

Small Homes, Public Schools and Property Tax Capitalization^{*}

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Abstract

Efforts to estimate the degree to which local property taxes are capitalized into house values are complicated by any spurious correlation between property taxes and unobserved local amenities or public services. One public service of particular interest is the provision of local public schools. Not only do public schools bulk large in the local property tax bill, but the inherent difficulty in measuring school quality has potentially undermined earlier attempts at achieving unbiased estimates of property tax capitalization. This particular problem has been of special concern since Oates' (1969) seminal paper.

We work to sidestep the problem of omitted or misspecified measures of school quality by focusing on a segment of the housing market that likely places little-to-no value on school quality: small homes. Because few households residing in small homes (defined as homes with two bedrooms or less) have public school children, we anticipate that variations in small homes' values do not account for differentials in public school quality. This allows us to avoid much of the omitted variable bias likely present in earlier studies, especially for those based on a sample containing larger homes. Using restricted-access microdata provided by the U.S. Census, and a quasi-experimental identification strategy, we estimate that local property taxes are nearly fully capitalized into the prices of small homes.

1.0 Introduction

Empirical efforts to measure the capitalization of local property taxes are greatly complicated by the challenges of controlling for public benefit levels. The early approach to this problem was to include tax rates and various measures of service levels in a hedonic analysis of housing prices.¹ But achieving adequate controls for public services in such hedonic equations has proven to be extremely difficult. The extent, quality, and location of all potentially relevant public services are not easily measured. Chief among these hard to quantify characteristics are the dimensions of public school quality. Recent attempts to estimate willingness to pay for public school characteristics (Black, 1999; Bayer, Ferreira, & McMillan, 2007; Gibbons, Machin, & Silva, 2009) have generated a wide range of results that relied on a various proxies for school quality. For those concerned with measuring school quality these difficulties must be addressed directly. But for those attempting to measure the capitalization of property taxes, the best strategy is to identify quasi-experiments that hold local public service levels (and quality) constant, while allowing tax rates to vary.

Palmon & Smith (1998a, b) construct an interesting quasi-experiment of this type by limiting observed variation in home values and taxes to those that occur across a select number of municipal utility districts (MUDs) operating within the unincorporated sections of Harris County, TX (northwest of Houston). With the exception of schooling, many public services are evenly supplied to all households in their sample by either the county or by the MUDs themselves.² However, due to historical accidents, the effective rate of property taxation is not equal across MUDs. Thus, while holding most public services constant, there are observed variations in property taxes. Taking advantage of this unique circumstance, Palmon & Smith

¹ See Oates (1969, 1973), Pollakowski (1973), Rosen & Fullerton (1977), and King (1977) for early examples.

² Palmon & Smith note that the MUDs are responsible for distributing sewer and water services and that these services are likely identical across MUDs. They also note that three separate school districts serve their sample of homes. They do not control for differences in school district tax rates but, instead, suggest the rates are quite similar across the three districts. They also argue that there are only small differences in school quality, noting test scores, demographics, and relative expenditures are similar across these districts.

estimate rates of property tax capitalization near 100%, suggesting effective property tax differentials may be a major determinant of home price differentials.

The use of MUDs to measure inter-jurisdictional tax differentials represents a major improvement over earlier identification strategies that were unable to explicitly hold many public services constant across jurisdictions.³ However, in light of recent methodological developments, it is worthwhile to reexamine property tax capitalization within the context of an identification strategy that provides even further controls for potentially endogenous fiscal variables. For example, beginning with Cushing (1984) and Black (1999), it is now standard practice within the home price capitalization literature to control for the “neighborhood” within which homes on either side of a jurisdiction fall. This is because homes in close proximity to one another are more likely to benefit from the same level of unobservable and spatially localized public services (e.g., public parks). Failure to control for public services of this kind will bias any estimates of tax capitalization if the services in question are correlated with tax rates. For example, a MUD’s tax rate is a direct function of its subdivisions’ levels of completion. This is because less-complete subdivisions (i.e., fewer homes than initially intended) will need relatively high residential property tax rates to finance debt payments. However, because less-complete subdivisions are also more likely to have fewer developed parks, failure to control for neighborhood fixed effects may bias property tax capitalization estimates.

Palmon & Smith’s estimates are also potentially complicated by their failure to control for public school characteristics which, although perhaps similar in some respects, as they note, may vary along many difficult-to-measure dimensions (e.g., value added, accountability, pupil-to-teacher ratios, etc.) that are thought to be valued by the housing market. To the extent that these factors are correlated with inter-jurisdictional tax differentials, estimates of property tax capitalization will be biased. This issue has plagued much of the housing price capitalization literature for years, primarily due to the difficulty and debate surrounding appropriate measures of perceived school quality.⁴

³ Earlier studies attempted to explicitly control for the distribution of public services. However, as is made clear by the debate between Oates (1973) and Pollakowski (1973), as well as papers by King (1973) and Rosen & Fullerton (1977), measuring public service levels (especially with respect to public schooling) is difficult and likely subject to much error.

⁴ There exists an extensive literature surrounding the capitalization of school quality as well as which dimensions of school quality are actually capitalized into housing value. See Taylor (2005), Brasington & Haurin (2006), Gibbons,

We make no attempt at improving upon these measures of perceived school quality. Rather, in recognition of the many difficulties inherent in measuring school quality, we look to sidestep this complication altogether by focusing on a segment of the housing market that pays public school property taxes but presumably places little-to-no value on the level of public school services provided: small homes. For example, the 2000 Census reports that, within suburbs of metropolitan Chicago, only 13% of U.S. owner-occupied households residing in small homes (defined as homes with two bedrooms or less) had children enrolled in public schools. This is to be compared to 34% for households residing in homes with three or more bedrooms (hereafter referred to as “large homes”).⁵ This disparity suggests that much, if not all, of the problem associated with controlling for public school quality stems from the market for larger homes. Buyers of large homes, because they are more likely to have children, drive up the prices of homes in good school districts, thus complicating any estimates of property tax capitalization that cannot fully control for school quality. Conversely, smaller homes will not likely reflect school quality differentials, thus neutralizing the problem of school quality capitalization. Empirical estimates supporting this claim are provided by Black (1999) who reports that, as opposed to large homes, small homes do not sell for a premium when located near good schools.

For small homes, observing inter-jurisdictional variation in school district property taxes, while controlling for other taxes and public services, will offer unique insights into the nature and degree of property tax capitalization. For this stratum of the housing market, educational property taxes are essentially direct transfers to households with children in the public schools. These transfers represent a tax without a corresponding direct benefit.⁶ The fact that households buying these small homes are statutorily required to “contribute” to this redistribution program provides the motivation for our identification strategy. A hedonic equation for these small homes should be free of complications generated by the problems inherent in measuring

Machin, & Silva (2009), and Hilber (2011) for comprehensive reviews of this literature. See Stiefel *et al.* (2005) for a broader discussion concerning the various problems associated with measuring school performance and accountability. Rosen & Fullerton (1977) is one of the earliest housing price capitalization studies to address this problem.

⁵ This statistic is 28% for homes with three bedrooms, 42% for homes with four bedrooms, and 48% for homes with five or more bedrooms. This data was downloaded from www.ipums.org (see Ruggles *et al.*, 2010).

⁶ Kurban, Gallagher & Persky (forthcoming) provide estimates of education tax redistribution in suburban Chicago from households without children in public schools to those with children in those schools. They estimate that such transfers account for about two-thirds of all owner-occupied, education property taxes in the area.

education quality. The vast majority of home-buyers of small homes do not directly benefit from the local schools because they do not have children enrolled in the local public schools.

Of course, as indicated above, the inter-jurisdictional distribution of non-education public services will impact small home values. To the extent that these services are unobserved and correlated with school district taxes, estimates of property tax capitalization will be biased. To minimize this potential problem, the present study incorporates a border discontinuity design similar to that used by Black (1999) and Bayer, Ferreira, & McMillan (2007, hereafter BFM). Here, household observations are limited to those falling within a quarter-mile of a public school district border that itself intersects a single municipality. Spatially localized unobservable characteristics are then controlled for by identifying a given home's localized neighborhood that, while falling completely within a municipality, straddles a public school district border (quarter mile on either side of the border and a half mile in length). Thus, the key comparisons made in the empirical equations presented below are between small houses subject to differing education property tax rates, but similar neighborhoods, non-education services, and non-education municipal taxes. Our empirical findings suggest that, for small homes, education property taxes are capitalized almost fully into home values, thus supporting the earlier findings of Palmon & Smith and others.

In the discussion that follows, Section 3 outlines our empirical design and describes the data used while Section 4 discusses our results. Section 5 concludes and provides directions for future research.

2.0 Empirical Design and Data

2.1. Identification Strategy

This paper estimates a hedonic housing price equation in order to assess the degree to which property taxes are capitalized into home values. Under ideal circumstances, estimation would involve taking advantage of complete information on relevant structural characteristics of an individual home as well as fiscal, amenity, and socio-demographic characteristics of the home's

immediate neighborhood. Following convention, this data could then be used to return unbiased parameter estimates for the following hedonic equation:

$$\ln(V_{imsj}) = \alpha + \mathbf{X}_i' \boldsymbol{\beta}_i + \mathbf{Z}_{mj}' \boldsymbol{\beta}_{mj} + \gamma_\tau(\tau_m + \tau_s) + \gamma_Q Q_s + \varepsilon_{imsj} \quad (1)$$

where $\ln(V_{imsj})$ is the natural log of home i 's value (in municipality m , school district s , and neighborhood j), \mathbf{X}_i is a vector of i 's structural characteristics, \mathbf{Z}_{mj} is a vector of characteristics of neighborhood j within municipality m (including public services), τ_m is the non-education property tax rate (consisting of municipal taxes) and τ_s and Q_s measure effective school district tax rates and quality, respectively, for district s . For the purposes of this study, the parameter of particular interest is γ_τ , which, in equilibrium, measures the level of compensation required by the marginal home buyer for incremental increases in property tax rates.

As noted by Black (1999) and others, a major complication to obtaining unbiased parameter estimates for Equation (1) is the problem of omitted variables. In particular, unobservable fiscal, amenity, and socio-demographic characteristics relevant to a home's value (contained in \mathbf{Z}_{mj} and Q_s) are likely correlated with $(\tau_m + \tau_s)$. We address this concern in several ways. First, because unobserved components of \mathbf{Z}_{mj} may be correlated with τ_s , we limit our sample to homes that fall within a quarter-mile of a school district border that, itself, intersects a municipality. This allows us to extend the methodology of Black (1999) and BFM by replacing the unobserved components of \mathbf{Z}_{mj} with a full set of boundary dummies that control for a particular (half-mile-by-half-mile) neighborhood falling along the length of a school district border. Specifically, we include a dummy variable, D_{mj} , in Equation (1) that is equal to unity for all homes falling within a particular neighborhood. The inclusion of D_{mj} effectively controls for all unobservable neighborhood characteristics (specific to localized area j in municipality m), while retaining variation in school district characteristics. Figure 1 characterizes this particular border-discontinuity design.⁷

[Insert Figure 1 About Here]

⁷ Notice that since the τ_m 's can be written as a linear combination of the D_{mj} 's, these cannot be separately included in the estimating equation (2).

Next, as discussed in Section 1, we attempt to neutralize any problems associated with unobservable characteristics in school quality, Q_s , by further limiting our sample to small homes. By treating the typical buyer for a small home as someone who receives little-to-no direct value from public school quality, the parameter γ_Q is assumed to be effectively equal to zero, which eliminates any problems associated with omission or measurement error. Altogether, Equation (1) then reduces to:

$$\ln(V_{imsj}) = \alpha + \mathbf{X}_i' \boldsymbol{\beta}_i + \phi_{mj} D_{mj} + \gamma_\tau \tau_s + \varepsilon_{imsj} \quad (2)$$

where ϕ_{mj} captures the implicit value placed on the bundle of characteristics unique to neighborhood j in municipality m .

2.2 Data

The major source of data for this project is the restricted-access micro data sample of the 2000 Decennial Census of Population and Housing, which provides detailed data on all responses to the long-form questionnaire.⁸ The long-form was distributed to about one out of every six U.S. households, approximately 16% of the population. The sample reports detailed socio-demographic and housing-related data for all respondents and, of particular use to this study, provides geographic indicators for each household down to the census block level.⁹ This level of geographic fineness allows us to identify, with relative accuracy, the location of a household vis-à-vis a school district border, thus facilitating our border-discontinuity design.¹⁰

⁸ A similar sample from 1990 was used in BFM in their study on the impact of school test scores on housing prices.

⁹ See ICPSR (2011) for full documentation.

¹⁰ The public-use micro sample (PUMS) for the 2000 Census identifies household geography down to the level of a Public-Use Microdata Area (PUMA) which is far larger in geographic scope than a census block. PUMAs contain at least 100,000 people and often cross school district borders. Census blocks are the finest unit of geography measured by the U.S. Census and are bounded on all sides by visible (e.g., streets, rivers, highways, etc.) and invisible (e.g., townships, municipalities, counties, etc.) features and, therefore, are much more likely to fall completely within a school district border. BFM use this same approach.

The sample for this study consists of owner-occupied small homes within a select number of cities in Cook County, Illinois (excluding City of Chicago). Each of these cities is served by two school districts such that a single school district border splits the geography of the city into two separate communities.¹¹ To facilitate the border-discontinuity design illustrated in Figure 1, this sample is limited to small homes that are within a quarter-mile of the school district border, thus limiting a neighborhood to a half-mile in width.¹² Using the geographic centroid of a home's census block to define its location in space, each home is then assigned to a unique half-mile-by-half-mile buffer that demarcates an artificial neighborhood along a school district border.

Summary statistics for the sample of small homes lying on either the low- or high-tax side of a school district border are provided in Table 1. As expected, home prices are significantly higher on the low-tax side, suggesting school district property taxes are capitalized at least partially into property values.¹³ Additionally, there is evidence that households sort into school districts based on socio-demographic traits. In particular, high-income as well as Hispanic households appear to be over represented on the low-tax sides of a border. As initially suggested by BFM, because sorting patterns of this type occur even within neighborhoods but across district borders, failure to account for the socio-demographics of a particular home's "side" of a neighborhood may bias estimates of Equation (2). Lastly, it does appear that homes on either side of a school district border are similar in their structural attributes, especially with respect to home size, as defined by number of rooms and bedrooms.

[Insert Table 1 About Here]

¹¹ For the purposes of this study, school district borders are defined according to secondary or unified school districts. We discuss the treatment of school district borders in greater detail in Appendix A2.

¹² The following observations were also dropped from the sample: all homes failing to report a property value, mobile homes or RVs, homes with an assigned household weight of zero, farms, homes in rural areas, homes with allocated property tax data, homes with an effective property tax rate of zero, homes falling into neighborhoods that cross municipal boundaries, homes that fall into neighborhoods that straddle more than two school districts, homes that fall into neighborhoods that do not have at least one sampled observation on either side, homes that fall into neighborhoods where the difference in effective tax rates is smaller than the average difference for the metropolitan area.

¹³ Our methods of constructing measures for home value, *Home Value*, and effective property tax rates, τ , are discussed in the Appendix.

3.0 Estimation Results

The OLS estimates of Equation (2) are provided in Table 2. It should be immediately noted that the relatively high values for the adjusted r-squared indicates that the model does a good job of explaining home value. Although much of this explanatory power is attributable to the inclusion of neighborhood fixed effects, the strength of this model helps mitigate the concern that excluded determinants of home value may bias our estimates.¹⁴ With the exception of τ_s , all other control variables enter the equation with only weak precision, presumably due to the strength of the neighborhood dummies.

The variable of primary interest, τ_s , is of the anticipated sign, large, and statistically significant, indicating that property taxes are capitalized negatively into home values. In particular, the estimate reported here suggest that a one percentage point increase in property taxes (or about a 50% rate increase in the total effective property tax rate) holding all else unchanged, reduces home values by approximately 34%. This estimate is not directly comparable to those provided by Palmon & Smith (1998a, b) who report a capitalization formula as opposed to a hedonic price equation. However, it is not difficult to approximate the relationship between our estimate and theirs at mean tax rates. Doing so also allows us to gauge the rate of capitalization implied by our results.

[Insert Table 2 About Here]

In principle, a fully specified capitalization equation takes the form:

$$V_{imsj} = \frac{R(X_i, Z_{mj}, Q_s)}{\rho + \delta(\tau_m + \tau_s)}$$

where $R(\cdot)$ is a function returning the rental value of a home's structural, neighborhood, and school district characteristics, ρ is the net user cost of housing, τ_m and τ_s are non-school and

¹⁴ It is interesting to note that Black (1999, Table II) and BFM (Table 3, Columns 2 & 4) report similar r-squared statistics, ranging from 0.63 to 0.67.

school district property tax rates, respectively, and δ is the rate of property tax capitalization. Consider now the ratio of values for two structures with the same rental values, R^* , a given net cost of capital ρ^{*15} , the same non-school tax rate τ_m^* , but with school taxes differing by a small positive amount, $\Delta\tau_s$. Then the difference of the logarithms of the two values just equals:

$$\ln(V') - \ln(V) = \ln(\rho + \delta(\tau_m + \tau_s)) - \ln(\rho + \delta(\tau_m + (\tau_s + \Delta\tau_s))) \quad (3)$$

where V' is the value of the house with a higher tax rate. The left hand side can be estimated directly from our semi-logarithmic hedonic, i.e. Equation (2). Since all terms other than τ_s are the same for V' and V , this just gives:

$$\ln(V') - \ln(V) = \gamma_\tau \Delta\tau_s.$$

which is taken from Equation 2. Using our estimate of -0.34 for γ_τ and setting $\Delta\tau_s = 0.1$, gives -0.034. Substituting this value for the left hand side of Equation (3) yields:

$$-0.034 = \ln(\rho + \delta(\tau_m + \tau_s)) - \ln(\rho + \delta(\tau_m + (\tau_s + \Delta\tau_s))) \quad (4)$$

which for given values of ρ , τ_m , and τ_s can be solved for δ , the rate of property tax capitalization.

As a simplification, $\delta = \frac{\rho}{[32.3\Delta\tau_s - (\tau_m + \tau_s)]}$ $\delta = \frac{\rho}{32.3\Delta\tau_s - (\tau_m + \tau_s)}$. Setting $\rho = 1.0$, and the average values of τ_m and τ_s to 1.0 and of 1.2, respectively, yields $\delta = .97$, which suggests near full capitalization of property taxes.¹⁶

This estimate is quite close to those reported by Palmon & Smith (1998a, b), who report rates of capitalization near 100%. Oates (1969) and Rosen & Fullerton (1977) also suggest

¹⁵ We assume constant net user cost across neighborhoods and an infinite discounting horizon. Constant net user cost implies that discount rates and rates of maintenance, inflation, and capital gain/depreciation are constant across households.

¹⁶ The average values of τ_m and τ_s are taken from the sample as well as the Illinois Department of Revenue (1998).

property taxes are heavily capitalized into property values, suggesting rates of capitalization between 66% and 88%. Altogether, a consensus appears to have emerged within the literature: when benefits are reasonably controlled for, property taxes are found to be negatively, and quite strongly, capitalized into property values. This is a rather intuitive conclusion and consistent with the general belief that, holding benefits constant, households will require a discount in order to buy into a community with higher property tax rates. However, it is also very important to note that it is the quasi-experimental designs, such as the one used in this paper, that have regularly returned estimates of nearly full (i.e., 100%) capitalization.¹⁷ Because an identification strategy of this type is explicitly designed to avoid biases resulting from spurious correlation (between taxes and unobserved public services), this suggests that the earlier studies likely reported capitalization rates that were biased towards zero as a result of omitted variables, though not necessarily biased to a terribly large degree.

An important caveat should be noted as these estimates (like those of other studies) are highly sensitive to the chosen net user cost, ρ . Thus, the choice of values for this parameter is not trivial. The value used here is based on Quigley & Raphael (2004) and Cho, Kim & Wachter (2010), both of which observe a fall in the cost of capital in the late 1990s and early 2000s. Indeed, Cho, Kim & Wachter (2010) suggests that by 2002 the cost of capital had gone negative. Notice, previous work appropriately used higher net user costs consistent with characteristics of an earlier housing market. This complication is systemic to the capitalization literature and inherent in using a semi-log hedonic equation. Similar sensitivities, however, characterize non-linear estimations of the capitalization equation.

4. Conclusion and Discussion

This study suggests that focusing on education taxes and small homes provides a convincing approach for estimating the rate at which property taxes are capitalized into home values. As argued above, this rate seems to be close to 100%. The findings reported here are of particular interest because they avoid much of the potential for bias that has been present in earlier studies. In addition to our border discontinuity design, we limit our sample of homes to a stratum of the

¹⁷ Cushing (1984) was the first to adopt a quasi-experimental border discontinuity design for the study of housing price capitalization. His estimates also suggest near full capitalization of property taxes.

housing market whose values are not believed to reflect differentials in a commonly omitted and difficult-to-measure variable: the provision and quality of local public schools. This is because, for most households living in small homes, education property taxes represent a cost without an offsetting benefit.

It is reasonable to ask why this straightforward approach has not been attempted before. Interestingly, the conditions for this quasi-experiment did not hold fifty years ago when the capitalization literature first began. The requirement for the estimations presented here is the imposition of a significant tax without a significant benefit. By the year 2000 small suburban homes were only rarely occupied by households with children attending local public schools. This is the key to our identification strategy. However, data from 1960 shows that households occupying small homes in that year were considerably more likely to include public school students than similar homes in 2000. As shown in Table 3, in 1960 almost 30% of small homes in suburban Illinois included public school children. In 2000 the corresponding figure was only 12%.¹⁸ The identification strategy used here would not have worked for 1960 because suburban households in small homes then often had children in public schools. Indeed, the 30% figure for small homes in 1960 is almost as large as the 2000 figure for large homes, 32%. Thus, small homes in 1960 must have been just about as caught up in the complexities of capitalizing schooling benefits as large homes in the later year. From this perspective, the identification opportunity used in this paper only appeared relatively recently.

The data for large homes in Table 3 suggest the increasing difficulty of thinking about the impact of school quality and taxes on the value of these homes. In contrast to 1960, by 2000 the owner-occupiers of large suburban homes are a highly heterogeneous group, with only a minority actively using the public school system. While capitalization theory for small homes is fairly straightforward, these large homes present serious theoretical questions for today's housing market. Fischel's (2001) home voter hypothesis must seem weaker as the proportion of households without children in the public schools increases. Under that hypothesis, the median household in a suburban community places heavy weight on the quality of schools for two reasons. First, that household may include children attending local public schools. Second, the hypothesis also anticipates that when a household eventually sells its home, school quality will

¹⁸ The data are for Illinois suburban households in owner-occupied homes. Data for suburban Cook County are not available for 1960. See Ruggles *et al* (2010) for documentation.

be capitalized into home value because potential buyers will also value schools. With the median voter well disposed toward school quality, there is strong support for education taxes. However, if less than a third of suburban households have students in local schools, the median voter in any given jurisdiction is not likely to have children enrolled in those schools. Moreover, when that median household sells, a large proportion of potential buyers will themselves not have public school children. In essence, what is currently the case for small homes is increasingly the case for all homes.

From this perspective, public school systems look less and less like traditional public goods and increasingly like redistribution programs (see Kurban, Gallagher, & Persky, forthcoming). Resolving the multifaceted sorting issues raised by this observation is a research task well beyond the current paper. We make these observations only to underscore that in many ways small suburban homes are substantially less complex objects of study.

The full property tax capitalization rate estimated here for small homes still leaves open the question of which households bear the burden of that taxation. If buyers of small homes are fully compensated for education property taxes, to whom are these taxes shifted? Our results do not provide a clear answer to this question. Possibly some of the burden may be shifted back onto former owners who purchased their homes in a period when the market for small homes involved more households with public school children. At an earlier date, small homes in high quality/high expenditure school districts might have even sold at a considerable premium. These homes might have represented relatively cheap entry points to valuable public services. Holding on to such real estate over an extended period, while facing a changing pattern of market demand, households may have realized substantial capital losses. Of course such losses would have been hard to isolate in markets characterized by considerable nominal and real appreciation. Sellers were most likely unaware of this change. Alternatively, for newer dwellings, developers of small homes (including condos) in high tax school districts may have borne a considerable portion of the negative capitalization. Other things equal, these developers could sell their product only at a discount from the price obtained for similar units in nearby low school-tax jurisdictions. In the long-run we would expect developers of small homes to only build on the low-tax side of such boundaries.

Looking forward, residents of small homes may become more hostile to efforts to improve the local public schools. Indeed, given the trend toward fewer and fewer households with public school children, we might expect to see a more general decline in support for schools from local residents. Much evidence already suggests these trends, especially among elderly households (Button, 1992; Poterba, 1997; Harris, Evans, & Schwab, 2001). More generally, many of the issues raised here with respect to education taxes, appear in more modest fashion with respect to other local services. The broad trend in suburban finance toward user fees would seem to underscore this observation (Netzer, Schill, & Susin, 2001; Been, 2005). The increases in suburban heterogeneity, differences in tastes for public goods, and an increasing ability to tailor public services to individual user demands all seem to suggest a breakdown in the Tiebout picture of local public goods provision. All these observations point toward the need for rethinking our models of suburban public finance.

Finally, we can only speculate on the appropriateness of extending our finding of full capitalization of property taxes on small homes to the larger population of owner-occupied suburban dwellings. We find the case for such an extension plausible. But, precisely because of the confusion surrounding the distribution of benefits achieved from diverse publicly funded goods over increasingly diverse suburban populations, it will remain quite difficult to empirically validate this proposition in the foreseeable future.

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Appendix

A1 Estimating the Home Values

Self-reported home values reported in the 2000 Census microdata file are placed into 24 bins ranging from a low of “\$0 – \$10,000” to a high of “≥ \$1,000,000”, thus adding much noise to the dependent variable of our hedonic housing price equation. To obtain a more accurate measure of property values we use self-reported property tax payments, along with a host of local property tax rate data (including exemptions), to impute home value.

Self-reported property taxes reported in the restricted-access Census 2000 microdata file, tax_i , include all real estate taxes paid on the property in question, i , for calendar year 1999. Thus, one benefit to our imputation technique is that it relies on relatively recent tax data that, unlike property value, most households likely know with relative certainty. In addition, because tax_i is continuous (ranging from \$0 to \$9,999), it allows us to impute a continuous measure of home value. To this end, for every owner-occupied house, i , located in county c , township t , and city k , we make the following assumption:

$$tax_{i,ctk} = \tau_{ctk} \overbrace{ctk}^{\text{taxable value}} (V_{i,ctk} \times E_c - \text{senior}_c - \text{owner}_c) \quad (A1)$$

where τ_{ctk} is the average aggregate statutory property tax rate for the geographic region intersected by county c , township t , and city k , V_i is a particular home's market value, E_c is the equalization rate applied to owner-occupied home values in county c , and senior_c and owner_c are lump-sum senior (for householders aged 65+) and owner exceptions for county c , respectively.¹⁹ Rearranging terms solves for V_i :

¹⁹ The variable $\text{senior} = \$2,500$ in Cook County, IL and \$2,000 on all other metropolitan counties. We apply the senior exemption to households in cases when the self-reported household head is age 65 years or older. The variable $\text{owner}_c = \$4,500$ in Cook County and \$3,500 for all other counties. Because our sample is limited to owner-occupied dwellings, we apply the appropriate value of owner_c to all homes in the sample. The equalization

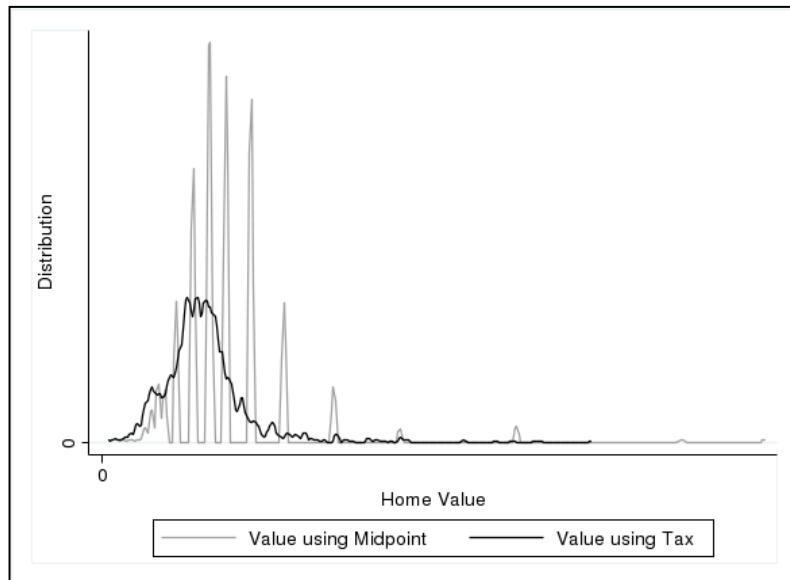
$$V_{i,ctk} = \left(\frac{\text{tax}_{i,ctk}}{T_{ctk}} + \text{senior}_c + \text{owner}_c \right) \frac{1}{E_c}$$

(A2)

Statutory tax rate data use to construct T_{ctk} came from the Illinois Department of Revenue's (IDOR) *1998 Illinois Property Tax Statistics* report (IDOR, 1998) which provides data on aggregate statutory property tax rates applicable in calendar year 1999. These rates are provided for all county seats as well as cities with populations of 10,000 or more people. Rates for these cities are geographically disaggregated by county and township. In instances where multiple rates are reported within a particular township an average is taken.

Figure A1 reports k-density plots for two imputed values of V_i : (a) using the midpoint of the self-reported 24 bins reported in the microdata file and (b) using the method described above (i.e., from tax_i).²⁰ Imputation from property tax payments clearly smoothes out the, otherwise “lumpy”, distribution of house values. The general skew of both distributions is relatively similar, although the imputation using taxes has a substantially lower mean and standard deviation.

**Figure A1:
Imputed Home
Values (k-
density plots)**



factor, E_c , is 0.241 in Cook County and 0.333 in all other suburban counties (see Kurban, Gallagher, & Persky (forthcoming) for a more detailed explanation on equalization in metropolitan Chicago).

²⁰ To avoid disclosure, the k-densities are generated from 1,688 sampled households (12,861 after applying household weights) for the entire metropolitan area. Only observations from Cook County are used to estimate the hedonic price equation. The bins have a width of \$2,500.

Variable	Mean (Std. Dev.), \$	Variable	Mean (Std. Dev.), \$
Home Value From Tax	154,002 (63,759)	Home Value From Tax	154,002 (63,759)
Home Value (midpoint)	185,704 (85,301)	Home Value (midpoint)	185,704 (85,301)

A2 Estimating Effective School District Tax Rates

The average effective property tax rate for school district s , τ_s , is calculated using public school district operating tax rate data (for fiscal year 2000) provided by Illinois' State Board of Education (ISBE) ILearn database (ISBE, 2009). These statutory rates (either unified or elementary *plus* high school) are first assigned to census blocks (based on the geographic intersection of blocks and school districts) and then applied to all imputed owner-occupied home values, V_i , in that block.^{21, 22} This yields the unadjusted school district tax liability for each home, taxes_i . For each school district, the average statutory property tax rate, τ_s , is then calculated as:

$$\tau_s = \left(\frac{\sum_{i \in s} w_i \times \text{taxes}_i}{\sum_{i \in s} w_i \times V_i} \right) \frac{\sum_{i \in s} w_i \times \text{tax}_i}{\sum_{i \in s} E_s(c) w_i \times V_i} \quad (\text{A3})$$

where w_i is the household frequency weight and $E_s(c)$ is the equalization rate for school district s in county c .

²¹ School district boundaries are defined using secondary or unified school district borders in order to facilitate the comparison of average effective tax rates across communities. In particular, the U.S. Census identifies three different types of school districts in Chicago suburbs: unified districts, high school districts and grammar school districts. In cases where a household's block is not part of a unified district, but belongs to separate taxing high school and grammar school districts, we can in principle obtain the exact (as opposed to average) effective tax rate for that home. Such matching would ultimately allow a finer determination of effective tax rates. However, for unified districts, the tax rates funding secondary and grammar expenditures cannot be distinguished. This makes comparisons across communities difficult. Thus, to facilitate comparisons, we aggregate grammar school districts up to their corresponding high school district boundaries.

²² The variable V_i is imputed using the midpoint of the self-reported bin provided in the Census 2000 long-form. The imputed values discussed in Appendix A1 could not be used because many homes fall outside of municipalities with populations of 10,000 people or more.

$$\tau_{ij} = \tau_s \times E_i \text{ (c)}$$

Table 1: Summary Statistics for Sample of Small Homes with .25 Miles of School District Boundary

Variable	Cook County		Difference in Means: High-Tax Side <i>less</i> Low-Tax Side	Difference in Means: t-statistic
	High-Tax Side	Low-Tax Side		
Home Value (imputed)	125,818.60 (38,717.6)	139,800.10 (57,780.6)	-13,981.50	-6.07**
% Black	0.02 (0.07)	0.02 (0.07)	0.00	-0.15
% Hispanic	0.02 (0.08)	0.13 (0.24)	-0.11	-13.22**
Income (Median)	49,522.4 (19,161.8)	56,817.0 (24,434.3)	-7,294.60	-7.08**
τ_s	1.32 (0.19)	1.07 (0.09)	0.26	35.86**
Bedrooms	1.93 (0.25)	1.91 (0.32)	0.03	1.95
Rooms	4.73 (0.91)	4.65 (1.05)	0.08	1.71
Sampled HH Obs.	106	113	n/a	
HH Obs. (weighted)	878	928		

Note: The standard deviation for each variable is reported below the mean in parentheses. ** $p \leq 0.01$, * $p \leq 0.05$. The variables “Pct. Black” and “Pct. Hispanic” measure the percent of a census block’s household heads that are either Black or Hispanic, respectively. The variable “Household Income” measures the median household income at the block level. The reported t-statistic tests the hypothesis that the means between the samples on the high- and low-tax side of a school district border are equal.

Table 2: Regression Results

Variable	Estimate
τ_s	-0.34** (0.11)
share black	0.10 (0.28)
share Hispanic	-0.19 (0.19)
income (median)	1.1E-06 (8.7E-07)
Adj. R-squared	0.68
Sampled HH Obs.	219
Weighted HH Obs.	1,806

Note: ** $p \leq 0.01$, * $p \leq 0.05$. Dependent variable = natural logarithm of imputed home value. Standard errors are reported in parentheses, robust to heteroskedasticity, and clustered around school district. Neighborhood fixed effects and constant term are excluded in order to conserve space. Additional structural explanatory variables included in the regression but not reported here include number of rooms, number of bedrooms and dummy variables indicating:

- (a) whether or not the property was a condo,
- (b) the property type (attached single-family, detached single-family on ≤ 1 acre of land, detached single-family on $1 < \text{acre of land} \leq 10$, detached single-family on > 10 acres of land,
- (c) the decade the home was built.

Table 3: 1960 & 2000 Suburban Illinois Owner-Occupied Household Data

Year	Home Size	# of Households	# of Public School Children	# of Households with Public School Children	% of all Households	% of all Public School Children	% Households with Public School Children
1960	large	87,926	77,766	41,818	57.7%	71.3%	47.6%
1960	small	64,557	31,276	19,226	42.3%	28.7%	29.8%
2000	large	674,902	385,461	216,124	75.4%	90.3%	32.0%
2000	small	220,382	41,624	27,176	24.6%	9.7%	12.3%

Note: Data are from 1960 and 2000 iPUMS. As in the rest of the paper, small homes are those with two or fewer bedrooms. Data are for suburban Illinois households (within a metropolitan area but not within a central city).

Figure 1: Border-Discontinuity Design

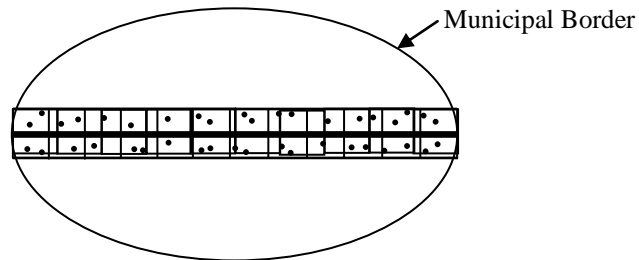


Figure 1: The dark line represents a school district border and the squares measure half-mile-by-half-mile neighborhoods along that border. Black dots represent household observations (as measured by a census block's centroid).