Property Tax Funded Suburban Public Education:

Tiebout Benefits or Community-Based Redistribution?

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Abstract:

The Tiebout-Hamilton model focuses on benefit taxation in homogeneous communities. It is well known that local heterogeneity implies the likelihood of local redistribution. Yet there are no studies of the extent of such transfers. This paper provides evidence that local redistribution in property-tax based suburban schools is substantial (amounting to $2.3 billion for Chicago suburban districts). Most of those transfers flow not from high to low income households, but rather from households with no children in local school systems to households with children in those systems. We show that capitalization offsets little if any of these education "contributions."

Keywords: local public finance, suburban education, property taxes, redistribution, empty-nesters, Tiebout model

1. Introduction

For years, economists' discussions of suburban local public finance have wrestled with the implications of the Tiebout model and its emphasis on demographic homogeneity. (Tiebout, 1956; Hamilton, 1976; Ross and Yinger, 1998, Fischel, 2001)[1] Numerous studies now suggest considerable suburban heterogeneity by income and many demographic characteristics (Persky, 1990; Rhode and Strumpf, 2003). Such heterogeneity has raised a number of issues, including the capitalization of local property taxes and services (Ross and Yinger, 1999; Black, 1999; Bayer, Ferreira, and McMillan, 2007), the residential choices of the elderly (Farnam and Sevak, 2006; Bayer, Ferreira, and McMillan, 2007; Hilber and Mayer, 2009; Shan, 2008), and the role of suburban commercial and industrial property (McDonald and McMillen, Ch. 13, 2007). Despite these concerns, and somewhat surprisingly, little attention has been paid to measuring the actual extent of redistribution achieved in local suburban services. The purpose of this paper is to provide evidence on the existence and magnitude of such redistribution through decentralized education property taxes in suburban school systems.

When local property taxes are Tiebout-Hamilton benefit taxes, redistribution plays no role. However, substantial heterogeneity suggests the possibility, indeed the likelihood, of considerable redistribution. While this question has been in the background of the suburban, local public finance literature, it has only rarely been addressed directly.[2] Yet, in even modestly heterogeneous suburbs, we should expect some redistribution through locally financed suburban public services and major redistribution through suburban public schools. While local governments have long been viewed as unsuitable agents of

redistribution (Oates, 1999), public education remains a major exception, one that still commands an ideological commitment from much of the population. There are serious doubts concerning the quality of schooling achieved in large central cities. Heterogeneity in central cities may achieve little in redistributing real opportunities. But suburban systems are much stronger, even modest heterogeneity may generate considerable redistribution. Indeed, the central thesis of this paper is that suburban public schools are a major component of redistribution in the nation. If this is true, then access to such school systems becomes critically important.

This paper estimates the extent of redistribution through suburban Chicago public schools. How large are such "contributions"[3]? To anticipate our central finding: in fiscal year 2000, home owners in Chicago suburbs paid about $2.3 billion in education property taxes over and above any "benefits" to their own children. This amounts to about two-thirds of all education property taxes paid by suburban home owners and can be compared to the approximately $8.5 billion in social security payments made to suburban Chicagoans. We go on to ask who pays and who benefits from this process. While those with more expensive houses contribute more in terms of property taxes, by far the bulk of the observed redistribution flows from households with no children in the public school system. Finally we consider the extent to which these contributions are offset through the capitalization process and find that capitalization offsets little if any of these education "contributions." These results add further empirical support to the range of critiques of the Tiebout hypothesis and its emphasis on local benefit taxation.

2. Empirical Strategy

We develop an empirical methodology to estimate the level of redistribution that takes place within suburban school districts in six counties of the Chicago metropolitan area. Every homeowner contributes to the local school district by paying property taxes.[4] The cost of local public education to an owner household is determined by tax rate times the equalized assessed value of her home.[5] Within a school district, every homeowner faces the same school district property tax rate, but the total tax bill varies depending on the house value. Even if two households with similar home values face similar property tax bills to support local public education, the direct benefits that they derive from the local public school district can be quite different. Those benefits are determined by the number of children that the two families send to the local school system. Thus household size can be a major factor leading to substantial redistribution among households, even households of similar income and house value. As far as we are aware, the extent of redistribution through family size has not been explored in the local public finance literature.

We aggregate our estimated benefits and costs at school district level. We use school districts because education tax rates are the same in school districts and redistribution decisions are effectively being made at school district level. Only those who reside in a school district can directly benefit from that district's redistribution. Previous studies have focused on the relationship between housing prices and per pupil expenditure levels or school quality. We know of no study that tries to estimate the level of redistribution that actually occurs.

2.1 Constructive Methodology

The key variables in our estimates are year 2000 school district tax rates and per pupil expenditures[6] (from Illinois I-Learn, 2009) and individual household and house characteristics (from the Integrated Public Use Microdata Sample (PUMS) 5% sample of the 2000 Census I-PUMS (2008). Unfortunately we do not have information on the fine geographic location of PUMS households.[7] The basic geography available from the I-PUMS is that of a household's public use microdata area (PUMA), an area of at least 100,000 people. Thus a major problem is how to allocate households to school districts. Our approach to this problem has two steps. First we attempt to allocate households in a PUMA to a specific block group. The second and much easier step aggregates block groups up to school districts using the Mable program from the Missouri Census Data Center.[8]

The PUMA data is rich in detail, with respect to both household and dwelling characteristics. Aggregate block group statistics on many of these variables are available from the Census's SF(3) files. Our basic approach is to allocate households to block groups so as to minimize an error-loss function: $\Sigma \left| (X^*_{ij} - X_{ij}) \right|$, where X^*_{ij} is the value of one of forty-four characteristics (i) for block group (j) and X_{ij} is the estimated value from the allocation. Minimization is carried out through a process of hill climbing.[9] Starting from a random allocation of households, we search through a series of local moves and swaps that reduce the error-loss function. This process is repeated with alternative starting points. See Table 1 for a list of all fifty-four characteristics in the error-loss function. See Appendix 1 for a fuller description of the hill-climbing

technique used here.

Our district level school tax and expenditure data are from the Illinois State Board of Education's I-Learn. A typical PUMA is larger than a typical public school district. There are three types of public school districts: unified school district, high school district and elementary school district. Each school system has its own school district property tax rate applied to assessed property value.

INSERT TABLE 1 ABOUT HERE

2.2 Property Taxes and contributions

2.2.1. Taxes

Any estimate of property-tax financed education redistributions must take as its base estimates of education property taxes. As indicated above we have school tax rate data from I-Learn for each school district. Once a household is assigned to a block group the calculation of its school taxes is straightforward. District tax rates (unified or elementary-and-high school) applicable to a household's assigned block group are summed. The overall rate is then applied to an estimate of equalized assessed value (EAV) for that household less any applicable exemptions.[10] In general the EAV is just equal to the household's self-reported house value from the PUMA times 1/3.[11] The only exemptions included here are the standard household exemption applicable to all households ($4500 in Cook County and $3500 elsewhere) and the senior exemption ($2500 for Cook County and $2000 elsewhere) which we only included if the head of household as reported in the PUMA data was over 64 years of age.[12]

As a check on bias in our micro-estimates, we can compare the collar county aggregates[13] of our estimated education property tax payments to the actual education property tax extensions reported by the Illinois Department of Revenue (1999) for residential property taxes in the same collar counties for the 1998 tax year. The state estimate is $2,426 million, while our estimate is $2,304.[14] Since we are confident about the accuracy of the tax rate data obtained from I-Learn, we take this close match as evidence that the self-reported Census figures for housing values are reasonably accurate in aggregate.

2.2.2. Contributions

Once armed with household education property tax estimates, we can move on to estimate the share of those taxes going for redistribution. Of course that share might be defined in several ways because local school financing draws on many sources. As discussed in more detail below, local school districts obtain financing not only from residential property taxes, but also from commercial and industrial property taxes, state government transfers and federal transfers. Since we are primarily interested in the extent to which residential property taxes go for redistribution purposes, we work with a concept of contributions over and above any gross transfers received by property tax payers. Thus, in any year, a household is defined as making a "contribution" equal to the difference between its property tax payments and the local school expenditures on that household's public school students. If this difference is negative, the household's contribution is defined as zero. In a sense, this definition provides a lower bound to redistribution. A household making a "contribution" might at the same time be

benefiting from dollars originating in non-residential sources such as commercial or industrial property taxes.[15]

The data on expenditures per student are put together much like the data on taxes, except we take weighted averages, rather than simple sums. That is expenditures per student on a given block group are the average of the expenditures per student for each relevant school district, using the block's public school student populations as the weights. For a given household then, its "contribution" is equal to its education property tax payment as estimated above minus the number of public school enrolled students in the household (obtained from the PUMS data) times the weighted average expenditure per student for the block. Only positives are counted as "contributions." Total contributions for a block group or a pseudo-unified school district are sums of household contributions using household weights from the PUMS.

3. Results

A surprisingly large share of residential, education property taxes in the Chicago suburbs take the form of contributions as defined here. Some $2.3 billion out of suburban homeowners' $3.5 billion in education property taxes go for redistribution, just about two-thirds. According to our estimates in Table 2, these contributions finance more than 23% of all Chicago suburban public school expenditures. That figure is of course much larger than self-payments, i.e. residential property taxes which are not contributions. It is of the same order of magnitude as other local sources (including commercial and industrial education property taxes) and support from the state of Illinois.

INSERT TABLE 2 ABOUT HERE

The contribution share differs substantially across pseudo-unified school districts, from about 0.4 to 0.8. As shown in Figure 1, the outer suburbs generally have lower shares, while inner suburbs have higher shares, although there are definitely exceptions to this pattern, for example Aurora West Unified District 129, which includes an older satellite city of the region.

INSERT FIGURE 1 ABOUT HERE

In perfect Tiebout sorting we would expect each school district to contain homogeneous populations and therefore to lack education-property tax redistribution. Property tax payments in such a world would simply represent benefit taxation. But clearly populations in school districts must differ in a number of ways since we estimate over two-billion dollars in contributions.

Perhaps the most obvious heterogeneity in suburbs is the variation in housing prices themselves. Since property taxes are roughly proportional to housing values, heterogeneity in housing values within a school district implies that some households pay more than others. Housing value heterogeneity is considerable in Chicago school districts. Moreover, heterogeneity varies from district to district. The Bloom Township High School District 206 in Chicago Heights has an interquartile variation in house value of 1.21, while Plainfield School District 202 in Plainfield has an intequartile variation of

only 0.28. Figure 2 shows the distribution of interquartile variation in housing values across pseudo-unified school districts.

INSERT FIGURE 2 ABOUT HERE

To what extent is a high contribution share in education property taxes associated with greater variation in housing values? The simple correlation between these two variables is 0.34. Regressing contribution share on the interquartile variation in housing values gives a coefficient of 0.10 with a standard error of 0.03. A somewhat weaker but similar correlation is evident between contribution share and interquartile variation in income

Differences in housing values affect households' contributions on the tax side. Estimated contributions are also affected by the number of children a household has in the public school system. Indeed, this is by far the stronger connection. The simple correlation between contribution share and the share of households in a school district with no children enrolled in the public schools (nopub share for short) is 0.89.[16] The similarity in the geography of contribution shares (Figure 1) and that of the nopub shares (Figure 3) is striking.

INSERT FIGURE 3 ABOUT HERE

A simple regression of contribution shares on nopub shares gives a coefficient of 0.96 with a standard error of 0.54. If we enter both the nopub shares and the interquartile

variation of housing values on the right hand side of the equation, the latter is completely dominated by the former. Indeed, the coefficient of interquartile variation falls to 0.00. The interquartile variation of housing values "works" on contribution share only through its simple correlation of 0.38 with the nopub share.

Who are the suburban households without public school children? The most obvious members of this group are households with older heads. A surprisingly large number of older households remain in suburbs even though they continue to contribute, but no longer benefit from education property taxes. On average, 25% of the households in pseudo-unified school districts have a head 60 years old or older. Figure 4 shows the distribution of this variable across suburban pseudo-unified school districts. Share-60-or-over maps across school districts in much the same way as nopub-share. The simple correlation between nopub share and share of households with heads 60 or over is 0.66.

INSERT FIGURE 4 ABOUT HERE

A weaker correlation (0.20) exists between nopub share and renter share (i.e. renting households as a share of all households.) On the other hand, young household share (head younger than 35), Hispanic household share and black household share are all negatively correlated with nopub share (-0.21, -0.21, -0.07, respectively). When we regress contribution share on this complete set of controls, nopub share still strongly dominates, with only weakly significant positive effects for black share and Hispanic share and a somewhat surprising weak negative effect of rental share.

4. Capitalization and Contributions

The estimates in the last section suggest that the larger share of suburban education property taxes goes for redistribution. These are clearly not Tiebout benefit taxes. The literature on suburban property taxes seems at times to suggest that any tax other than a pure benefit tax will be fully capitalized into property values (Ross and Yinger, 1999). Some suburban households, those with children in the public school system, benefit from education expenditures. For them a high level of expenditures per student even when associated with high taxes may be viewed as an amenity, putting upward pressure on local housing prices. But for the majority of suburban households who don't have children in the local schools, public school taxes are a burden. Efforts to include the presence of school age children as a taste-determining demographic characteristic in sorting models (e.g. Bayer et al., 2007) seem to produce relatively small effects of this variable on willingness to pay. Under the circumstances it is an empirical issue whether school districts with high levels of expenditures increase or lower housing values. In particular, we are concerned whether redistribution contributions are offset by lower house values and hence lower mortgage payments.

As an empirical strategy we estimate capitalization equations of the traditional type for all home owners in the Chicago suburbs. The basic data are again from the PUMS 5% sample. In our first equation (Table 3) we regress home value on the dummy variables for the number of bedrooms, number of rooms, three lot sizes (<1 acre, 1-10 acres, >10 acres), whether the unit is a condominium, dummies for structure's age, the average household income in the block group of the unit, share of households with a black head, share of households with an Hispanic head and county dummies.

INSERT TABLE 3 ABOUT HERE

The results for the overall equation suggest a rough balancing of positive effects from higher levels of expenditures per student and negative effects from higher tax rates. If we interpret the overall equation mechanically, it would imply that the school tax and expenditure variables increase housing values in the Chicago suburbs by over $9 billion in comparison to an expenditure-tax package that generates zero capitalization effects.[17] On an annual basis (at a real cost of capital of 7.5%) this would imply additional out-of-pocket costs (e.g. mortgage payments) or opportunity costs of about $675 million. Interpreting this literally, suburban homeowners, in aggregate, are paying a premium compared to an (admittedly implausible) counterfactual of no public school taxes or expenditures.

The above calculations are not very informative for our purposes. We are most interested in whether "contributing" households are paying a premium or receiving a discount. Limiting the sample to such contributors gives an annual payment of $486 million. At least according to this calculation, contributors are actually paying for the privilege of supporting the public schools perhaps in accordance with their only modestly reduced willingness to pay. Alternatively, it may be that such households, especially the empty nesters among them, demonstrate in their residential choices not so much a willingness to pay for a "good" as simple inertia.

It seems reasonable that capitalization levels will vary by type of home. In

Table 3 we present capitalization coefficients for four equations, stratified by number of bedrooms. For homes with zero or one bedroom, the coefficients aren't significant (although the tax rate coefficient is close to the 10% level). Still, if we use these point estimates, the 35 thousand (after weighting) "contributors" in such units receive an annual offset of $18.5 million in lower capital costs against their contributions of $41.3 million. It would seem that the bulk of households in this market are unlikely to have children in public schools and the capitalization factors reflect their inability to benefit from school expenditures. However, even then the offset seems considerably less than the redistribution contributions.

The capitalization equations for all larger home sizes suggest that contributing households pay an education premium over and above their "contributions." For two bedroom homes we estimate this at $16.1 million. For three bedroom homes at $188 million, and larger homes at $261 million. If these numbers are reasonable, contributors, even after adjusting for home size, are paying about $430 million annually in higher capital costs, despite their considerable contributions to the public school systems of their communities.

While we find some evidence for offsetting capitalization for "contributors" in small homes (35 thousand households), the bulk of contributors (almost 950 thousand households) in homes with more than one bedroom receive no capital offset to their redistributional education payments.

5. Other Financial Sources of Education Redistribution

Up to now, we have only considered contributions made by home owners. A surprisingly large number of suburban households rent their dwellings. Overall renters account for about 24% of all households in the Chicago suburbs. About three-quarters of these households (as compared to two-thirds of home owners) have no children in the public schools. Still, renting households account for a little more than 19% of all public school children in the suburbs. The question naturally emerges as to the extent of education contributions made by renters.

In Table 2 we estimated the education property tax payments made on rental properties to be 6.3% of all education expenditures. This estimate is admittedly crude. It is based on a simple capitalization of Census self-reported monthly rents to estimate the value of rental structures. This rough value figure is then used to estimate assessed values and education property taxes.

Assuming these estimates are at least roughly accurate, we still face the considerable problem of who pays these taxes, the owners or the renters. While historically the assumption has been that property taxes are shifted to renters (Aaron, 1975) the recent literature is a good deal more mixed. We do not try to solve this conundrum here. Instead, we ask a simpler question: given the estimated taxes paid on a rental dwelling, how common is it for those payments to exceed the expenditure benefits reaped by the households living in that dwelling? This difference, when positive, we define as "rental contributions." For a given rental household then, the "contribution" is equal to its education property tax payment as estimated above minus the number of public school enrolled students in the household (obtained from the PUMS data[18]) times

the weighted average expenditure per student for the block/pseudo-unified school district. Only positives are counted as "contributions." Total contributions for a block group or a pseudo-unified school district are sums of household contributions using household weights from the PUMS.

We estimate in this way rental contributions of $529 million out of the total education property tax payments of $722, i.e. about 73%. These contributions like those of home owners are primarily generated from the three-quarters of rental households without children in public schools. While the incidence of property taxes on rental units is complex, these units generate considerable "contributions." Both rental households and owner households in total receive education benefits much greater than the corresponding education tax payments on their dwellings (the latter are about 42% of the former for owners and 38% for renters). If renters are paying their property taxes, then the picture here is not substantially different than homeowners. Since renters are not distributed randomly across suburbs, but rather are more concentrated in older suburbs, the correlation between renter contribution per student and owner contribution per student is relatively low at 0.25.

Another major source of funding for Chicago suburban public schools is aid from the state of Illinois. We get these figures for each school district from the I-Learn data. State aid is determined by a foundation level and is aimed at compensating for low levels of local tax bases.[19] As such it is explicitly redistributional in character. Interestingly it accounts for less redistribution than contributions by home owners (19% as compared to 23%). In this sense education property tax contributions are a larger redistribution program than the education program of the state. However state transfers per student are

concentrated on poorer districts, while contributions per student are larger in richer districts. State transfers per student have a correlation of -0.48 with the median household income of pseudo-unified districts, while owner contributions per student have a positive correlation of 0.63. Thus the two sources of funding per student are negatively correlated at (-0.54).[20]

We also attempt to estimate the funds coming from other local sources to suburban school districts. From the I-Learn data we have information on total local education revenues including all property taxes and other local sources. Subtracting our estimates of residential and rental property taxes from this local total gives us a residual figure, accounting overall for 29% of suburban education expenditures. By far the largest components of this residual are education property taxes on commercial and industrial structures. Again it is difficult to determine the precise incidence of these property taxes. To the extent they fall on business owners they are strongly redistributional in character. To the extent they fall on residents/customers in the suburbs they are more diffuse. Again such a determination is beyond the present exercise. However, we do note that these other revenues measured per student are not closely correlated with median incomes (-0.11) or with owner education contributions (-0.04), but are more clearly inversely correlated with state transfers per student (-0.48).

6. Discussion and Speculation

While the Tiebout model looks at suburbs as a means of achieving efficiency in the provision of local public goods (matching each household with the bundle of public goods and benefit tax payments it most desires), observers have long realized that

suburban public school financing involves redistribution. The estimates presented here suggest that such redistribution is considerable. Suburban households without children in the public schools make especially large contributions to the education of their neighbors children. These contributions are larger for the suburbs of Chicago than all state funding for public schools in that area. These contributions do not fit neatly into a Tiebout world. Nor do they seem to be offset by any process of housing value capitalization.

Where Tiebout envisions a residential location process dominated by the search for desired local public services, the suburbs described here are as much characterized by a commitment to community redistribution as by a narrow calculus of household costs and benefits from education services. We do not pretend to understand the full economics and sociology of these communities. Older households in particular seem willing to accept large property tax bills even when they do not have children benefiting from local public education. For sure these contributions may be partially offset by other amenities, e.g. security, low densities, and the like. At the same time such households may remain in their homes from a sense of community or familiarity. They may well subscribe to a norm that accepts the appropriateness of making contributions to the education of young people living in one's immediate neighborhood, young people who are likely to be from a similar social, racial and class position (Hilber and Mayer, 2002). Alternatively, empty nesters may simply evince an inertia in their residential choices that has little to do with maximization. In that case, willingness to pay may not be the most useful modeling strategy.

Whatever the explanations for these observed patterns, it is clear that the redistribution described here is not primarily from the well off to households with low

income. Indeed, suburban segregation by income while not complete, largely limits such redistribution.

Given the highly segregated nature of U.S. suburbs, and Chicago suburbs in particular[21], the redistribution through education property taxes does relatively little to reallocate resources from more prosperous households in largely white suburbs to African American or Hispanic communities in greater need. While redistribution through the state does address such questions, in Illinois the larger education redistribution through property taxes has no similar effect.[22] A broader redistribution of these property taxes might be achieved through regional tax sharing (Orfield, 2002), but such programs have little if any support in suburban communities.[23]

While public finance theory has often suggested that redistribution activities should be concentrated at the highest levels of federal governments (Oates, 1999), public education in U.S. suburbs is heavily financed from local and state sources. Indeed, it represents almost a reversal of the traditional wisdom. Where social security, food stamps, and earned income tax credits are all housed at the national level, education remains primarily a local concern. Since the United States prides itself on extending education opportunity to all and the dominant world view emphasizes redistribution through education rather than directly through transfers, it seems particularly odd that we have left education so considerably at the local level. Redistribution does occur in public education, even in the suburbs. But the bulk of that redistribution is largely intra-communal.

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Appendix: Hill Climbing

Our basic approach to allocating individual households identified by PUMAs to block groups and then school districts has two steps. First we allocate households in a PUMA to a specific block group. The second and much easier step aggregates block groups up to school districts using the Mable program from the Missouri Census Data Center mcdc2.missouri.edu/websas/geocorr2k.html. The only difficulty in this second step arises in the situation where a block group straddles two or more school districts. The Mable program allocates shares of the block group to each district based on the number of housing units at the block level in each district.

The first step, allocating households in a PUMA to block groups, is much more challenging. The PUMA data is rich in detail, both with respect to household characteristics and dwelling characteristics. The problem is to use this data to classify all the sample households in a suburban Puma into block groups. For each block group the Census gives us considerable data on a range of statistics and distributions (SF3).[24] We use these block group statistics and distributions to construct a multivariate error function. Minimizing this function becomes our immediate goal.

Our basic approach to this minimization problem uses a hill climbing heuristic.[25] We start from a random allocation. Had we stopped there, in effect, we would be assuming that every block group has the same distribution of household characteristics as its PUMA. Such an assumption grossly misrepresents the composition of most block groups.

For each separate PUMA our heuristic adjust the random allocation of households to block groups according to a hill climb plan aimed at minimizing an error loss function: $\Sigma \left| (X^*_{ij} - X_{ij}) \right|$, where X^*_{ij} is the value of one of forty-four characteristics (i) for block

group (j) and X_{ij} is the estimated value from the allocation. The fifty-four block group level characteristics include number of black households, number of Hispanic households, the age distribution of household heads, number of rentals, number of public school kids, distribution of household income, distribution of housing value.

Within each PUMA, the early adjustments through hill climbing are based on 500 thousand random local moves of individual households. For a PUMA, these local searches were repeated twenty times separated by random reassignments to avoid only local searching. These assignments were then modified by a series of random swaps between block groups ($50^2 - 200^2$ for each PUMA). Finally a series of deterministic swaps allowed a search through each pair of block groups for the best household swaps. For the households in each PUMA the final allocation is the one which minimizes the loss-function over all visited allocation. In general these final scores were about an eighth of the score obtained from a single local search.

Clearly the heuristic employed here has a somewhat arbitrary character. In particular, it can't guarantee a minimum or even specify our error as compared to that unknown global minimum. However, we can, in this case, provide reasonable bounds on the relevant calculations in the text. We are primarily concerned with our estimates of contributions by suburban property owners. In a perverse world where contributors sought out the block group with the lowest possible tax rates in their PUMA, their contributions would be much smaller than actual. Alternatively, should contributors seek out the highest possible tax rates in their PUMA, contributions would be much higher than actual. We can relatively easily perform this experiment for each PUMA. The upper and lower bounds average +/- 20% off the estimated values. (See Appendix Table

A1.) From the perspective of this paper it is the lower bound which is of greatest interest. A 20% error in this direction would imply a 20% reduction in contributions. While significant, such reductions would still leave overall contributions large. Moreover, we have no reason to expect our estimates to be biased. The balance of the minimum and maximum bounds supports this proposition.

Table 1: Variables Used in the Hill Climbing Allocation Heuristic

Total Households	Rental Households
Number of Public School Students	24 House Value Categories
Black Headed Households	Hispanic Headed Households
9 Household Head Age Categories	16 Household Income Categories

The heuristic used to assign households from PUMAs in the I-PUMS data to block groups searches for a minimum sum of the absolute errors of all fifty-four of these variables.

Table 2: Contributions and Other Sources as Shares of Public School Expenditures

Source	Mean	Std. Dev.
Contributions/Expenditures	0.230	0.086
Self-payments/Expenditures	0.119	0.048
Rental Property Taxes/Expenditures	0.063	0.039
All Other Local Revenues/Expenditures*	0.291	0.127
State Revenues/Expenditures	0.192	0.110
Federal Revenues/Expenditures	0.036	0.039
Other (Expenditures-Receipts)/Expenditures	0.068	0.095

The distribution of funding sources for suburban public school expenditures based on I-Learn data and estimates by the authors.

* Includes commercial and industrial property education taxes, calculated as a residual from “local sources” category in I-Learn.

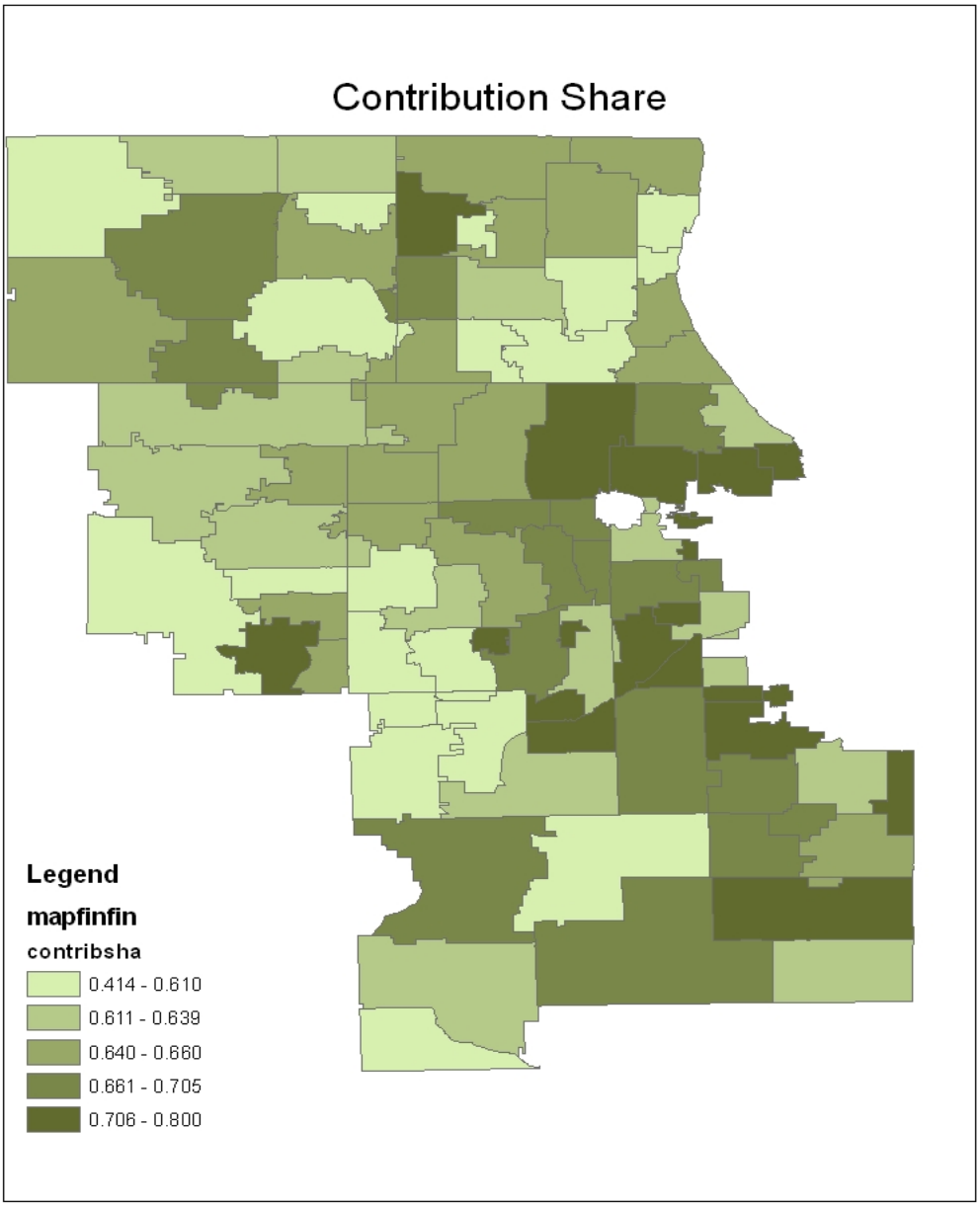

Figure 1: “Contributions” as a share of all owner education property taxes for Chicago suburban school districts range from about 40% to 80%.

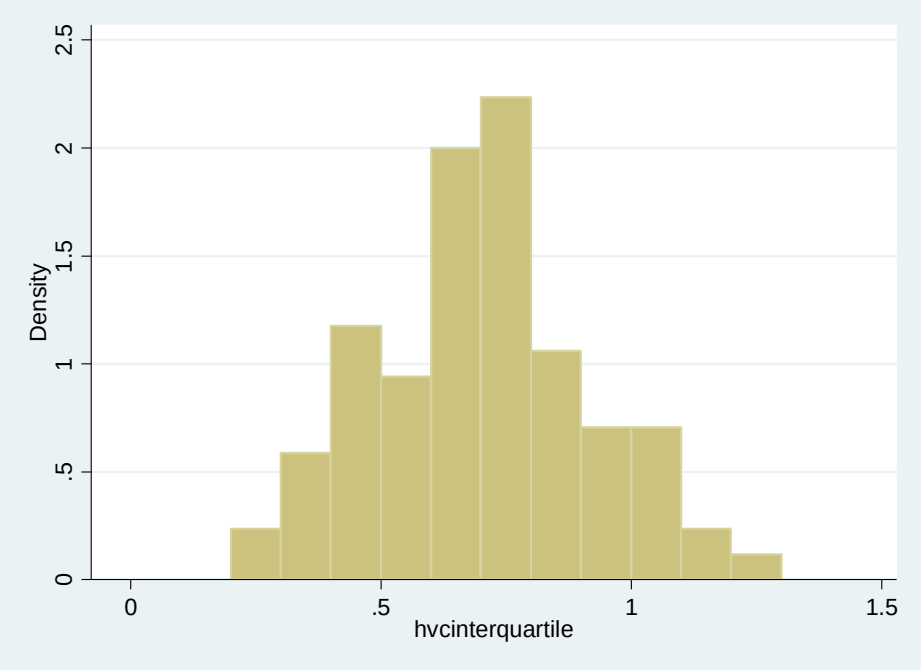

Figure 2: Interquartile variations in house values differ substantially from one Chicago suburban school districts to another.

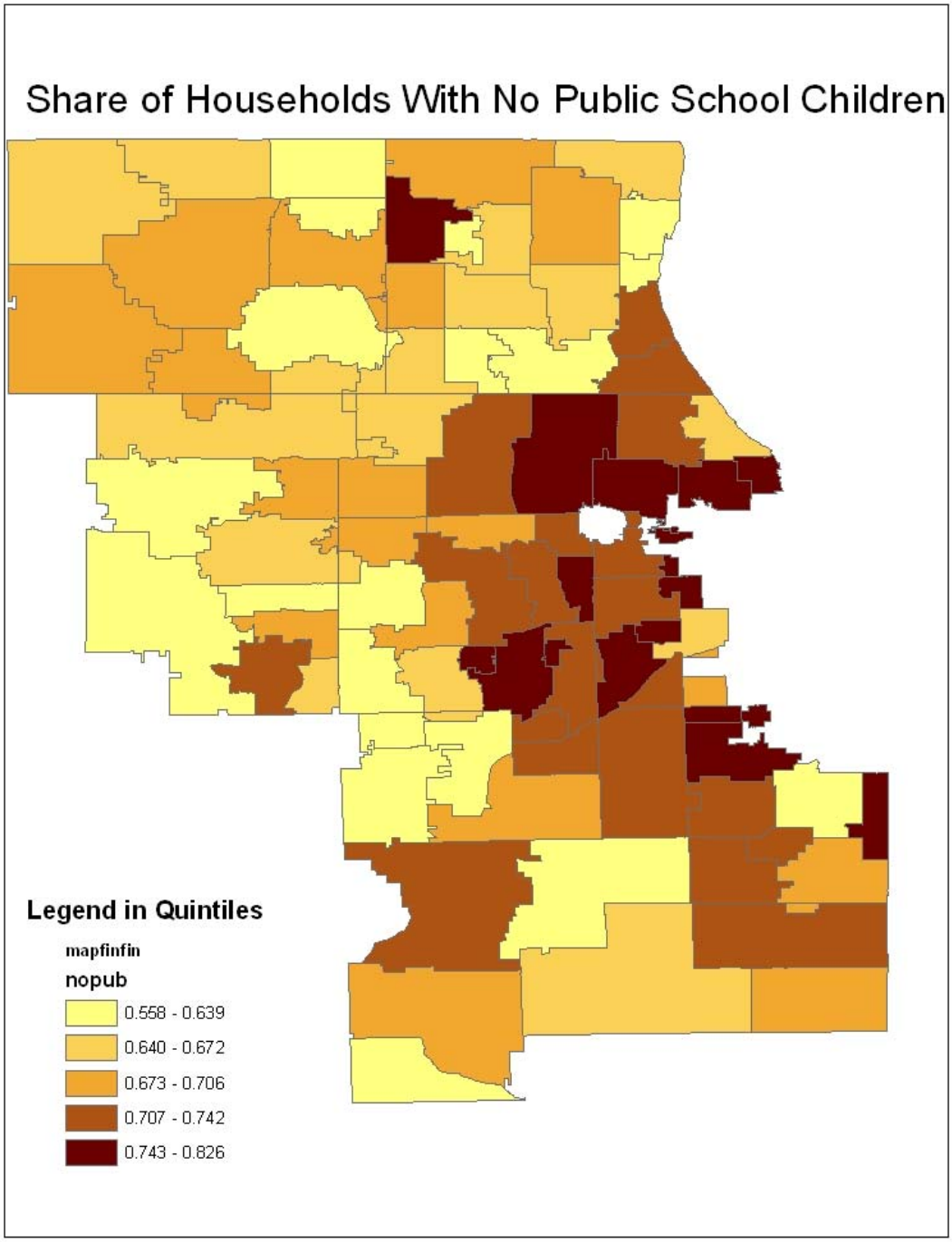

Figure 3: The shares of households in suburban Chicago school districts with no children in those districts vary from 55% to 83% and tend to be lower near the metropolitan periphery.

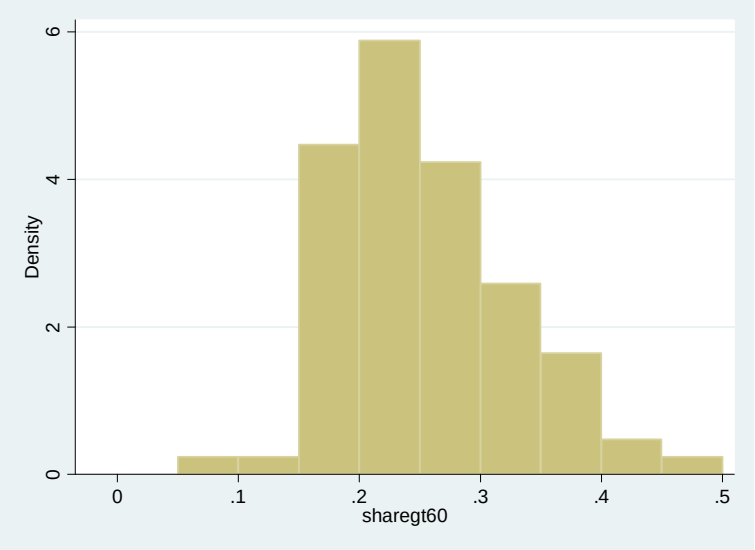

Figure 4: Shares of households with head 60 or over in Chicago suburban public school districts vary from less than 10% to close to 50%.

Table 3: Capitalization Equations Stratified by Number of Bedrooms

	Tax rate	Benefit / Student	R^2
All units	-11708***	6.373***	0.54
	(2309)	(1.189)	
Zero or one bedroom	-3593	1.081	0.17
	(2299)	(0.925)	
Two bedrooms	-7357***	4.002***	0.28
	(1210)	(0.861)	
Three bedrooms	-9101***	5.070***	0.40
	(1634)	(0.899)	
>Three bedrooms	-17754***	9.605***	0.52
	(4531)	(1.796)	

Small homes only show a modestly positive and insignificant benefit capitalization coefficient. For controls, see text.

*** significant at better than .01 with standard errors (in parentheses) clustered by school districts

Table A1: Owner Contributions with Bounds

PUMA	Minimum	Best	Maximum		% min	% max
3001	$42.2	$46.3	$51.3		-8.9%	10.9%
3002	$40.9	$50.4	$57.6		-18.9%	14.2%
3003	$39.5	$48.5	$53.8		-18.6%	10.8%
3004	$58.7	$61.0	$66.1		-3.8%	8.5%
3005	$23.0	$24.3	$25.7		-5.3%	5.9%
3006	$53.4	$61.6	$72.3		-13.2%	17.4%
3101	$19.6	$42.3	$71.0		-53.6%	67.7%
3102	$18.1	$25.8	$30.2		-29.7%	17.0%
3103	$51.4	$57.9	$61.9		-11.2%	6.9%
3104	$56.8	$62.2	$64.3		-8.7%	3.2%
3201	$79.4	$92.1	$105.2		-13.9%	14.1%
3202	$64.9	$67.0	$73.0		-3.2%	9.0%
3203	$48.5	$53.3	$61.7		-9.0%	15.7%
3204	$73.5	$88.9	$110.6		-17.2%	24.4%
3205	$69.0	$70.8	$94.4		-2.5%	33.4%
3206	$59.8	$79.0	$103.3		-24.4%	30.6%
3301	$62.0	$90.1	$123.7		-31.1%	37.4%
3302	$24.0	$24.8	$28.9		-2.9%	16.6%
3303	$71.8	$89.9	$114.9		-20.1%	27.9%
3304	$51.2	$70.0	$86.8		-26.8%	24.1%
3305	$42.3	$71.2	$90.5		-40.7%	27.1%
3401	$45.7	$65.8	$73.5		-30.5%	11.7%
3402	$62.5	$72.6	$77.4		-13.9%	6.7%
3403	$119.4	$112.5	$130.0		6.1%	15.5%
3404	$95.3	$122.7	$136.5		-22.4%	11.2%
3405	$107.7	$163.6	$213.9		-34.2%	30.8%
3406	$20.5	$34.9	$44.8		-41.2%	28.3%
3407	$48.3	$66.6	$84.3		-27.4%	26.6%
3408	$47.5	$55.4	$61.6		-14.2%	11.2%
3409	$39.9	$60.2	$79.5		-33.6%	32.1%
3410	$64.5	$81.8	$111.9		-21.1%	36.7%
3411	$45.2	$51.9	$75.1		-13.0%	44.8%
3412	$39.0	$38.2	$44.7		2.2%	17.2%
3413	$33.7	$44.3	$53.9		-23.9%	21.6%
3414	$48.8	$60.3	$90.9		-19.0%	50.9%
				Average	-18.6%	22.0%

Endnotes:

[1] Extensions of the Tiebout model such as those by Epple and Sieg (1999) and Bayer et al. (2007) emphasize that intra-community income variation accounts for the bulk of income variation in metropolitan areas. Such models still assert a rough homogeneity in the demand for public goods including education.

[2] Perhaps the most relevant work in this regard is Bernhard and Strott (1977), but they focus on redistribution in the city of Milwaukee, a much more heterogeneous population than most suburbs.

[3] By the term "contribution," throughout the paper, we mean a household's education property tax payments over and above any education benefit/expenditure that household's children may receive in local public schools. Although quotation marks might be warranted, in the interest of simplicity, we drop them for the rest of the paper.

[4] We discuss rental housing below.

[5] Equalization refers to the state of Illinois' effort to guarantee that the assessed value in a county be approximately equal to 33% of the market value of that county's properties. The only exception is Cook County where we estimate a 24% rate.

[6] We attempt to adjust all data to the school year 1999-2000, corresponding to the tax assessment year 1998.

[7] Ideally we would want access to the actual addresses of individual households, data not available in the I-PUMs files. Such access is increasingly available through Census Research Data Centers. See Bayer et al. (2007).

[8] The only difficulty in this second step arises in the situation where a block group straddles two or more school districts. The Mable program allocates shares of the block group to each district based on the number of housing units at the block level in each district.

[9] For an introduction to hill-climbing search methods see Michalewicz and Fogel (2004).

[10] Actually reported house value is discounted by the Case-Shiller (Standard and Poor's, 2009) housing price index for the Chicago area for two years (89%) to bring the house value in 2000 in line with its value in 1998 which would be the base for taxation and expenditures in 2000.

[11] The exception to this rule is the case of Cook County with its property classification system and its differential assessment rates by property type. For Cook County, the Chicago Civic Federation (2006) reports the following two ratios for the year 2000: (.517 = Housing Assessed/Total Assessed) and (.716=Housing Market Value/Total Market Value). The Civic Federation figures are based in turn on data from the Illinois Department of Revenue. The ratio of these two ratios, .722 is just equal to the ratio of (Housing Assessed Value/Housing Market Value)/(Total Assessed Value/Total Market Value). By law the state adjusts all assessments in Cook County so that the second term, Total Assessed Value/Total Market Value is just equal to a third. Hence the first term, (Housing Assessed Value/Housing Market Value), is just equal to .333*.72 or .241. This is the effective assessment rate for Cook County housing. The before equalization statutory assessment rate for housing is .16. The calculations above do assume that the state equalization factor achieved its goal of an overall equalized assessment rate of one third.

[12] We should note here that we have no way of adjusting for any residential Tax Increment Financing Districts in Chicago suburbs. Residential TIFs are relatively rare outside the central city and should not appreciably influence our results as presented here.

[13] We exclude suburban Cook County data from this comparison because we lack data to exclude the City of Chicago from that county.

[14] Since the state figures include all residential real estate, our figure here includes, in addition to taxes on owner occupied housing, estimated education property taxes on rental properties. See section on rental properties below for the methodology.

[15] The obvious alternative would be to calculate not contributions but "positive net benefits" which count as redistribution the difference of all household benefits received and household property tax payments when positive. Notice in a world in which residential property taxes were the only source of education funding the two definitions would be equal.

[16] A similar, and only slightly weaker, correlation exists between contribution share and average number of public school students per household.

[17] Given the coefficients of the hedonic equation such a package must generate $1837 in expenditures per student for every 1% in taxes on equalized assessed value.

[18] Rental households like owner households are assigned to block groups through the hill-climbing methodology described above and in the appendix.

[19] The exact formula is available from the Illinois Comptroller's Office, http://www.ioc.state.il.us/FiscalFocus/article.cfm?ID=204

[20] Across the U.S., Murray, Rueben and Rosenberg (2007) find the state share of K-12 public school funding to be 47%. Obviously states differ considerably in this share and

Illinois is not among the highest. However we are concentrating here on the suburbs of metropolitan Chicago. The state share in Illinois overall is currently 32%. Federal contributions are an even smaller share of expenditures (3.6%).

[21] In our 85 pseudo-unified school districts, based on our household assignments, we calculate a black-white(non-Hispanic) index of household head segregation in the Chicago suburbs of 0.63. Hispanic households are also segregated, but at a considerably lower level, 0.39.

[22] In states with more centralized school funding mechanisms, e.g. California, redistribution across income and racial groups is presumably much greater. Dee (2000) suggests that such centralized controlled transfers are highly capitalized in housing values of poorer communities.

[23] Minneapolis which has limited tax sharing, includes only industrial and commercial properties in its sharing formulas.

[24] Unfortunately, the Census doesn't give us intra-block group correlations between variables.

[25] See Michalewicz and Fogel (2004) for an introduction to hill climbing. Our programs are available on request.