0.85
Adjusted R^2	0.71	0.82	0.85	0.85

Table A5: The effects of local taxation reliance on the capitalization of local public goods

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^D(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* Exp_j *is the total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts educational score. Columns (1) show the baseline analysis, and columns (2) and (3) show the coefficients for school districts with high and low level of dependency on local property taxes (above/below median). Standard errors, presented in parentheses, are clustered at the CBSA fixed effects level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)					
	all		High reliance		Low reliance	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.656*	0.589	0.055	−0.024	1.260***	1.269***
	(0.359)	(0.383)	(0.378)	(0.399)	(0.316)	(0.314)
Expenses per pupil ($\bar{\delta}$)	0.011		0.018		−0.014**	
	(0.010)		(0.015)		(0.007)	
Expenses per pupil (δ^{ND})		−0.027***		−0.030**		−0.003
		(0.010)		(0.015)		(0.018)
Expenses per pupil x DedShare (δ^D)		0.147***		0.164***		−0.060
		(0.032)		(0.033)		(0.088)
Demographics	X	X	X	X	X	X
CBSA fixed effects	X	X	X	X	X	X
Observations	8,890	8,890	4,445	4,445	4,445	4,445
R^2	0.923	0.923	0.929	0.930	0.914	0.914
Adjusted R^2	0.914	0.914	0.919	0.920	0.894	0.894

Table A6: The effects of residents' federal tax rate on the capitalization of local public goods

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* Exp_j *is the total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts educational score. Columns (1) show the baseline analysis, and columns (2) and (3) show the coefficients for school districts with high and low residents' mean federal tax rate on income (above/below median). Standard errors, presented in parentheses, are clustered at the CBSA fixed effects level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)					
	all		High tax rate		Low tax rate	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.656*	0.589	−0.506	−0.559	1.649***	1.687***
	(0.359)	(0.383)	(0.353)	(0.363)	(0.340)	(0.332)
Expenses per pupil ($\bar{\delta}$)	0.011		0.031**		−0.005	
	(0.010)		(0.015)		(0.005)	
Expenses per pupil (δ^{ND})		−0.027***		−0.006		0.014
		(0.010)		(0.023)		(0.016)
Expenses per pupil x DedShare (δ^{D})		0.147***		0.112**		−0.106
		(0.032)		(0.045)		(0.083)
Demographics	X	X	X	X	X	X
CBSA fixed effects	X	X	X	X	X	X
Observations	8,890	8,890	4,445	4,445	4,445	4,445
R^2	0.923	0.923	0.930	0.930	0.872	0.872
Adjusted R^2	0.914	0.914	0.918	0.918	0.843	0.843

Table A7: The effects of private school availability on the capitalization of local public goods

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^D(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* Exp_j *is the total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts educational score. Columns (1) show the baseline analysis, and columns (2) and (3) show the coefficients for school districts with high and low level of public enrollment (above/below median). Standard errors, presented in parentheses, are clustered at the CBSA fixed effects level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)					
	all		High penetration		Low penetration	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.982***	0.939***	1.420***	1.382***	0.502	0.492
	(0.301)	(0.323)	(0.323)	(0.345)	(0.330)	(0.336)
Expenses per pupil ($\bar{\delta}$)	0.001		0.010		−0.009	
	(0.008)		(0.013)		(0.008)	
Expenses per pupil (δ^{ND})		−0.030***		−0.035***		−0.014
		(0.011)		(0.012)		(0.017)
Expenses per pupil x DedShare (δ^D)		0.142***		0.212***		0.024
		(0.053)		(0.073)		(0.055)
Demographics	X	X	X	X	X	X
CBSA fixed effects	X	X	X	X	X	X
Observations	7,358	7,358	3,679	3,679	3,679	3,679
R^2	0.921	0.922	0.930	0.931	0.929	0.929
Adjusted R^2	0.910	0.910	0.911	0.912	0.909	0.909

Table A8: The effects of land supply availability on the capitalization of local public goods

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* Exp_j *is the total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts educational score. Columns (1) show the baseline analysis, and columns (2) and (3) show the coefficients for school districts with high and low level of land availability (above/below median). Standard errors, presented in parentheses, are clustered at the CBSA fixed effects level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)					
	all		High developed		Low developed	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.651*	0.589	−0.500	−0.529	2.140***	2.132***
	(0.368)	(0.390)	(0.469)	(0.470)	(0.223)	(0.224)
Expenses per pupil ($\bar{\delta}$)	0.012		0.041***		−0.0001	
	(0.010)		(0.015)		(0.004)	
Expenses per pupil (δ^{ND})		−0.025**		0.015		−0.007
		(0.011)		(0.039)		(0.011)
Expenses per pupil x DedShare (δ^{D})		0.142***		0.075		0.037
		(0.033)		(0.083)		(0.048)
Demographics	X	X	X	X	X	X
CBSA fixed effects	X	X	X	X	X	X
Observations	8,732	8,732	4,366	4,366	4,366	4,366
R^2	0.923	0.924	0.932	0.932	0.920	0.920
Adjusted R^2	0.915	0.915	0.920	0.921	0.901	0.901

Table A9: The effects of commercial properties taxation on the capitalization of local public goods

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* Exp_j *is the total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts educational score. Columns (1) show the baseline analysis, and columns (2) and (3) show the coefficients for school districts with high and low level of highly developed land (above/below median). Standard errors, presented in parentheses, are clustered at the CBSA fixed effects level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(house value)					
	all		High commercial		Low commercial	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.651*	0.589	0.088	0.037	1.579***	1.542***
	(0.368)	(0.390)	(0.406)	(0.425)	(0.278)	(0.286)
Expenses per pupil ($\bar{\delta}$)	0.012		0.035**		0.003	
	(0.010)		(0.016)		(0.005)	
Expenses per pupil (δ^{ND})		−0.025**		−0.004		−0.018*
		(0.011)		(0.031)		(0.010)
Expenses per pupil x DedShare (δ^{D})		0.142***		0.120*		0.097***
		(0.033)		(0.072)		(0.034)
Demographics	X	X	X	X	X	X
CBSA fixed effects	X	X	X	X	X	X
Observations	8,732	8,732	4,366	4,366	4,366	4,366
R^2	0.923	0.924	0.931	0.932	0.932	0.932
Adjusted R^2	0.915	0.915	0.918	0.918	0.915	0.916

Table A10: The effects of state finance reforms on the capitalization of local public goods

This table reports the estimates of the paired regressions $log(V_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X'_j\beta + \epsilon_j$ *and* $log(V_j) = \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X'_j\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $DedShare_j$ *is the share of taxpayers deducting property taxes on their federal taxable income in 2017 computed from the SOI.* Exp_j *is the total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share, education achievements, homeownership rate, the share of minority, the share of people less than 19 years old, the share of people of 65 years old or more, and a measure of school districts educational score. Columns (1) show the baseline analysis, and columns (2) and (3) show the coefficients for school districts within states that passed or did not pass a school equalization reform, respectively. Standard errors, presented in parentheses, are clustered at the CBSA fixed effects level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable: log(value)					
	all		reformed		Not-reformed	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.656*	0.589	0.117	0.047	1.618***	1.581***
	(0.359)	(0.383)	(0.416)	(0.441)	(0.234)	(0.236)
Expenses per pupil ($\bar{\delta}$)	0.011		0.018		−0.006	
	(0.010)		(0.013)		(0.009)	
Expenses per pupil (δ^{ND})		−0.027***		−0.020*		−0.038**
		(0.010)		(0.011)		(0.017)
Expenses per pupil x DedShare (δ^{D})		0.147***		0.140***		0.142**
		(0.032)		(0.034)		(0.063)
Demographics	X	X	X	X	X	X
CBSA fixed effects	X	X	X	X	X	X
Observations	8,890	8,890	5,896	5,896	2,994	2,994
R^2	0.923	0.923	0.928	0.929	0.907	0.908
Adjusted R^2	0.914	0.914	0.921	0.922	0.890	0.891

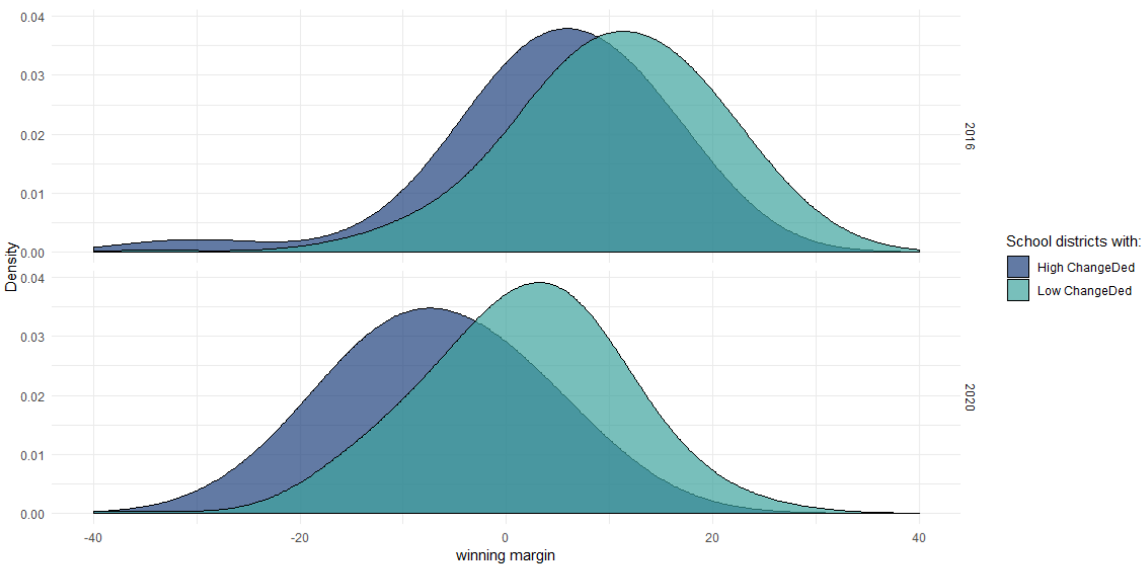
B Supporting material for referendum study section

In this section, we provide additional material to support the motivating results of Section 1. Specifically, we describe the data, the methodology and the robustness analyses. The results support the conclusion that residents tax deductions subsidy increases their demand for local public goods.

B.1 Summary statistics.

The data consists of 1,548 referendums occurring from 2018 to 2020 in Californian school districts. The dependent variable is the referendum approval rate defined as the ratio of *Yes* votes over the number of votes total ($WinningMargin_{j,t}$). As various referendums require different thresholds to be approved, we subtract the passing threshold from the share of *Yes* votes to facilitate comparison across referendums. We construct the explanatory variable of interest, $ChangeDed_j = DedShare_{j,2017} - DedShare_{j,2018}$, to capture the extent to which residents of a school district were impacted by the TCJA changes to the standard deduction and property tax deduction limits. Figure B1 shows the distribution of winning margins in 2016 and 2020 for school districts that score high and low on $ChangeDed_j$ (above or below the median of 13.9%). Table B1 reports the summary statistics of the variables used in this study.

Figure B1: Distribution of school districts referendum results in 2016 and 2020



Note: These figures show the distribution of school districts referendum Winning margins for all referendums in 2016 (panel A) and 2020 (panel B). The dark blue distributions show the Winning margins for school districts with $ChangeDed_j > 0.18$ *(i.e. school districts that were impacted the most by the TCJA). The turquoise distribution shows the school districts with low* $ChangeDed_j$*.*

Table B1: Summary statistics of referendum study

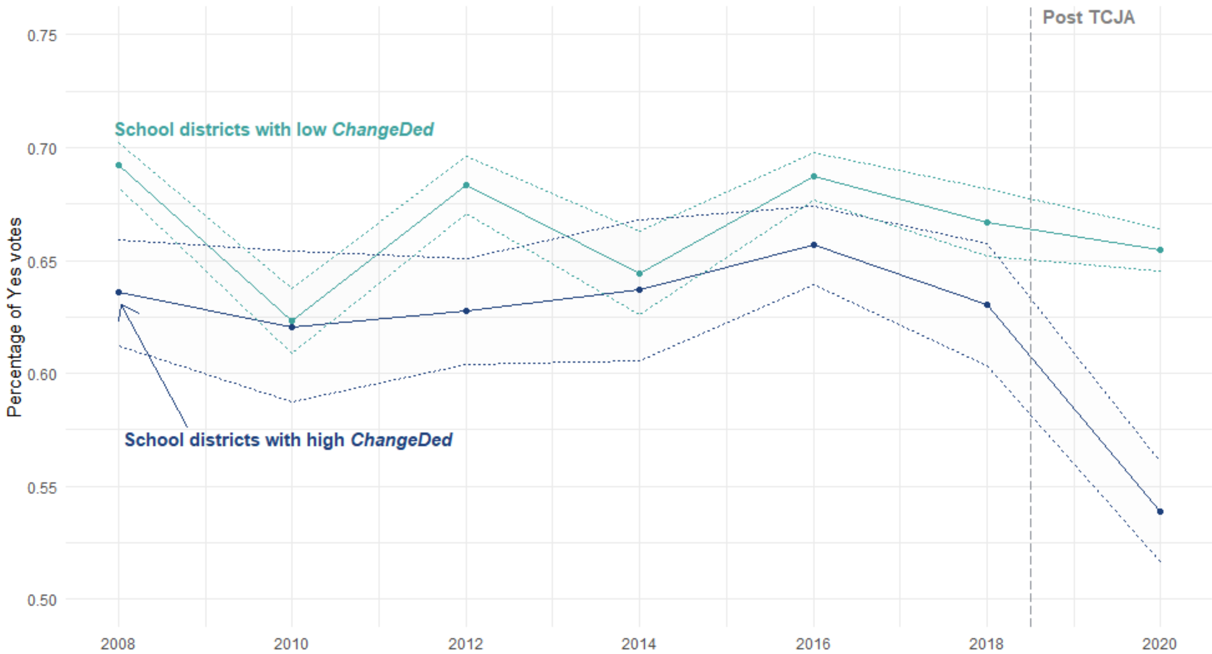
This table reports the summary statistics of the variables used in the referendum study. All California school districts referendums results from 2008 to 2020 are matched with data from the IRS Statistics of Income and with the ACS demographics data. WinningMargin is the share of Yes votes minus the threshold for the referendum to be approved, ChangeDed is the change in the share of property tax deducters, Post is an indicator for elections occurring after 2019 inclusive, Presidential election is an indicator for referendums occurring on a U.S. presidential election day, odd year election is an indicator for referendums occurring on odd years, Bond amount is the proposed bond amount on the referendum for bond referendums, Parcel levy is the the dollar amount of proposed increase in parcel levy tax, Recently defeated is an indicator that equals one if the preceding referendum within the same school districts was defeated, Voters' turnout is the number of cast votes over the population over 18 years of age, SALT change per house is the change in SALT deduction between 2017 and 2018 standardized by the number of housing units, Change in SALT is the percentage change in SALT deduction between 2017 and 2018, Wasted SALT per house is the dollar amount per housing unit of SALT deduction not claimed because of the 10,000$ cap introduced with the TCJA, and Share of SALT wasted is the ratio of the wasted SALT deduction over the total SALT deduction claimed.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Winning Margin (%)	1,548	5.38	11.13	−55.00	0.00	6.46	12.37	45.00
ChangeDed (%)	1,547	13.46	3.72	2.70	11.06	13.30	15.99	25.37
Post indicator	1,548	0.16	0.37	0	0	0	0	1
Presidential election	1,548	0.33	0.47	0	0	0	1	1
Odd year election	1,548	0.10	0.31	0	0	0	0	1
Bond amount (Million $)	1,170	96.82	318.92	0.05	12.00	35.00	98.00	7,000.00
Bond amt per housing unit (0.001 $)	1,159	6.48	34.44	0.004	2.09	3.45	5.69	978.26
Parcel levy ($)	306	177.16	236.47	2.20	76.50	99.00	189.00	2,763.00
Recently defeated indicator	1,548	0.14	0.34	0	0	0	0	1
Voters' turnout (%)	1,525	36.58	20.34	0.002	21.91	36.22	49.42	100.00
SALT change per house (000's $)	1,524	7.75	12.52	0.03	1.58	3.53	8.24	220.60
Change in SALT (%)	1,547	0.76	0.09	0.55	0.70	0.75	0.80	0.96
Wasted SALT per house (000's $)	1,524	4.34	8.38	0.00	0.40	1.40	4.16	122.71
Share of SALT wasted (%)	1,547	0.53	0.19	0.00	0.39	0.50	0.67	0.95

B.2 Parallel trend assumption.

Because Biasi et al. (2021) find that over the last 20 years there was a decrease in capital expenditure for public schools more pronounced in high-income school districts, a pre-trend could explain our results. Figure B2 shows the parallel share of *Yes* votes share through time for school districts that score high or low on $ChangeDed_j$ (below or above the median). In addition, we run placebo tests using different years for *Post* that are shown in Table B2.

Figure B2: Percentage of *Yes* votes on school district referendums



Note: These line graphs show the aggregated percentage of Yes votes on school district referendums in California. The dark blue line show the results for school districts with high DedShare, greater than the mean of 14%, while those with low DedShare, in turquoise, show the results for all other school districts. The shaded area represents the 95% confidence interval.

Table B2: Testing for parallel trends in approval rates of referendums

*This table reports the estimates γ of the regression $WinningMargin_{j,t} = \alpha_j + \alpha_t + \gamma(ChangeDed_j \times Post_t) + X'_{j,t}\beta + \epsilon_{j,t}$. $Post_t = 1$ for elections occurring after year t, indicating in the column names. The sample comprises all California school districts referendum results from 2008 to 2018 with winning margins within 25 percentage points of the passing threshold. $WinningMargin_{j,t}$ is the share of Yes votes minus the threshold for the referendum to be approved, α_j are school district fixed effects, α_t are election fixed effects, $ChangeDed_j$ is the change between the ratio of property tax deducters before and after the TCJA, and $X_{j,t}$ are additional control. Standard errors, presented in parentheses, are clustered at the school district level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable:									
	Winning Margin									
Post =	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post x $ChangeDed$ (γ)	−25.41	−21.25	−19.20	−26.24	−19.41	−12.79	−14.31	−16.91	13.61	8.57
	(35.38)	(30.88)	(21.35)	(18.22)	(16.14)	(16.53)	(19.55)	(19.57)	(27.98)	(29.14)
School district fixed effects	X	X	X	X	X	X	X	X	X	X
Election fixed effects	X	X	X	X	X	X	X	X	X	X
Additional controls	X	X	X	X	X	X	X	X	X	X
Tight election results	X	X	X	X	X	X	X	X	X	X
Observations	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243
R^2	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Adjusted R^2	0.43	0.43	0.43	0.44	0.43	0.43	0.43	0.43	0.43	0.43

B.3 Local governments' margins of adjustment.

The decrease in the willingness to vote in favor of school district referendums may be caused by a change in the number or nature of the referendums proposed. To rule out this explanation, and also to document other potential margin of adjustment of local governments, we estimate our main empirical specification (equation [1]) with alternative dependent variables. The results are shown in Table B3. In column (1), we consider whether a school district held a referendum in year t in a Logit regression model, in column (2) we use the number of referendums proposed each year estimated with Poisson model. Next, we consider the value of the proposed bond standardized by the number of housing units (column [3]), and the proposed parcel levy amount (column [4]). Note that there is not enough property tax referendums in the Post period to perform similar tests with the proposed property tax increase. In column (5), we verify whether voters' turnout has been impacted by the change in deducters share.

Table B3: Loss of deductibility benefits and local governments' margin of adjustment

*This table reports the estimates γ of the regression $Y_{j,t} = \alpha_j + \alpha_t + \gamma(ChangeDed_j \times Post_t) + \epsilon_{j,t}$. The sample comprises all California school districts referendums results from 2008 to 2020. $Y_{j,t}$ is an indicator that equals one if a school district held a referendum in a given year (column [1]), the number of yearly referendums (column [2]), the bond amount (column [3]), the parcel levy amount (column [4]), and the voters' turnout (column [5]). α_j is a school district fixed effect, α_t is an election fixed effects, and $ChangeDed_j$ is the change between the ratio of property tax deducters before and after the TCJA. Standard errors in columns (3-5), presented in parentheses, are clustered at the school district level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable:				
	Referendum on ballot	Number of referendums	Bond amount per house ($)	Parcel levy amount ($000's)	Voters' Turnout
	Logit	*Poisson*		*OLS*	
	(1)	(2)	(3)	(4)	(5)
Post x $ChangeDed$ (γ)	1.37	0.506	-0.05^{*}	-6.09	0.38
	(6.36)	(1.861)	(0.03)	(8.98)	(0.29)
School district FE	X	X	X	X	X
Time FE	Year	Year	Election	Election	Election
Observations	12,779	12,779	1,158	296	1,524
Log Likelihood	-656.96	$-3,554.323$			
R^2			0.85	0.69	0.79
Adjusted R^2			0.66	0.32	0.63

B.4 Intensive margin effects.

After the TCJA, many taxpayers stopped itemizing their deductions. Additionally, for the residents who keep itemizing, the TCJA imposed a cap of $10,000 on SALT deductions. Hence, in addition to the extensive margin effect that we document, there might be an intensive margin effect. We include a triple interaction to test whether the intensive loss of the deductibility subsidy further reduces referendum approval rates:

$$
\begin{aligned}
WinningMargin_{j,t} \quad = \quad & \alpha_j + \alpha_t + X'_{j,t}\beta + \gamma^{ex}(ChangeDed_j \times Post_t) \\
& + \gamma^{in}(ChangeDed_j \times LossDed_j \times Post_t) + \epsilon_{j,t}
\end{aligned} \tag{B.1}
$$

We report the results in Table B4 using four different measures for $LossDed_j$. Following Li and Yu (2022), we focus on the change in SALT deductions amount between 2017 and 2018 standardized by the number of houses in the school district, the percentage change of SALT deductions between 2017 and 2018, the sum of the SALT deductions that is wasted due to the cap (standardized by the number of houses), and the ratio of wasted SALT deductions on the total SALT deductions that could have been deducted.

Table B4: Does the cap on SALT deductions magnify the decrease in approval rates?

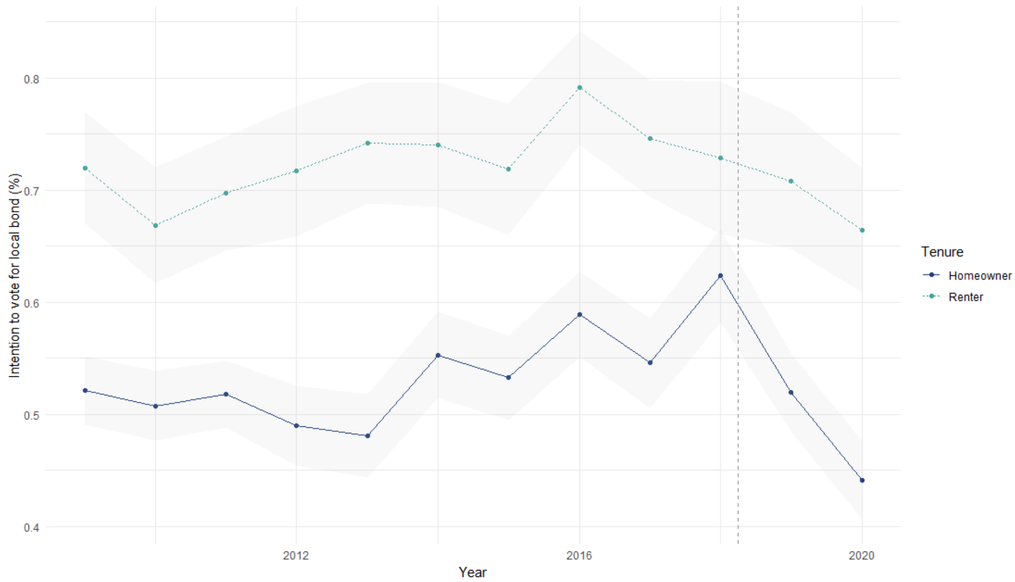
This table reports the estimates of the regression $WinningMargin_{j,t} = \alpha_j + \alpha_t + \gamma^{ex}(ChangeDed_j \times Post_t) + \gamma^{in}(ChangeDed_j \times LossDed_j \times Post_t) + X'_{j,t}\beta + \epsilon_{j,t}$. *The sample comprises all California school districts referendum results from 2008 to 2020 with winning margins within 25 percentage points of the passing threshold.* $WinningMargin_{j,t}$ *is the share of Yes votes minus the threshold for the referendum to be approved,* α_j *are school district fixed effects,* α_t *are election fixed effects,* $Post_t = 1$ *for elections occurring after 2019 inclusive,* $ChangeDed_j$ *is the change between the ratio of property tax deducters before and after the TCJA, and* $X_{j,t}$ *are additional controls.* $LossDed_j$ *are different measures aim at capturing the intensive loss of deductibility benefits due to the cap on State and Local Taxes (SALT) deductions. Column (1) uses the change in SALT deduction between 2017 and 2018 standardized by the number of houses in the school district, column (2) uses the percentage change in SALT deduction between 2017 and 2018, column (3) uses the dollar amount per house of wasted SALT deduction, and column (4) uses the ratio of the wasted SALT deduction over the total SALT deduction claimed. Standard errors, presented in parentheses, are clustered at the school district level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% level, respectively.*

	Dependent variable:			
	Winning Margin (%)			
	(1)	(2)	(3)	(4)
Post x $ChangeDed$ (γ^{ex})	-41.36^{*}	-61.23	-44.62^{**}	-55.49^{**}
	(22.65)	(55.25)	(22.38)	(26.67)
.. x SALT change per house (γ^{in})	-0.46^{*}			
	(0.27)			
.. x Change in SALT (γ^{in})		13.21		
		(69.28)		
.. x Wasted SALT per house (γ^{in})			-0.56	
			(0.40)	
.. x Share of SALT wasted (γ^{in})				7.67
				(30.73)
Controls	X	X	X	X
School district fixed effects	X	X	X	X
Election fixed effects	X	X	X	X
Tight election results	X	X	X	X
Observations	1,476	1,476	1,476	1,476
R^2	0.71	0.71	0.71	0.71
Adjusted R^2	0.47	0.47	0.47	0.47

B.5 Covid-19 outbreak and willingness to spend locally.

The identification relies mostly on post-TCJA referendums that took place in 2020 as most referendums occur in even years. Thus, the results may be driven by reluctance to increase local public spending because of the uncertainty related to the Covid-19 pandemic. To rule out this potential explanation, we collected answers to the Public Policy Institute of California (PPIC) Statewide Survey that ask respondents about their intention to vote in favor of a school bond referendum (Brunner and Sonstelie, 2003). The PPIC conducts surveys of 1,500 representative California residents every April since 2007.[22] This survey is valuable because it includes respondents from all parts of California and therefore does not restrict the analysis to residents of school districts that have had a referendum. Figure B3 shows that the stated support for local bonds for homeowners and renters' respondents.

Figure B3: Intention to vote in favor of school bond referendums - survey data



Note: This line graphs shows the percentage of respondents who stated that they would vote in favor of a school bond referendum should there were one in their respective school districts. The data is compiled from the annual PPIC Statewide Survey. The data is split between homeowners and renters respondents. The grey area shows the 95% confidence interval.

[22]PPIC bears no responsibility for the interpretations presented or conclusions reached based on analysis of the data.