Federal Tax Policy and the Capitalization of Local Public Goods*

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Abstract

In the United States, taxes paid to local jurisdictions can be deducted from federal taxable incomes. We develop a theoretical model of local public goods capitalization that accounts for the deductibility of property taxes and test its predictions using cross-sectional and temporal variations in deductions and school district spending. We find empirical support that a higher share of residents deducting property taxes relates to a greater capitalization of local public spending. Our results thus emphasize the importance of the interaction between local and national policies when evaluating the optimal level of local public good provisions.

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Since Ricardo (1815)'s fervent opposition to the Corn Laws, the capitalization of public policies in land value has been the concern of many economists. Quantifying capitalization effects —or the change in land prices to a change in local economic factor— is essential because it allows for estimating the value residents place in nonmarket amenities and in turn for evaluating public policies (Black, 1999; Rossi-Hansberg et al., 2010; Brueckner and Singh, 2020; Albouy et al., 2020). The intensity of housing capitalization is also substantive because it influences households' choices such as voting (Fischel, 2002; Ahlfeldt and Maennig, 2015), investment in housing stocks and neighborhoods (Autor et al., 2014; Hornbeck and Keniston, 2017), and opposition to real estate development (Diamond and McQuade, 2019; Asquith et al., 2023).[1] Although these capitalization effects are *local*, we provide evidence that *national* tax policies may amplify them and thus change the positive conclusions about various policies.

To study the interaction between national tax policies and the capitalization of local public goods, we exploit an implicit fiscal transfer from the federal to local governments of the United States (U.S.). The federal tax system indirectly subsidizes local governments by allowing taxpayers to deduct from their taxable incomes all taxes paid to lower-level governments. In doing so, it effectively reduces the costs associated with local public goods for those taxpayers who deduct their state and local taxes (SALT). Using local variation in the share of taxpayers benefiting from these deductions, this study provides evidence that residents who take advantage of the deduction value local public goods more than they would absent such fiscal subsidy. Thus, the results provide insights into how national fiscal policies can exacerbate capitalization and thus household sorting.

To establish empirical predictions on the interaction between national and local tax policies, we first develop a theoretical framework of local public goods capitalization drawing on models of Brueckner (1979, 1982, 1983), Cellini et al. (2010), and Lang (2018). In the model, a jurisdiction becomes more attractive if the benefits of addi-

[1]See Hilber (2017) for a comprehensive review of the implications of house price capitalization.

tional public spending outweigh the consumption forgone by the increase in property tax payments. Because both public spending and taxes are capitalized in house prices, our model implies that local governments should spend to reach the point where the marginal increase has zero effect on housing prices. By contrast, under-provision (over-provision) of local public goods may occur if housing values increase (decrease) with a marginal increase in local spending. The innovative feature of our model is the introduction of the property tax deduction, which amplifies the capitalization of public spending in jurisdictions where residents take advantage of this fiscal subsidy. We specifically show that regardless of the level of local public goods, the capitalization of public spending is greater in jurisdictions with a higher share of households who deduct their local taxes, implying a different efficient provision of local public goods.

We then present three empirical tests of this prediction that exploit different variations in the data to overcome issues associated with identification and endogeneity. The first test relies on cross-sectional variation in school district educational spending for the school year 2016-2017. With data on income taxes, housing prices, school district budgets, test scores, and demographics, we show that a marginal increase in local public spending is, on average, not related to a change in house prices. However, we show that the marginal change in house prices to a marginal change of school spending 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. And, we find that 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 school spending corresponds to a 2.7% decrease in house values in school districts where no resident deducts property taxes but with a 0.7% increase in property values in districts where 25% of the residents take advantage of the property tax deduction. Hence, the traditional capitalization model, which omits federal tax deductions, fails to capture the heterogeneity created by the deductibility of local 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.

Our second test of the model's predictions exploits the exogenous shock to the share of residents benefiting from the SALT deductions caused by the 2018 Tax Cuts and Jobs Act (TCJA). The combination of provisions in the TCJA, including the doubling of the standard deduction and the cap on SALT, resulted in a drop of taxpayers who deducted SALT by 61%. To leverage this shock in testing our main prediction, we construct a 2-year school district panel dataset spanning the period surrounding the TCJA and compute the change in capitalization of school test scores pre- and post-TCJA. Consistent with the cross-sectional results, this panel data analysis shows that as the share of residents deducting property taxes declines, the capitalized value of school test scores also declines.

In our last test, we triangulate the empirical findings using an alternative dataset comprising housing transactions in 2017 and 2019. To achieve identification, we exploit temporal variation in the share of taxpayers benefiting from the property tax deductions (pre- and post-TCJA), and spatial variation in school test scores by using housing transactions along school district borders. The results of this analysis confirm that, in states with the highest share of residents who stopped deducting property taxes, the value residents placed in better schools declined.

As a final exercise to validate our empirical approach, we examine possible channels that could either magnify or dampen the capitalization effect. We show that the capitalization of school spending in jurisdictions with a high share of property tax deducters is amplified 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.

Our paper contributes to the large literature on the housing capitalization of local public goods and taxes. Many studies confirm the conjecture of Oates (1969) demonstrating the capitalization of school quality (Black, 1999; Bayer et al., 2007;

Lafortune and Schönholzer, 2022), infrastructure investments (Baum-Snow and Kahn, 2000; Haughwout, 2002; Gupta et al., 2022), environmental (dis)amenities (Bento et al., 2015; Bernstein et al., 2019; Amini et al., 2022), and local taxes (Bradbury et al., 2001; Brülhart et al., 2021; Koster and Pinchbeck, 2022). We add to this literature by documenting the importance of considering the national fiscal policies when estimating the capitalization effects of local public goods.

Central to the capitalization literature is the framework developed in Brueckner (1979, 1982, 1983) on the efficient allocation of local public goods. Following his proposed capitalization test, 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, whereas Barrow and Rouse (2004), Cellini et al. (2010), and Lang (2018) show they are under provided. In contrast, Brueckner (1982), Bradbury et al. (2001), and Bayer et al. (2020b) find no evidence of under or over provision. Our model and empirical results, which account for the deductibility of local taxes, can provide a mechanism to reconcile these results.

Finally, our study relates to the literature on the incidence of fiscal deductions. Many theoretical and empirical papers have investigated the effects of mortgage interest deductions with evidence of housing capitalization (Hanson, 2012; Hilber and Turner, 2014) and negative effects on homeownership and welfare (Sommer and Sullivan, 2018; Blouri et al., 2023; Valentin, 2023). Likewise, numerous studies document the effects of allowing for the deductions of charitable and political contributions (Reece and Zieschang, 1985; Auten et al., 2002; Fack and Landais, 2010; Almunia et al., 2020; Cage and Guillot, 2023).

In contrast, little is known about the consequences of the SALT deductions. Older papers on the subject established that the SALT deductions incentivize jurisdictions to change their revenue share in favor of deductible taxes (Feldstein and Metcalf, 1987) and to increase tax rates on those taxes (Holtz-Eakin and Rosen, 1990). More recently, using local referendum results, Ambrose and Valentin (2024) show that residents are less willing to fund local public goods after a reduction in SALT deduction subsidy. On a macro level, Albouy (2009), which builds on the Rosen (1979) and Roback (1982) spatial model, shows that the SALT deductions reduce the spatial inefficiency embedded in the current federal income tax system. We add to this literature by showing that residents value these fiscal benefits through higher capitalization.

As the sunset of the TCJA approaches, the findings are also important for evaluating the SALT deduction policy. Because our results indicate that residents consider this subsidy in their housing purchases, wealthier communities, which benefit more from the SALT subsidy, have greater house prices than they would absent such subsidy. This higher capitalization not only encourages local governments to provide additional public goods but also raises the incentive for households to sort based on income thereby creating more stratified communities. In light of this evidence, omitting federal tax deductions in standard evaluations of the capitalization of local public goods can be misleading in understanding households' voting and sorting behaviors.

1 Theoretical framework

In this section, we present a stylized theoretical model that depicts the connection between federal tax deductions and the capitalization of local public goods, focusing on local public goods financed by property taxes.[2] 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_j), housing consumption (h_{ij}), and consumption of a numeraire good (c_i) such that $u_{ij} = U_i(g_j, h_{ij}, c_i)$ is quasi-concave, where i denotes a resident located in jurisdiction j. All residents in j consume the same level of non-congestible public goods g_j, and housing

[2]We do not intend to propose a model for evaluating the SALT deductions policy from a welfare standpoint. Consequently, our analysis does not encompass several factors that would typically aid in such evaluations, such as a federal balanced budget, public goods spillovers, or the precise SALT deductions schedule. We rather aim to demonstrate how a federal policy that subsidizes local taxes leads to distinct conclusions regarding the capitalization of local public goods.

service is a function of exogenous housing characteristics X_i and jurisdiction attributes Z_j such that $h_{ij} = h(X_i, Z_j)$. Residents are fully mobile and have the same preference for local public goods so that those with the same disposable income w achieve the same utility level. Writing the indirect utility as $V_i(g_j, h_{ij}, w_i - r_{ij})$, the implicit function theorem implies that household bid for housing services $r_{ij} = r(g_j, h_{ij}; w_i)$, or rent, adjust to ensure that residents are indifferent between houses that differ in housing service quality and in local public goods.

Local governments collect ad-valorem property taxes at rate τ_j to finance public goods.[3] Because the property tax rate is applied to both land and improvements at market value (Glaeser, 2013), housing rent r_{ij} and net of deductions property tax payments are capitalized into resident *i*'s house value:

$$\begin{aligned} p_{ij} &= \frac{1}{\theta}\Big(r(g_j, h_i) - \tau_j p_{ij} + \mathbb{I}_{ij}(\tau_j \; p_{ij} \; T_{ij})\Big) \\ &= \frac{r(g_j, h_i)}{\theta + \tau_j - \mathbb{I}_{ij}\tau_j T_{ij}} \end{aligned} \tag{1}$$

where θ is the discount rate, T_{ij} is the tax rate on federal income, and $\mathbb{I}_{ij}$ 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 jurisdiction *j* comprises *n* houses, the aggregate housing value $P_j = \sum_{i=1}^{n} p_{ij}$ serves as the jurisdiction's tax base. Because local governments must balance their budgets (Glaeser, 2013), local government's *j* budget constraint is $P_j \; \tau_j = C(g_j)$, where $C(g_j)$, the cost for providing g_j, is assumed to be convex.

To conceptualize the impact of federal property tax deductions, we consider two extreme cases. First, we consider the case where no residents deduct property taxes from their taxable income $(\sum_i \mathbb{I}_{ij} = 0)$ and denote the tax base for a jurisdiction with no deducters as P_j^{ND}. Combining the budget constraint with the price function of Equation (1), we can thus rewrite the aggregate housing value as a function

[3] Although we assume that local public goods are exclusively financed by ad-valorem residential property taxes, we relax this assumption and consider other funding sources including grant transfers from higher-level governments, and commercial property taxation in the empirical study.

of the cost of public goods ((g_j)), and the exogenous stock and quality of houses ($\mathcal{H}_j \equiv (h_{1j}, h_{2j}, ..., h_{nj})$):

$$P^{ND}(g_j, \mathcal{H}_j) = \frac{1}{\theta}\Bigg(\sum_{i=1}^{n} r(g_j, h_{ij}) - C(g_j)\Bigg). \tag{2}$$

Because both rent $r(g, h)$ and cost $C(g)$ increase with g, the net effect of an increase in public goods on housing value is ambiguous. We differentiate (2) with respect to the level of public goods to obtain the capitalization parameter:

$$\begin{aligned} \frac{\partial P^{ND}}{\partial g} &= \frac{1}{\theta}\left(\sum_{i=1}^{n} \frac{\partial r_i}{\partial g} - \frac{\partial C(g)}{\partial g}\right) \\ &= \frac{1}{\theta}\left(\sum_{i=1}^{n} \frac{u_g(g, h_i, w_i - r_i)}{u_c(g, h_i, w_i - r_i)} - \frac{\partial C(g)}{\partial g}\right) \end{aligned} \tag{3}$$

where $u_g(.)$ and $u_c(.)$ denote the marginal utility with respect to g and c, respectively. If $\frac{\partial P^{ND}}{\partial g} = 0$, 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 $\frac{P^{ND}}{\partial g} \neq 0$, the level of public goods provision is not efficiently provided.[4] Given the concavity of $r(g, h)$ and the convexity of $C(g)$ with respect to g, $P^{ND}(g, \mathcal{H})$ 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 1 illustrates this trade-off. For any level of g below g^*, public goods are under-provided ($\frac{\partial P^{ND}}{\partial g} > 0$) and values above g^* imply that public goods are over-provided ($\frac{\partial P^{ND}}{\partial g} < 0$).

We now consider the opposite case where all residents take advantage of the property tax deduction ($\sum_i \mathbb{I}_{ij} = 1$). Assuming that deducters have a constant tax rate on federal incomes within jurisdiction j at $T_{ij} = T_j \forall i \in j$, the tax base for a jurisdiction

[4]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.

where all residents deduct their property taxes (P^D) can be written as:

$$P^D(g_j, \mathcal{H}_j, T_j) \;=\; \frac{1}{\theta}\Bigg(\sum_{i=1}^{n} R(g_j, h_i) - C(g_j)(1 - T_j)\Bigg). \tag{4}$$

Equation (4) 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 which increases with the federal tax rates on incomes. As a result, the capitalization of public goods into aggregate house values when all residents deduct their property taxes is:

$$\frac{\partial P^D}{\partial g} \;=\; \frac{1}{\theta}\Bigg(\sum_{i=1}^{n} \frac{u_g(g, h_i, w_i - r_i)}{u_c(g, h_i, w_i - r_i)} - \frac{\partial C}{\partial g}(1 - T_j)\Bigg). \tag{5}$$

Thus, regardless of the level of public goods provision and as long as local governments finance a share of their budget through property taxation ($\tau_j > 0$), we note that $\frac{\partial P^D}{\partial g} > \frac{\partial P^{ND}}{\partial g}$ for the same level of g. Panel B of Figure 1 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, P^D lies above P^{ND} for all positive levels of public goods.

We now consider the general case of jurisdictions comprising a combination of residents who do and do not take advantage of the property tax deduction to develop a series of testable predictions. We assume that local jurisdictions comprise a combination of residents who deduct property taxes and others who use the standard deduction with the ratio $DedShare_j = \frac{1}{n}\sum_i \mathbb{I}_{ij}$. We can rewrite the aggregate housing value as a function of public goods (g_j), the exogenous stock and quality of houses ($\mathcal{H}_j$), and thus the share of residents benefiting from the tax deduction subsidy ($DedShare_j$):

$$P(g_j, \mathcal{H}_j, DedShare_j) \approx \frac{1}{\theta}\left[\sum_{i=1}^{n} r(g_j, h_i) - C(g_j) + DedShare_j C(g_j) T_j\right]. \tag{6}$$

Because $0 \leq DedShare_j \leq 1$, P_j from equation (6) lies within the curves of the extreme cases shown in panel B of Figure 1. Taking the partial derivative of (6) with respect to g leads to insights into whether local public goods are on average efficiently provided:

$$\frac{\partial P}{\partial g} \begin{cases} > 0 & \text{if g is under-provided} \\ = 0 & \text{if g is efficiently provided} \\ < 0 & \text{if g is over-provided} \end{cases} \tag{7}$$

Given the longstanding debate regarding whether local public goods are efficiently allocated (Tiebout, 1956; Samuelson, 1954; 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 is an empirical question in many applications.

Finally, Equation (6) unambiguously shows that the capitalization of local public goods increases with the share of property tax deducters as

$$\frac{\partial^2 P}{\partial g \, \partial DedShare} > 0. \tag{8}$$

In contrast to models that do not consider property tax deductions, our model predicts that a higher aggregate tax deduction subsidy corresponds to a higher capitalization parameter regardless of the efficiency conclusion drawn from the sign of $\frac{\partial P}{\partial g}$.[5] The following empirical analysis specifically tests this prediction: *In the presence of tax deducters, the capitalization of local public goods in house prices is systematically higher.*

2 Empirical framework

Our identification strategy relies on variations in housing values, public goods, and the share of property tax deducters. Due to the inherent correlations among these variables, establishing a definitive causal link is challenging in this context. There-

[5]Although variations in T_j might imply heterogeneity in capitalization too, we do not expect useful variations in any cross-sectional empirical applications because the tax rate schedule is determined uniformly at the federal level. We however use a proxy for $DedShare_j T_j$ in Table A3 to demonstrate the robustness of our main empirical specification.

fore, we rely on a preponderance of evidence using a variety of methods that leverage various data variations to support our conclusions. Specifically, we propose alternative econometric specifications that capture cross-sectional, temporal, or both types of variations to identify and test our main proposition.

Because the theoretical predictions are derived in a comparative statics framework, our main test relies on cross-sectional regression analysis 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). In Section 4, we however provide additional support for the main propositions of the theoretical model using temporal variation in the share of tax deducters.

2.1 Estimation

To test the theoretical model's predictions we use 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 (Calabrese et al., 2023). 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. In addition, the relation between residential choice and school quality is well-documented (Black, 1999; Barrow and Rouse, 2004; Bayer et al., 2007; Nguyen-Hoang and Yinger, 2011; Avery and Pathak, 2021; Lafortune and Schönholzer, 2022), which reinforces the link between local spending and housing values.

In the cross-sectional setting, we estimate the following regressions:

$$log(P_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j \quad (9)$$

and

$$
\begin{aligned}
log(P_j) &= \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^{D}(Exp_j \times DedShare_j) \\
&\quad + \phi DedShare_j + X_j'\beta + \epsilon_j
\end{aligned} \tag{10}
$$

where P_j is the house price 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.). Because school test score affects the willingness to pay for rent, we include school district average test scores in X_j, which also alleviates concerns regarding the use of input versus output level variables when discussing residents' preferences for schools (Bradford et al., 1969; Downes and Zabel, 2002; Turnbull and Zheng, 2019). Thus, all the results are conditional on school district pupils' performance.[6]

We estimate equations (9) and (10) in parallel to specifically show the amplifying capitalization effect when we introduce the share of residents who deduct their property taxes. We include $DedShare_j$ in both regressions to not only better compare estimates across specifications but also because it might correlate with other housing deductions such as the mortgage interest deductions. Thus, we expect ϕ to be positive because these housing deductions are capitalized into housing prices (Poterba et al., 1991). Despite controlling for income, homeownership rate, and other demographic characteristics that highly influence the level of *DedShare*, we note that 16.7% of variation in *DedShare* survive with these controls. This remaining variation in *DedShare* is thus the source of identifying variation for δ^D. Figure 1 intuitively shows the empirical strategy where each point depicts a jurisdiction for which we observe its house value and current level of public goods. Panel A shows the hypothetical best linear fit when no heterogeneity with respect to the share of property tax deducters is included as in

[6]The full list of controls includes median income quartile fixed effects, income distribution share from SOI, the share of residents with at least a College degree, homeownership rate, the share of minority residents, the share of people less than 19 years old, the share of people of 65 years old or more, and school districts mean test score.

Equation (9). Panel B shows the hypothetical linear best fits in the case of two groups of jurisdictions with heterogeneous shares of deducters.

In equation (9), $\bar{\delta}$ is the average capitalization parameter and its sign provides information about the average efficiency of public goods provision (Brueckner, 1979). In equation (10), 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.

2.2 Data

We collected housing statistics from Zillow's home value index (ZHVI) for January 2017 and January 2020 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.[7] 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 the full years 2017 and 2019.

We use the SOI of the IRS to construct the share of residents who deduct property taxes from their taxable income. The SOI aggregates information from the individual tax forms 1040 for each zip code with more than 100 tax returns. We specifically collect the number of residents who deduct real estate taxes (N18500) and the number of

[7] 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).

households (N1) to construct:

$$DedShare_z = \frac{\text{\# of tax returns with property tax deductions}_z}{\text{\# of tax returns}_z}. \quad (11)$$

We cross-walk the zip code $DedShare_z$ to school districts using the School District Geographic Reference Files to calculate the share of residents in school district *j* who deduct their property taxes. To illustrate the heterogeneity in $DedShare_j$, Figure A1 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.

We obtained school district spending information from the Census Annual Survey of School System Finances (ASSSF). For each public school district, we collected the 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.[8] Adjusting 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 additionally obtain school districts' employment data from the Annual Survey of Public Employment and Payroll - School Systems. In all analyses, we keep school districts that provide elementary education thus keeping non-overlapping school districts and comparable per-pupil spending.

For control variables, we collected 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 also computed the share of residents within each income group defined by the SOI. We measure school performance by the *pooled across subjects test-based achievement score* of The Stanford Education Data

[8]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).

Archive. Last, we collected land use data from the National Land Cover Database computed at the school district level.

Table 1 shows the summary statistics of the cross-sectional study. We separate school districts based on the share of property tax deducters; 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). Figure A2, which empirically parallels Panel B of Figure 1, shows the raw relationship between educational spending, the share of deducters in the school districts, and the median house value. We note that the correlation between educational spending and housing value is negative for school districts with a low share of deducters (negative capitalization) while it is positive for school districts with a high share of deducters (positive capitalization).

3 A cross-sectional test of amplified capitalization

3.1 Main results

We present the main coefficients from equations (9) and (10) in Table 2 and the full set of coefficients are presented in Table A1. Consistent with the theoretical predictions and the housing user-cost literature (Poterba et al., 1991), the estimated coefficients for the share of residents who deduct their property taxes ($DedShare$) are positive and significant in most specifications, regardless of the spatial fixed effects included. The estimated coefficients indicate that a 10 percentage point increase in the share of residents who deduct property taxes corresponds to an approximate 6.0% increase in house values, an economically meaningful impact. Under full capitalization of housing expenses, the magnitude of ϕ corresponds to a marginal tax rate on housing expenses between 37.1% and 40.1%; a magnitude very close to the top marginal tax rate of 39.6% in 2017.

The coefficients $\bar{\delta}$ of Equation (9), the average capitalization parameter, is not significant in columns (1a) or (2a) suggesting 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 deduct taxes, the coefficient on the capitalization parameter δ^D is positive and significant at the 1% level. 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 add state fixed effects to mitigate endogeneity concerns that can arise within CBSAs that span different states. Although the magnitude of the estimated coefficients is smaller, the results are qualitatively and quantitatively unchanged. In columns (3a) and (3b), we set the spatial fixed effects to counties. In this case, 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 the under-provision of public goods on average. The results in column (3b) however 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 important implications regarding the efficient provision of local public goods.[9] 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 efficiency conclusion. Thus, absent the SALT deduction provision, local public goods would appear over-provided for the majority of school districts.

To provide greater clarity on the heterogeneous capitalization induced by the federal tax deductions, Figure 2 shows the capitalization estimates for different buckets of school districts that vary in their share of residents deducting property taxes. [10] In districts where residents do not deduct their taxes, the tax burden marginally outweighs the utility of local public goods as can be inferred from the negative capitalization effects. However, as the share of the residents who deduct their taxes increases, the benefits of public goods outweigh the associated 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. Failing to account for this heterogeneity in the federal fiscal subsidy would misleadingly assume a non-significant capitalization.

3.2 Robustness and external validity

First, we present alternative regressions varying various key variables in our specification. In Table A2, we present the results using the log of expenses per pupil. The results are qualitatively and quantitatively consistent. For example, the results of Column (1b) imply that a one percent increase in spending per pupil decreases house value by 7.7% in school districts with $DedShare = 0$ but increases it by 1.0% in

[9] 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.

[10] Although there is some non-linearity, the coefficient estimates presented in 2 cannot reject the assumption of linearity in δ^D we imposed by estimating Equation (10).

school districts with 25% of property tax deducters. In Table A3, we use as a proxy for the tax deductibility benefits by multiplying $DedShare$ with the mean federal tax rates in school district *j*. This variable, $TaxDedSub_j$ parallels the object $DedShar_jT_j$ of Equation (6) of the theoretical model. In our sample, this variable averages 4.56% and most of this variation is explained by variation in $DedShare$. The results of Column (1b) of Table A3 confirm the main proposition of the paper. A standard deviation increase in school spending decreases house prices by 2.8% in school district with no $TaxDedSub_j = 0$ but increases by 0.75% at the average of $TaxDedSub_j$.

As a robustness check on our cross-sectional results, we then report the coefficients $\bar{\delta}$, δ^{ND} and δ^{D} from equations (9) and (10) using different educational spending measures in Table 3. First, to verify the impact of test scores, we provide results of our main specification removing this control. As expected, the magnitude of the coefficients shown in Columns (1) are larger but our conclusions remain unchanged. Then, using different measures of school district spending, we observe that δ^{D} is positive and significant for all variables except one, ranging from 0.074 to 0.261. The non-significant coefficient of column (2b), indicates that additional *Instructional Expenses* are not capitalized in housing value. Because we control for test scores, the results suggest that spending on instruction is not valued except through the effects on test scores. Thus, regardless of how the school district spends educational funds, residents value that spending more intensively as the share of property tax deducters 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 local public goods. In Table 4, we show that the qualitative pattern of results is robust to spending on police. Interestingly, the negative coefficient for $\bar{\delta}$ suggests that a marginal increase in taxes for police spending, on average outweighs its marginal benefits. Despite this average capitalization effect that differs from the results with school spending, the coefficient δ^{D} is positive and significant in Columns (1b) and (2b), providing support for an amplified capitalization induced by the federal tax deductions. With state and CBSA fixed effects, the coefficient, however, appears non-significant.

The advantage of the cross-sectional empirical model is that it flows directly from the theoretical model and directly tests the equilibrium relations. It relies on equilibrium relations conditional on jurisdiction-level variables that we control in a ceteris paribus framework to achieve identification. However, this methodology 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 deduct taxes induced by the TCJA enactment.

4 Identification using a shock to deductibility status

4.1 Panel data identification

Our second test of the theoretical predictions exploits the exogenous decrease in the share of property tax deducters due to fiscal changes embedded in the TCJA. For this analysis, we convert the cross-sectional data into a two-year (January 2017 and 2020) panel and compute the change in capitalization of local school quality for each state.[11] The theoretical model predicts that jurisdictions that experience a decline in the share of residents taking advantage of the ability to deduct local taxes should have a corresponding decline in the capitalized value of local public goods. 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. However, this method suffers from the subjectivity in the choice of aggregation level to compute the capitalization estimates, the time-invariant school test score variable, the risk that other aspects of the TCJA confound the effect, and the possibility that resident sorting over the two-years.

Using median house values in January 2017 and 2020 merged with school district mean test scores, we first compute the rate of capitalization ($\frac{\partial P}{\partial g}$) before and after the TCJA within each state.[12] We compute $ChgDed_s = DedShare_{s,2017} - DedShare_{s,2018}$,

[11] We use January 2020 to avoid the massive disruption in the housing market from March 2020 and the unfolding of the Covid-19 pandemic.

[12] The rates of capitalization are computed via separated cross-sectional regressions in each state-year

the share of residents that stopped deducting their property taxes to the state level and present in Panel A of Figure 3 the change in the rate of capitalization against $ChgDed_s$. The relation between the change in the rate of capitalization and $ChgDed$ is negative and significant, consistent with the main proposition of the theoretical model. 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.

We also provide the results of pooled panel data regressions using 6 years of data in Table A4 that parallels the specifications of Equations (9) and (10). The coefficient estimates are very similar to those of the cross-sectional analysis even after the inclusion of county times year fixed effects (Columns [3a] and [3b]). The estimate δ^D ranges from 0.13 to 0.17 and is significant at the 1% level, thus supporting the main proposition of the theoretical model.

4.2 House-level identification using school district borders

Finally, to 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.[13] This method has the advantage of achieving identification by exploiting the spatial exogeneity of local jurisdictions (borders) as well as the exogenous shock to the share of deducters caused by the TCJA. However, because housing characteristics are not consistent across states in the data, school test scores are time-invariant, and the bandwidth along school district borders must be large to accommodate all states, this method imposes subjective specification assumptions. In addition, as opposed to the cross-sectional test that relies on data prior to the TCJA, in this analysis, we cannot rule out that many other aspects of the TCJA (cap on mortgage interest, income effects due to lower tax rates etc.) confound the effect.

with CBSA fixed effects and other demographics controls including the share of property tax deducters.

[13] 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 attendance boundaries because our theoretical model relies on the co-determination of public goods and property taxes.

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

$$\begin{aligned} log(P_{i,j,t,b}) &= \alpha_b + \alpha_t + \delta^{pre} SchoolTest_j + \delta^{change}(SchoolTest_j \times Post_t) \\ &\quad + X_i'\beta + Z_{j,t}'\gamma + \epsilon_{i,j,t,b} \end{aligned} \tag{12}$$

where $P_{i,j,t,b}$ is the transaction price of house i, located in school district j, adjacent to boundary b, and transacted in month t.[14] 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.[15]

We report in Table A5 the coefficient estimates for California and provide the estimated coefficients for each state in the Online Repository. We confirm that the inclusion of 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 deduct taxes is

[14] 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 borders are removed from the analysis. This approach also allows for heterogeneity in average capitalization coefficients across states, which is supported by the results presented in the online Appendix.

[15] 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

negatively associated with the change in capitalization of school quality in univariate linear regression models. Figure 4 shows the relation between the change in the share of tax deducters 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 capitalization effect 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 (borders) with temporal (pre- and post-TCJA) exogeneities, the results shown in Figure 4 further support our theoretical model.

4.3 Placebo tests using years prior to TCJA

In order to confirm the causal connection identified in this section, we perform placebo tests for the panel data and border discontinuity specifications by using years prior to the TCJA. We compute the change in capitalization between 2015 and 2017 that we relate to the change in tax deducters due to the TCJA. Absent any pre-trend, we should observe no statistical relation. First, we show in Panel B of Figure 3, the placebo panel data test. There is no relation between the two variables (p-value = 0.232). Second, in Figure A3, we reproduce the house-level analysis using housing transactions in 2015 and 2017. We plot the relations between the change in the share of tax deducters 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 significant relations between the two variables. These tests further support the causal effect of deducting local taxes on the capitalization of local public goods.

5 Channels magnifying or mitigating capitalization

Having established the larger capitalization of public goods 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 U.S. 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 5, panel A.[16] 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.

Income tax rate

All the predictions of the theoretical model are enhanced by the average tax rate on income because deducters with higher tax rates benefit more from the deductions of local taxes (See Equation [6] of the theoretical model). We compute the average in-

[16]Coefficient estimates for the tests discussed in this section are provided in details from Table A6 to Table A11.

come tax rate for each school district by dividing the federal tax revenues by the total adjusted gross income using data from the SOI. Due to SOI data aggregation, we can only compute the average tax rate in a school district for all residents as opposed to the tax rates associated with property tax deducters. In panel B of Figure 5, 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 heterogeneous capitalization prediction only holds in the subset of school districts where residents have a high mean federal tax rate. In the other districts, δ^D is non-significant.

Does private school 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. 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. Because we can only calculate this measure for unified school districts, we remove elementary school districts from this analysis. Panel C of Figure 5 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 values incorporate their demand for 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. This heterogeneity exists since an increase in housing supply can mitigate the price effect (Cheshire and Sheppard, 2004; Hilber and Mayer, 2009; Hilber et al., 2011; 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.[17] Panel D of Figure 5 presents the results. Consistent with previous studies, the mean capitalization estimate $\bar{\delta}$ is significantly different from zero only in school districts with high land scarcity. In less developed school districts, the coefficient is non-significant. The coefficients δ^D are, however, not different from each other across the two subsets.

Commercial properties taxation and capitalization.

Local governments collect property taxes on both commercial and residential properties. Thus, conditional on taxing both equally, the higher the share of commercial properties in the community, the lower the tax burden for residents (Brueckner, 1983). We expect a 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 5, 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 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.

[17]In contrast to *The Wharton Residential Land Use Regulatory Index*, this measure can be computed at the school district level instead of relying on larger and sparser spatial areas.

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 since the 1970s, 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.[18] We present the coefficients in panel F of Figure 5, and also the capitalization effects along the $DedShare$ axis in Figure A4. The similarity between the capitalization function for non-reformed states and the function shown in Figure 2 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 at a lower level of $DedShare$ showing a decreasing relation between $DedShare$ and capitalization. Interestingly, in these states, the capitalization of educational spending in school districts with a high level of property tax deducters is non-significant; suggesting that deducters do not respond to additional local public good spending. 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).

6 Discussion and Conclusion

This paper explores how the federal tax policy induces heterogeneous capitalization of local public goods. We derive a theoretical model establishing a causal connection between the capitalization of local public goods and the deduction of property

[18]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.

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. Together, these results confirm that local public goods that are financed by property taxes are valued less by residents who pay the full costs compared to the residents who benefit from a cost reduction induced by federal fiscal policies. Absent this regressive fiscal transfer, residents would likely demand a lower level of local public spending. This decrease in local public goods demand, which has materialized in local referendum results (Ambrose and Valentin, 2024), will have a sizable impact on the future of local finances.

Because the SALT deductions subsidy increases with household income and wealth, the differential in local public goods capitalization accentuates income sorting. Although we do not provide a direct test of sorting or voting with one's feet (Banzhaf and Walsh, 2008), we document that residents do consider federal tax deductions in their housing purchases. However, the 2017 TCJA revision to the tax code that included the almost complete removal of the SALT subsidy resulted in an equalization in the cost of public goods for the majority of taxpayers and thus reduced incentives for income sorting. With the looming potential sunset of the TCJA in 2025, understanding the capitalization of fiscal policies is of prime importance for guided revisions in the tax code.

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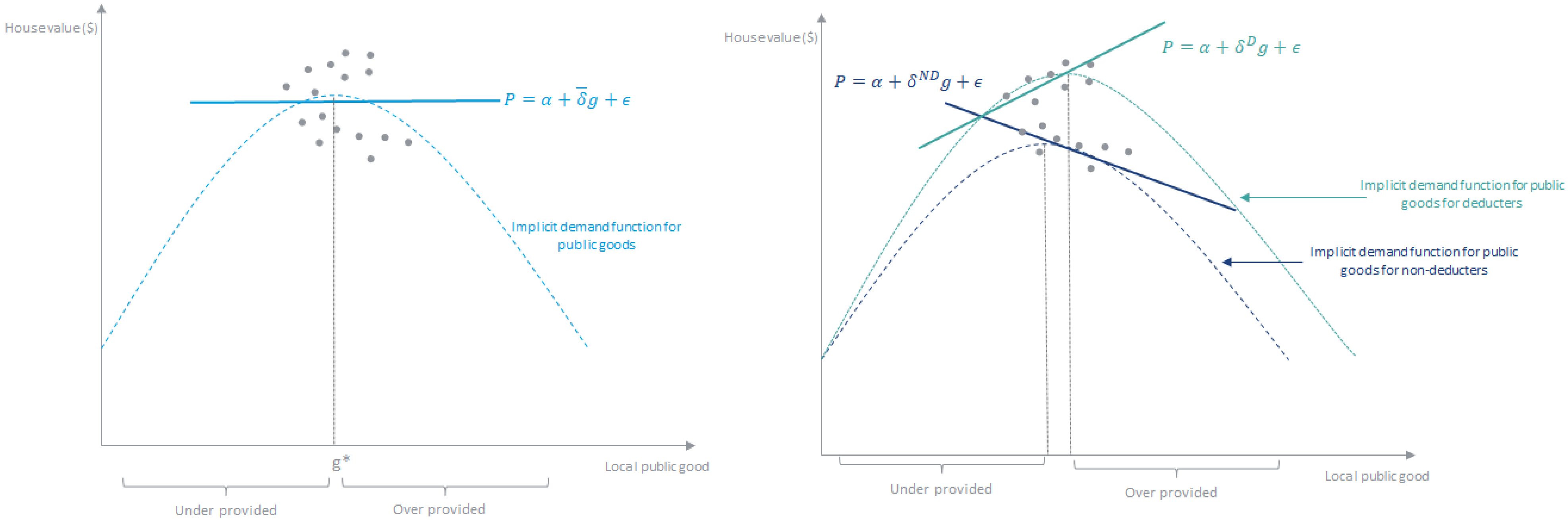
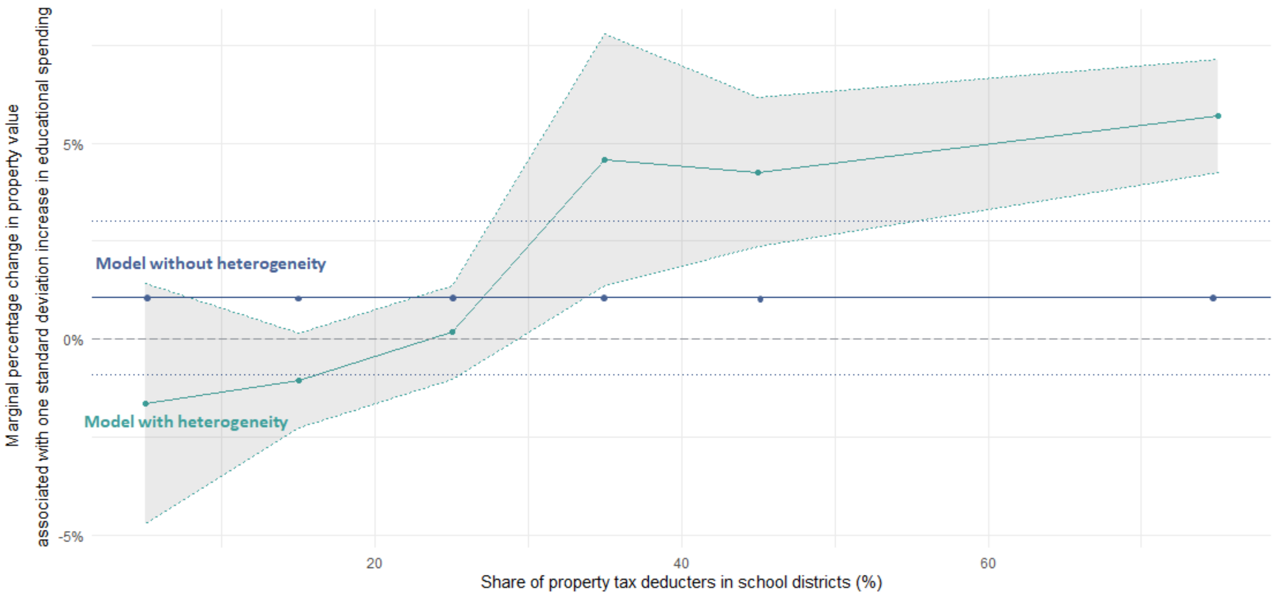
Figure 1: Capitalization of local public goods with property tax deductions



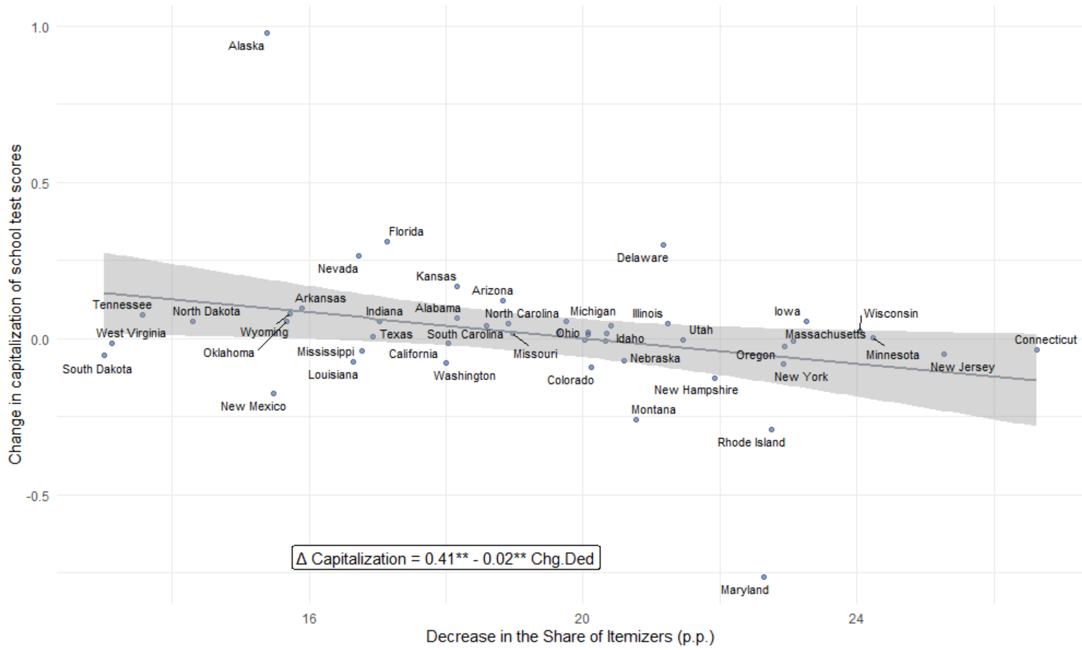
Note: The charts show the relation between the provision of public goods (x-axis) and aggregate house value (y-axis) conditional on exogenous housing and neighborhood quality level. Panel A shows the standard model as in Brueckner (1982). Panel B shows the demand function for jurisdictions composed of 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 2: The implied change in housing value from an increase in local public good

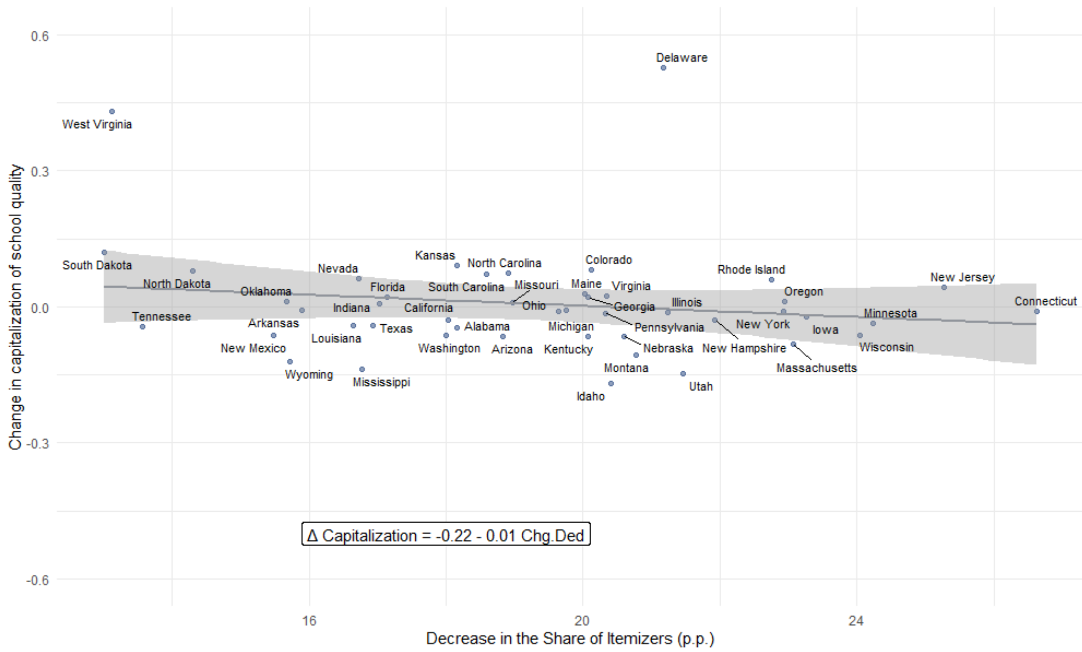


Note: The dotted turquoise line shows the implied marginal change in housing value to a one standard deviation increase in per pupil adjusted educational spending for school districts with a heterogeneous share of property tax deducters. The shaded area shows the 90% confidence interval. The horizontal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

Figure 3: Change in capitalization of public goods and decrease in tax deductions



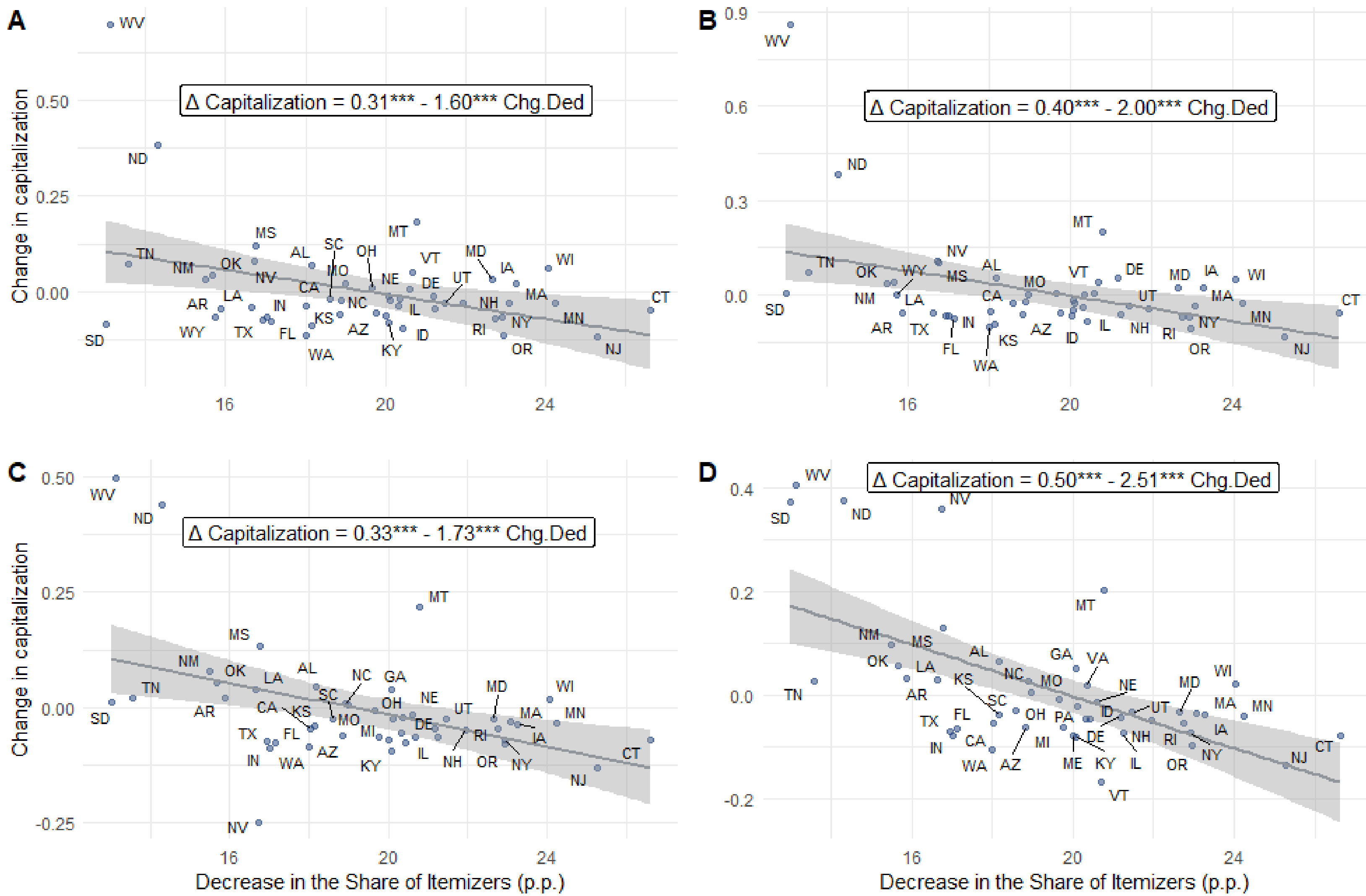
(a) Pre- and post-TCJA



(b) Placebo test: Pre- and pre-TCJA

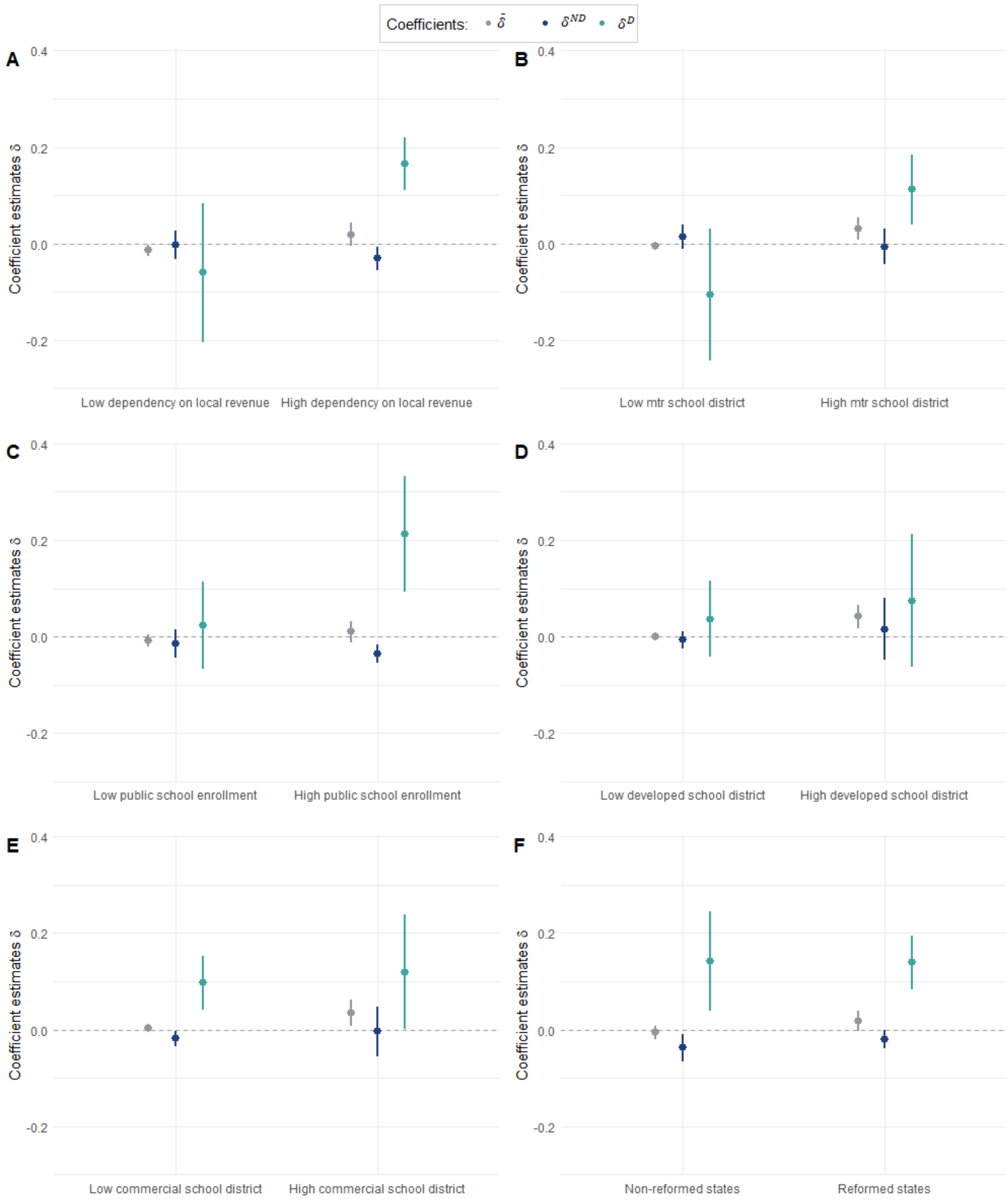
*Note: These scatter plots show the relation between the decrease in the share of residents deducting property taxes (x-axis) and the change in the rate of capitalization of school test score in house value before and after the TCJA. The decrease in the share of deducters is computed from the SOI of the IRS in fiscal year 2017, and 2018. The change in capitalization rates are computed via separate cross-sectional regressions in each state-year with CBSA fixed effects and other demographics controls including the share of property tax deducters. In Panel A, the change is computed over January 2020 (post-2020) and January 2017 (pre-TCJA) and in Panel B over January 2017 (pre-TCJA) and January 2015 (pre-TCJA). Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% levels, respectively.*

Figure 4: 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% levels, respectively.*

Figure 5: Testing the intensity of the mechanism



Note: The points, along with their 90% confidence intervals, show the coefficient estimates $\bar{\delta}$ of equation (9), and δ^{ND} and δ^{D} of equation (10) for different sub-samples of school districts. Panel A shows the coefficients for school districts with high and low levels 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.

Table 1: 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 a high share of property deducters and school districts with low levels of deducters. The means for the two groups are presented in columns (4) and (5). The difference in means is shown along the t-statistics of difference in means. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% levels, respectively.*

	Mean	Std. dev.	Median	High $DedShare$	Low $DedShare$	Difference	t-statistics
Main variables:							
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 2: Capitalization of local public goods with local tax deductions

This table reports the estimates of the paired regressions $log(P_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(P_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises 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 from their federal taxable incomes in 2017 computed from the SOI.* Exp_j *is the total school district expenses per enrolled pupil in school year 2016-2017 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share from SOI, 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 A1. Standard errors, presented in parentheses, are clustered at the CBSA level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% levels, 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 3: Capitalization of school spending by types of school expenses

This table reports the estimates of the paired regressions $log(P_j) = \alpha_{m(j)} + \bar{\delta} g_j + \phi DedShare_j + X_j' \beta + \epsilon_j$ *and* $log(P_j) = \alpha_{m(j)} + \delta^{ND} g_j + \delta^D (g_j \times DedShare_j) + \phi DedShare_j + X_j' \beta + \epsilon_j$ *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% levels, respectively.*

	Dependent variable: log(house value)							
	No test score		Instructional		Support		Others	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Share of deducters (ϕ)	0.616*	0.548	0.680*	0.653*	0.636*	0.579	0.563	0.509
	(0.352)	(0.375)	(0.358)	(0.366)	(0.362)	(0.375)	(0.383)	(0.372)
Public good ($\bar{\delta}$ or δ^{ND})	0.009	−0.028***	0.027*	0.008	−0.0001	−0.027**	−0.019**	−0.080***
	(0.010)	(0.011)	(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	0.922	0.923	0.923	0.923	0.923	0.923	0.923	0.925
Adjusted R^2	0.913	0.914	0.914	0.914	0.914	0.914	0.914	0.916

	Non-school		Capital expenditure		Employees		Non-deflated	
	(5a)	(5b)	(6a)	(6b)	(7a)	(7b)	(8a)	(8b)
Share of 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 4: Capitalization of police funding with local tax deductions

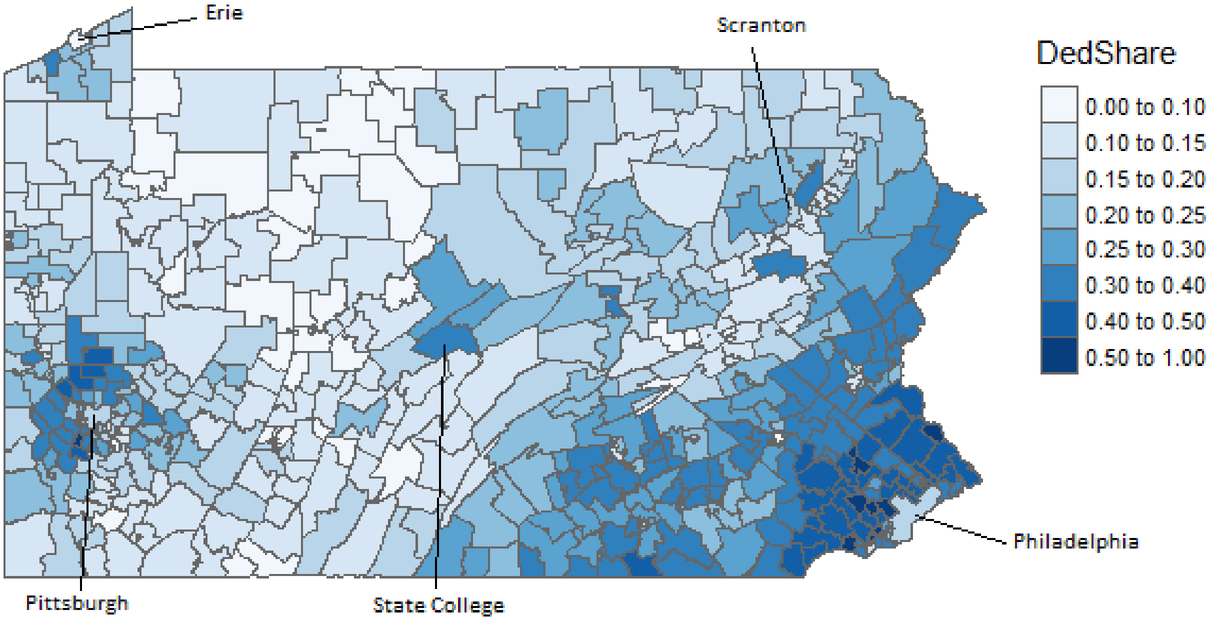
This table reports the estimates of the paired regressions
$log(P_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X'_j\beta + \epsilon_j$ *and*
$log(P_j) = \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X'_j\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises all urban U.S. counties and equivalents.* $DedShare_j$ *is the share of residents deducting taxes (itemizers) 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), and income quartile fixed effects. Standard errors, presented in parentheses, are clustered at the state level. Estimates followed by ***, **, and * are statistically significant at the 1%, 5%, and 10% levels, respectively.*

	Dependent variable: log(house value)					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of deducters (ϕ)	2.795***	2.777***	1.817***	1.861***	2.116***	2.165***
	(0.361)	(0.352)	(0.370)	(0.170)	(0.297)	(0.294)
Expenses per resident ($\bar{\delta}$)	−0.024*		−0.025		−0.030**	
	(0.014)		(0.019)		(0.013)	
Expenses per resident (δ^{ND})		−0.099***		−0.055***		−0.058**
		(0.023)		(0.018)		(0.026)
Expenses per resident x DedShare (δ^{D})		0.370***		0.140*		0.131
		(0.106)		(0.074)		(0.094)
Demographics	X	X	X	X	X	X
State fixed effects	X	X			X	X
CBSA fixed effects			X	X	X	X
Observations	1,758	1,758	1,758	1,758	1,758	1,758
R^2	0.876	0.878	0.961	0.961	0.966	0.966
Adjusted R^2	0.872	0.874	0.918	0.918	0.925	0.926

Online APPENDIX

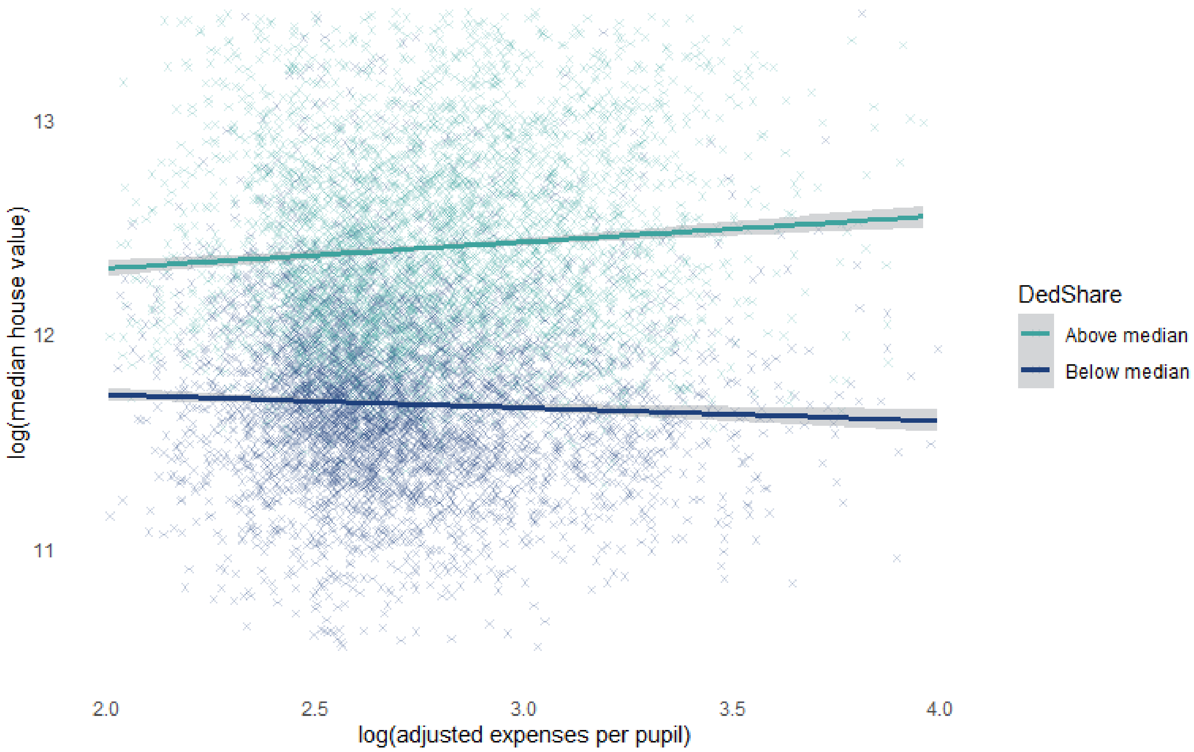
A Additional Figures & Tables

Figure A1: Share of property tax deducters in Pennsylvanian school districts in 2017



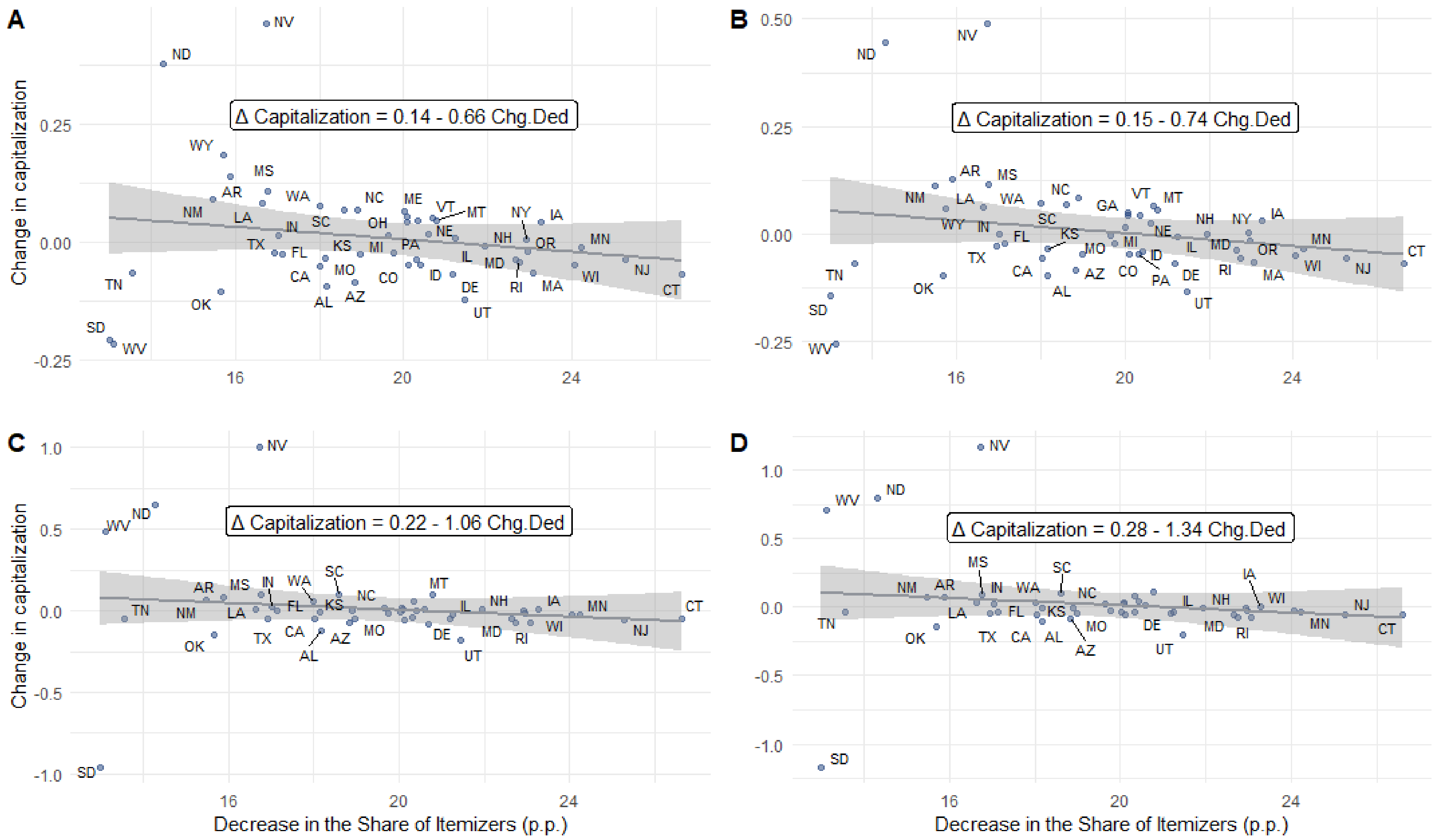
Note: This map shows the share of property tax deducters for Pennsylvanian school districts computed from Statistics of Income of the Internal Revenue Service cross-walked into school district with the School District Geographic Reference Files.

Figure A2: Educational spending, deducting property taxes, and housing value.



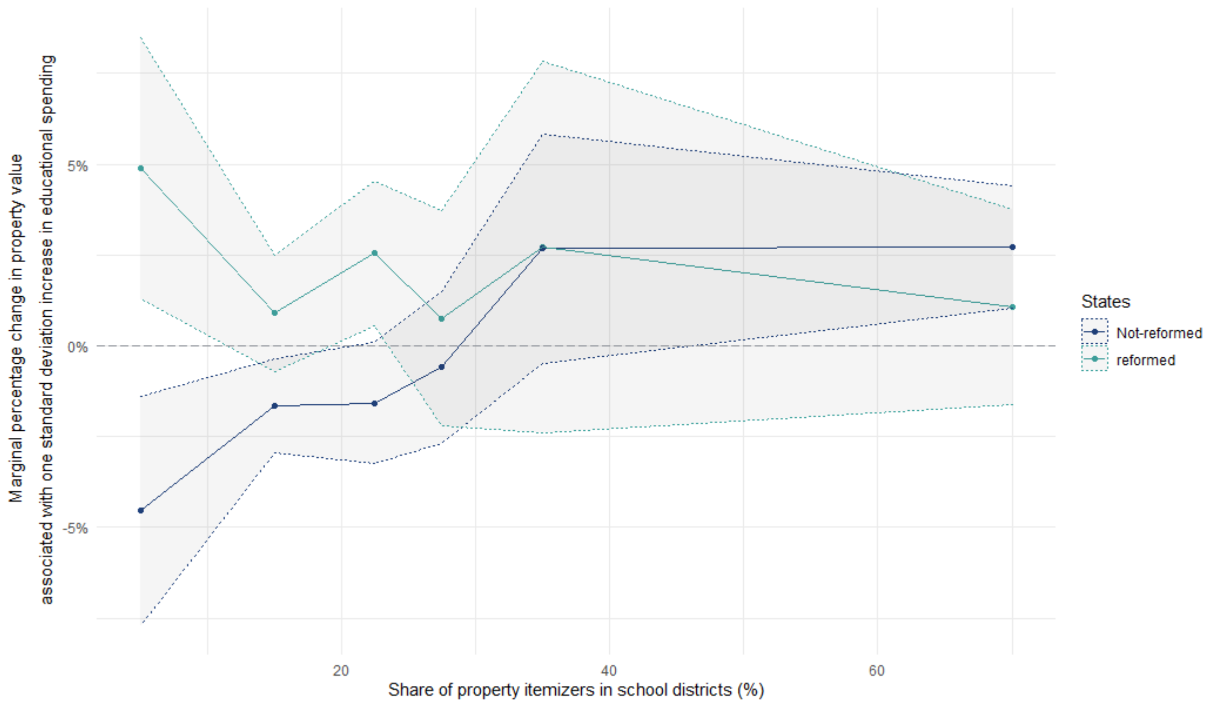
Note: This scatter plot shows the relationship between adjusted educational spending per pupil (x-axis) and the median housing value (y-axis) in each U.S. school district. The data is split between school districts with the share of property tax deducters ($DedShare$) below or above the median of 23.0%. Each dot represents a school district and both lines show the best linear fit with the corresponding 95% confidence interval.

Figure A3: 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 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% levels, respectively.*

Figure A4: Heterogeneous capitalization of school spending and 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 districts in states that did not (turquoise). The shaded area shows the 90% confidence intervals.

Table A1: Capitalization of local public goods with local tax deductions – All coefficients

This table reports the estimates of the paired regressions $log(P_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(P_j) = \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^D (Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *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% levels, 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 A2: Capitalization of local public goods with local tax deductions - log-log form

This table reports the estimates of the paired regressions
$log(P_j) = \alpha_{m(j)} + \bar{\delta} log(Exp_j) + \phi DedShare_j + X_j' \beta + \epsilon_j$ *and*
$log(P_j) = \alpha_{m(j)} + \delta^{ND} log(Exp_j) + \delta^{D}(log(Exp_j) \times DedShare_j) + \phi DedShare_j + X_j' \beta + \epsilon_j$ *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% levels, 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 A3: Capitalization of local public goods with local tax deductions - Alternative variable to capture local tax subsidy

This table reports the estimates of the paired regressions $log(P_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi TaxDedSub_j + X_j'\beta + \epsilon_j$ *and* $log(P_j) = \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^D (Exp_j \times TaxDedSub_j) + \phi TaxDedSub_j + X_j'\beta + \epsilon_j$ *in columns ending with a, and b respectively. The sample comprises urban school districts providing elementary education with at least 100 pupils in school year 2016-2017.* $TaxDedSub_j$ *is the share of taxpayers deducting property taxes from their federal taxable incomes in 2017 multiplied by the average tax rates in the school district computed from the SOI.* Exp_j *is the total school district expenses per enrolled pupil in school year 2016-2017 deflated across space by the CWIFT and standardized.* X_j *include demographics control including median income quartile fixed effects, income distribution share from SOI, 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% levels, respectively.*

	Dependent variable: log(house value)					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Tax deduction Subsidy (ϕ)	4.096***	3.579**	3.874***	3.406***	3.794***	3.329***
	(1.221)	(1.451)	(1.096)	(1.238)	(1.159)	(1.200)
Expenses per pupil ($\bar{\delta}$)	0.010		0.004		0.012*	
	(0.010)		(0.005)		(0.007)	
Expenses per pupil (δ^{ND})		−0.028***		−0.026***		−0.019**
		(0.008)		(0.007)		(0.009)
Expenses per pupil x TaxDedSub (δ^D)		0.778***		0.630***		0.637***
		(0.146)		(0.117)		(0.131)
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	0.924	0.927	0.928	0.946	0.946
Adjusted R^2	0.914	0.915	0.918	0.919	0.932	0.933

Table A4: Capitalization of public goods with tax deductions - Panel specification

This table reports the estimates of the paired regressions $log(P_{j,t}) = \alpha_{m(j,t)} + \bar{\delta}Exp_j + \phi DedShare_{j,t} + X'_{j,t}\beta + \epsilon_{j,t}$ *and* $log(P_{j,t}) = \alpha_{m(j,t)} + \delta^{ND}Exp_j + \delta^{D}(Exp_j \times DedShare_{j,t}) + \phi DedShare_{j,t} + X'_{j,t}\beta + \epsilon_{j,t}$ *in columns ending with a, and b respectively. The sample comprises all urban school districts providing elementary education with at least 100 pupils from 2015 to 2020.* $log(P_{j,t})$ *is the natural log of house prices in January from Zillow ZHVI.* $DedShare_{j,t}$ *is the share of taxpayers deducting property taxes on their federal taxable income in the previous fiscal year computed from the SOI.* $log(Exp_j)$ *is the standardized total expenses of the school district per enrolled pupil in school year 2017-2018 deflated across space by the CWIFT.* $X_{j,t}$ *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% levels, respectively.*

	Dependent variable: log(house value)					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Share of property deducters (ϕ)	0.383***	0.376***	0.546***	0.530***	0.454***	0.446***
	(0.120)	(0.133)	(0.170)	(0.179)	(0.154)	(0.162)
Expenses per pupil ($\bar{\delta}$)	0.002		0.009*		0.010	
	(0.006)		(0.004)		(0.007)	
Expenses per pupil (δ^{ND})		−0.024***		−0.024***		−0.018**
		(0.007)		(0.004)		(0.009)
Expenses per pupil x DedShare (δ^{D})		0.133***		0.167***		0.143***
		(0.026)		(0.013)		(0.029)
Demographics	X	X	X	X	X	X
Income Decile fixed effects	X	X	X	X	X	X
State x Year + CBSA FE	X	X				
CBSA x Year FE			X	X		
County x Year FE					X	X
Observations	53,300	53,300	53,300	53,300	53,300	53,300
R^2	0.925	0.926	0.922	0.923	0.946	0.946
Adjusted R^2	0.924	0.924	0.913	0.914	0.932	0.932

Table A5: Change of capitalization from house level transaction data – California

This table reports the estimates of the regression $log(P_{i,j,t,b}) = \alpha_b + \alpha_t + \delta^{pre} SchoolTest_j + \delta^{change}(SchoolTest_j \times Post_t) + X_i'\beta + Z_{j,t}'\gamma + \epsilon_{i,j,t,b}$. $P_{i,j,t,b}$ *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. Results for all other states are located in the Online Repository. 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% levels, 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 A6: Local taxation reliance and capitalization of local public goods

This table reports the estimates of the paired regressions $log(P_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(P_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *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 levels 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% levels, 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 A7: Residents' federal tax rate and the capitalization of local public goods

This table reports the estimates of the paired regressions $log(P_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(P_j) = \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^D (Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *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% levels, 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 A8: Private school penetration and capitalization of local public goods

This table reports the estimates of the paired regressions
$log(P_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and*
$log(P_j) = \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^D (Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *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 levels 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% levels, 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 A9: Land availability and capitalization of local public goods

This table reports the estimates of the paired regressions $log(P_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X_j' \beta + \epsilon_j$ *and* $log(P_j) = \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^D (Exp_j \times DedShare_j) + \phi DedShare_j + X_j' \beta + \epsilon_j$ *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 levels 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% levels, 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 A10: Commercial properties taxation and capitalization of local public goods

This table reports the estimates of the paired regressions $log(P_j) = \alpha_{m(j)} + \bar{\delta}Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(P_j) = \alpha_{m(j)} + \delta^{ND}Exp_j + \delta^{D}(Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *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 levels 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% levels, 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 A11: State finance reforms and capitalization of local public goods

This table reports the estimates of the paired regressions $log(P_j) = \alpha_{m(j)} + \bar{\delta} Exp_j + \phi DedShare_j + X_j'\beta + \epsilon_j$ *and* $log(P_j) = \alpha_{m(j)} + \delta^{ND} Exp_j + \delta^D (Exp_j \times DedShare_j) + \phi DedShare_j + X_j'\beta + \epsilon_j$ *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% levels, 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