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ESTIMATING LOCAL REDISTRIBUTION THROUGH PROPERTY-TAX-FUNDED PUBLIC SCHOOL SYSTEMS

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Local intra-suburban heterogeneity implies the possibility of redistribution through local public taxes and expenditures, yet there are no studies of the extent of such transfers. This paper provides evidence that local redistribution in the property-tax-financed school systems in suburban Chicago is substantial, amounting to $2.3 billion or two-thirds of property-tax-financed school expenditures. Most of those transfers flow from households with no children enrolled in local public schools to those with children in the local public schools, rather than from households with high-value homes to those with lower-valued homes.

Keywords: property taxes, redistribution, local public finance, suburban education, education finance

JEL Codes: H23, H52, H71

I. INTRODUCTION

Numerous studies indicate considerable suburban heterogeneity by income and other demographic characteristics (Persky, 1990; Rhode and Strumpf, 2003). Although such heterogeneity suggests that using proportional taxes, such as the local property tax, to finance local public services will result in significant redistribution, relatively little attention has been paid to measuring the magnitude of these redistributions. This paper addresses this gap in the literature by providing evidence on the amount of redistribution that occurs through property-tax-funded public school systems in suburban Chicago. We also determine the most important economic and demographic factors associated with this type of intra-community redistribution, and identify the parties most likely to receive redistribution benefits and those most likely to make redistribution payments.

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Our focus is on education property tax redistributions, defined as flows from households making annual education property tax payments in excess of the cost of in-kind education services received from local public schools.[1] Households without children in public schools, or households with relatively high-valued property and children in the public schools, will pay into this redistribution pool. However, most households with children in the local public schools will receive services costing more than their education property tax payments.[2]

How large is the local education property tax redistribution across households? To anticipate our central finding, in fiscal year 2000 homeowners in Chicago suburbs paid about $2.3 billion into the redistribution pool. This amount accounts for about two-thirds of all education property taxes paid by suburban homeowners.

While the question of local redistribution through public school systems has been in the background of the local public finance literature, it has rarely been discussed directly. One exception is an early report by Bernhard and Stott (1977) who make aggregate estimates of local redistribution generated in the city of Milwaukee. They estimate substantial redistributional flows to households with children in the public schools. However, their analysis does not consider the determinants of educational redistribution.

Local redistribution has been indirectly addressed in two literatures, the first dealing with intra-jurisdictional property tax capitalization, and the second concerned with the immobility of the elderly. A careful study by Palmon and Smith (1998) focuses on the capitalization required to offset intra-jurisdictional tax rate differentials that would otherwise be redistributional. In their study, area benefits are presumed equal while tax rates vary for historical reasons. They find evidence that these tax differentials are strongly capitalized into housing values, suggesting that intra-jurisdictional redistribution through property taxes will often be mitigated by such capitalization. However, redistribution on the expenditure side cannot be so easily handled since heterogeneous households, even if they face the same tax rates, will receive very different flows of public services. In particular, older households and others without children in the public schools receive no direct benefits from educational expenditures.

The other literature, which deals with the mobility and behavior of the elderly, touches on this issue. Farnam and Sevak (2006), Hilber and Mayer (2009), and Shan (2010) observe that the elderly receive little to no direct benefits from education property taxes, and thus recognize the presence of intra-jurisdictional redistribution. However, they do not try to measure this phenomenon. Their work does suggest that local educational

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[1] Of course, real benefits from dollar expenditures in different school systems may vary widely because of differences in school quality. This is a general problem in measuring the value to recipients of in-kind transfers.

[2] Note that school districts rely on several sources of revenue in addition to residential property taxes. Thus, households receiving redistribution payments from other households also receive subsidies from commercial and industrial properties, the state, and the federal government.

redistribution is influenced by life-cycle decisions, as they find evidence that many older households downsize their housing consumption and seek low tax jurisdictions. Such behavior will reduce the extent of intra-jurisdictional education redistribution.

This paper studies the extent and correlates of the intra-community redistributions that result from property tax financing of public education systems. We focus primarily on the statutory incidence of education property taxes and do not account for any offsets due to the capitalization of education property taxes or benefits (Section VI discusses this question in more detail). The sample area consists of suburban Chicago public school districts, which rely heavily on local property taxes.[3] These suburban districts are part of a partially equalized state system of educational finance where local property taxes provide the largest share of school revenues. While our approach can be used for any area with education property taxes, the extent of redistribution as a fraction of school revenues will vary depending on a number of factors. Most importantly, the share of school district revenues financed by local property taxes will be crucial.[4]

Ideally, education property tax redistributions should be calculated using microdata on households, most importantly their home values, property tax assessments including exemptions, circuit breakers, etc., and the number of children they enroll in local public schools. If such households can be identified by school district, then readily available statistics on district tax rates and expenditure levels would complete the basic information requirements. While microdata are available from sources such as the 2000 Census's Public Use Microdata Sample (PUMS), such sources lack school district identifiers (Minnesota Population Center, 2008). To resolve this problem, this paper uses the techniques of synthetic population construction to assign sampled households from Census Public Use Microdata Areas (PUMAs) to block groups. Using household sampling weights, each block group is fully reconstructed and their synthetic populations are then aggregated up to the level of school districts. The paper then measures intra-community redistributions and identifies the losers and winners from redistribution. While those with more expensive houses contribute more in terms of property taxes than they receive in services, by far the bulk of the observed redistribution flows to households with children in the public school systems from households with no children in those systems.

The paper proceeds as follows. Sections II and III describe our techniques for constructing synthetic school district populations and for estimating redistribution payments, respectively. Section IV discusses our empirical findings with special emphasis placed on the sources and demographic incidence of redistribution payments. Sections

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[3] The sample area includes all suburban school districts operating within Cook, Lake, Kane, McHenry, DuPage, and Will counties. We have excluded the City of Chicago school district because of its size. None of the suburban school districts serve the city of Chicago.

[4] While Illinois, with a property tax share of almost 50 percent, is the most dependent on these taxes, some 26 states draw on property taxes to provide 25 percent or more of their education revenues (U.S. Census Bureau, 2000).

V and VI extend our baseline analysis by touching on issues related to renter-occupied housing units and housing price capitalization, respectively. Section VII concludes and suggests directions for future research.

II. CONSTRUCTING SYNTHETIC POPULATIONS

The finest geographical division available from the 2000 PUMS 5 percent microdata sample is that of a household's PUMA. Suburban Chicago PUMAs, however, contain multiple public school districts. Because our goal is to estimate redistribution at the public school district level, ideally we would like to know the public school district for each PUMA household. In the absence of such information, we construct synthetic school district populations using the PUMA sample and Census data on block group aggregate counts (e.g., the tabular distribution of household incomes, house values, age of householder, etc.).[5] These synthetic populations allow us to estimate individual household property taxes and public school enrollment for each synthesized household.

There are several well-known methods for constructing synthetic small-area populations. Williamson, Birkin, and Rees (1998) first proposed the basic approach used in this paper, combinatorial optimization.[6] Combinatorial optimization relies on an iterative process whereby household observations are swapped across small areas in order to minimize a pre-specified error loss function. For the purposes of this study, we designed a combinatorial optimization procedure, iterated random fitting (IRF), that proceeds through a series of random and deterministic swaps, starting from a random allocation of households. Progress is measured in terms of how well the synthetic population matches block group aggregates as quantified in the error loss function. The loss function for each PUMA compares a block group's actual aggregate counts to synthetic estimates for that same block group. This loss function takes the form $\sum_i \sum_j \left| x_{ij}^* - x_{ij} \right|$, where x_{ij}^* is the actual value of one of 54 characteristics i for j^{th} block group in a PUMA and x_{ij} is the estimated value from any given allocation. Figure 1 presents an overview of the logic for building the synthetic populations at the block group level. A more complete description of IRF, along with validations, is provided in the technical appendix.[7]

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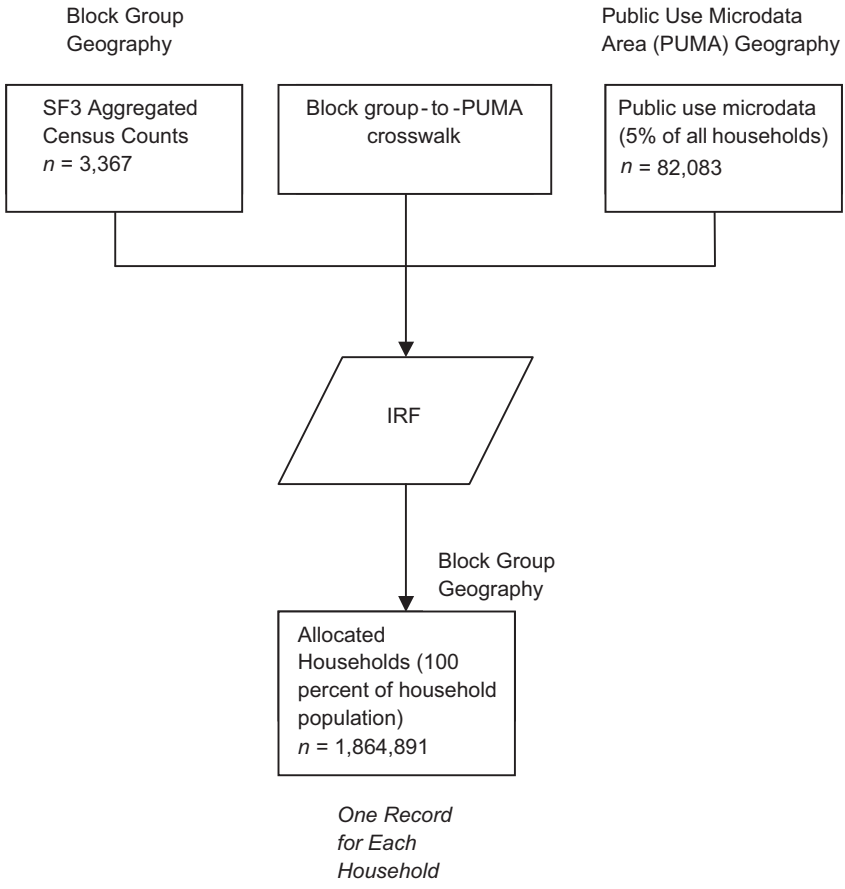
[5] PUMAs are contiguous geographic entities defined by the U.S. Bureau of the Census. They are the finest geography used in presenting the 5 percent public use microdata sample. Each PUMA is wholly contained within a single state and has at least 100,000 people. A Census block group is a cluster of Census blocks within a Census tract, generally containing 600–3,000 people. A block group falls entirely within a single PUMA.

[6] An alternative technique, synthetic reconstruction, was first proposed by Beckman, Baggerly, and McKay (1996) and has recently been applied in public health (Wheaton et al., 2009) and transportation (Moeckel, Spiekermann, and Wegener, 2003). However, a number of researchers have concluded that combinatorial optimization techniques outperform synthetic reconstruction in terms of accuracy and ease-of-use (Huang and Williamson, 2001; Voas and Williamson, 2000; Williamson, 2007; Ryan, Maoh, and Kanaroglou, 2009; Kurban et al., 2011) and that combinatorial optimization is often subject to less variation (Huang and Williamson, 2001).

[7] Technical appendix is available from authors.

Figure 1

Flow-Chart for Synthetic Population Generation



Source: Authors' adaptation from Wheaton et al. (2009).

The two primary data sources are the Summary File 3 (SF3) data on block group aggregate counts and the 5 percent PUMS household microdata, both from the 2000 Census. The SF3 file contains the basic Census statistics aggregated to the block group level for 3,367 block groups in suburban Chicago. The key aggregate counts included (and ultimately used in the loss function) are: total number of households, number of renting households, house value (24 categories), number of public school

students, number of African-American headed households, number of Hispanic headed households, nine household head age categories, and 16 household income categories. The 5 percent PUMS includes data on 82,083 sampled households in suburban Chicago. The synthesized population contains 1,864,891 households built up from the IRF heuristic, which allocated the sampled households (and their weights) to block groups.

While we apply IRF to synthesize block group populations, our chief concern is to construct synthetic populations for suburban Chicago school districts. Households allocated to a given block group are assigned to the corresponding school districts using data from the MABLE geographic correspondence engine of the Missouri Census Data Center (2008). MABLE 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 group is not part of a unified district but belongs to separate taxing high school and grammar school districts, we can in principle assign students to the school district level they are attending since information on a student's grade is available from the PUMS.[8] These assignments would ultimately allow a finer determination of expenditures on a household's students. However, for unified districts, elementary and secondary expenditures cannot be distinguished. This makes comparisons across communities difficult because expenditure per pupil is traditionally larger in high schools relative to grammar schools. Thus, to facilitate comparisons, we aggregate grammar school districts up to their corresponding high school district boundaries. This leaves us with a set of 85 "pseudo-unified" districts. For all tax and expenditure rates by school districts we aggregate to this "pseudo-unified" level.

Once the household allocations are made we can estimate any desired cross-classifications for the pseudo-unified districts from the individual household populations assigned to those districts. Table 1 provides some descriptive statistics for these 85 districts. In addition to basic data on property taxes and school expenditures, we include our estimates of redistribution shares and levels as well as key data on housing value heterogeneity, income heterogeneity, and the proportion of households without children in the public schools.

III. EDUCATION PROPERTY TAXES AND REDISTRIBUTIONS

In this section we describe how we calculate household property taxes and redistribution payments, limiting our attention to owner-occupied households (Section 5 considers households who rent their dwellings).

[8] Note that the PUMS allows us to distinguish between students attending public and private schools. Because private school students receive no substantial public education expenditures, they are excluded from consideration. Households with only private school students are treated in the same way as those without school age children.

Table 1

Descriptive Statistics for Owner Occupied Households in Chicago Suburban School Districts

Variable	Mean	Standard Deviation	Minimum	Maximum
Number of households	16,899	13,657	1,674	72,180
Number of public school students	9,306	7,245	838	35,946
Total education expenditures per student ($)	10,549	2,030	6,772	17,164
Average education property taxes per household ($)	2,456	954	573	6,003
Share of households with no public school students	0.68	0.06	0.57	0.82
Share of households with head aged 60 or over	0.27	0.08	0.07	0.49
Average income of households ($)	86,120	28,020	51,705	189,534
Inter-quartile ratio of household income (Q3/Q1)	2.43	0.42	1.82	4.65
Average value of owner occupied homes ($)	208,719	86,084	100,262	569,367
Inter-quartile ratio of home value (Q3/Q1)	1.76	0.32	1.18	2.78
Average redistribution payment per household[1] ($)	1,602	603	334	3,929
Average redistribution share of education property taxes	0.66	0.06	0.41	0.8

Note: The number of observations is 85.

[1]As explained in the text, education redistribution payments are the excess, if any, of a household's education tax payments over the value of its in-kind education services received. The denominator includes all households, not just those making payments. Hence, this figure also represents "Average Household-to-Household Redistribution Benefits per Household."

Source: Data are based on PUMS microdata as allocated to school districts through synthetic population generation (see text for details), data from Illinois I-Learn (2009), and authors' estimates.

A. Taxes

Any estimate of property-tax-financed education redistributions must start with estimates of education property taxes, determined for each household by the school district tax rate multiplied by the equalized assessed value (EAV) of a home. For each public school district, we have fiscal year 2000 school district tax rate data obtained from Illinois' State Board of Education (I-Learn, 2009). Once a household is assigned to a block group and school district the calculation of its school taxes is straightforward. District tax rates (either unified or elementary plus high school) for a household's assigned block group are applied to an estimate of the EAV for that household, less any exemptions.[9]

As a check on bias in our micro-estimates, we compare aggregates of our estimated education property tax payments to the actual education property tax bills reported by the Illinois Department of Revenue (1999) for residential education property taxes in the five collar counties for the 1998 tax year. (We can only include these five outer counties because the Illinois Department of Revenue does not distinguish the City of Chicago from the rest of Cook County.) The Department's estimate is $2,426 million, while our estimate is $2,304 million.[10] Since we are confident about the accuracy of the tax rate data, we take this close match as evidence that the self-reported Census figures for housing values are reasonably accurate in the aggregate.

B. Education Redistribution Payments

Because we are primarily interested in the extent to which residential education property taxes result in redistribution, we define redistribution payments as education property tax payments in excess of the cost of any in-kind education services received by property tax paying households. Thus, in any year, a household is defined as making a redistribution payment equal to the difference between its education property tax payments and the local school expenditures attributed to that household's public school students.[11]

As noted above, households that are not assigned to a unified district belong to separate high school and grammar school districts. To calculate expenditure-per-student in such situations we simply take the weighted average of expenditure-per-student across all types of school districts included in the relevant quasi-unified district. We use the number of students in each school district as the weighting factor. Again this allows the calculation of an "average" expenditure per pupil. While this approach mixes

[9] See the appendix for a detailed discussion of EAV and exemptions.

[10] These figures include renter-occupied dwellings in addition to owner-occupied dwellings. See Section V below for the methodology used to estimate taxes on rental properties.

[11] This provides a conservative definition of household-to-household redistribution. A household making education redistribution payments might at the same time be benefiting from dollars raised from non-residential sources such as commercial or industrial property taxes.

elementary and secondary students, it keeps all quasi-unified districts on a comparable basis.[12]

For a given household then, the cost of in-kind services (i.e., expenditures) received is calculated as the number of public school students in the household multiplied by the weighted average expenditure per student for the appropriate quasi-unified district.

IV. RESULTS

Aggregating across all weighted household observations, total redistribution payments are estimated to be approximately $2.3 billion. This is roughly two-thirds of the $3.5 billion in homeowner education property taxes, suggesting redistribution is a major source of suburban Chicago public school financing. According to our estimates in Table 2, redistribution payments finance almost 25 percent of all suburban Chicago

Table 2

Redistribution Payments and Other Funding Sources as Shares of Public School Expenditures

Funding Source	Mean	Standard Deviation	First Quartile	Median	Third Quartile
Homeowner property taxes[1]	0.373	0.134	0.282	0.378	0.465
Homeowner redistribution payments	0.245	0.09	0.184	0.255	0.288
Homeowner self-payments	0.127	0.052	0.090	0.127	0.152
Property taxes on residential rental real estate	0.078	0.053	0.041	0.065	0.102
All other local revenues[2]	0.253	0.137	0.171	0.262	0.310
State revenues	0.192	0.110	0.100	0.163	0.255
Federal revenues	0.036	0.039	0.018	0.026	0.039
Other	0.069	0.095	0.008	0.056	0.124

Note: This table shows the distribution of funding sources for the 85 suburban Chicago pseudo-districts.
[1]This source includes only owner-occupied dwellings. As defined in the text, redistribution payments are the excess of a household's education tax payments over the value of its in-kind education services received. Self-payment is the amount of a household's education property tax that goes toward supporting its own students. The sum of the two is always equal to the household's total education property tax. Notice that a household can receive in-kind services costing more than its total tax payment, but in this case it makes no redistribution payment and its self-payment is just equal to its total tax.
[2]This source includes commercial and industrial education property taxes.
Source: Illinois I-Learn (2009) data and estimates by the authors.

[12] Notice that the approach taken here overestimates education redistribution for households with high school students and underestimates those by households with elementary school students. We do not attempt in this paper to unravel these effects.

public school expenditures. This figure is twice as large as self-payments (i.e., residential education property taxes that are not redistribution payments) and is of the same order of magnitude as other local sources (which includes commercial and industrial education property taxes) and support from the state of Illinois. It should be noted that education redistribution payments for some households are education redistribution benefits for others. Within each school district, household-to-household payments and benefits must be equal.[13]

A. Bounding Redistribution Payments

Our estimates of education property tax redistribution are ultimately based on the IRF approach we used to build synthetic school district populations, which is potentially subject to error. To provide a sensitivity analysis, we estimate the maximum and minimum bounds for aggregate redistribution payments within each PUMA.[14] For the minimum bound we assign households without children in public schools to the school district in their PUMA with the lowest effective education property tax rate. Similarly, households with children in the public schools are assigned to the school district that minimizes their in-kind expenditures received after education property taxes. This minimum realistically captures any tendency missed in the IRF exercise for households without public school children to avoid higher taxes. Unrealistically, though, it assumes that households with children seek out minimum transfers. Together the two assumptions clearly offer a lower bound to the actual redistribution achieved within the school districts of a PUMA.

Because we are making a case for the significance of local education redistribution, the maximum bound is intrinsically less interesting than the minimum. However, for symmetry, we also calculate a maximum bound, assuming that households without children in the public schools seek out school districts in their PUMA with the highest education tax rate. Households with children in the local schools are assumed to seek out districts in their PUMA that will generate the highest redistribution transfer for them. This clearly gives a maximum redistribution. This technique places lower and upper bounds on redistribution payments of $1.8 billion and $2.9 billion, respectively.

The lower bound is 20 percent less than our best estimate but is still quite large, amounting to more than half of all suburban homeowners' fiscal year 2000 education property taxes. This estimate supports our basic claim that redistribution payments are an important source of public school finance and also gives insight into the capacity

[13] Recall that households receiving redistribution benefits from other households will also receive subsidies from non-household sources. Thus, while household-to-household benefit payments will be identical in size to household redistribution payments, total benefits will be much larger. Since there is no way for us determine what fraction of a household's total benefits come from non-household sources, we have assumed that household-to-household redistribution payments and redistribution payments from non-household sources are distributed across receiving households in the same proportions.

[14] See Table A1 in the technical appendix.

for households to limit their payments through local sorting. In particular, this lower bound suggests intra-PUMA sorting has the potential to reduce redistribution payments by 20 percent.[15]

If, counterfactually, households are sorted across PUMAs in such a way that minimizes redistribution payments, we generate an extreme lower bound of $893 million. This figure is approximately 61 percent lower than our best estimate of education redistribution, and equals only 25 percent of all suburban homeowners' fiscal year 2000 education property taxes. This suggests that, in principle, intra-metropolitan sorting can substantially reduce household redistribution payments and that many households could accrue significant direct gains by locating elsewhere within the metropolitan area. The magnitude of this reduction suggests that current intra-metropolitan sorting is much less than what might be expected in a pure Tiebout world. We make no attempt at providing a complete explanation for this finding but note that it is consistent with recent research by Rhode and Strumpf (2003), which suggests Tiebout motives may be second-order to other factors affecting migration decisions. In addition, Hilber and Mayer (2009) and Brunner and Balsdon (2004) provide evidence that house price capitalization of school quality and inter-generational altruism may reduce the migration propensity of older households.

The upper bound seems unrealistically high at more than 80 percent of education property taxes. The absolute magnitude of this upper bound suggests that contributing households, mostly households without school age children, have selected locations away from the highest taxed areas. This is consistent with recent research by Farnham and Sevak (2006) and Shan (2010), which finds that households without children, particularly the elderly, do indeed seek to avoid high education property taxes by relocating.

B. Variations in the Share of Redistribution Payments

Table 1 shows that redistribution payments as a share of all owner-occupied education property taxes differ substantially across school districts, ranging from about 0.4 to 0.8. At the school district level, the strongest correlate of redistribution share is the proportion of households without children in the public school system, *share_nopub*. The Pearson correlation between these two variables is 0.92 (p-value = 0.000).[16] This strongly supports the hypothesis that suburban school districts engage in considerable redistribution from households without students in the public schools to those with students enrolled in those schools.

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[15] It is important to note that households can also significantly reduce their redistribution payments even if they choose to stay in place. Research suggests elderly households have the potential to reduce educational taxes and expenditures through active political engagement within their communities and states. See Button (1992), Poterba (1997), Ladd and Murray (2001), Brunner and Balsdon (2004), and Figlio and Fletcher (2010) for recent work in this area.

[16] Most inner-ring suburban school districts exhibit relatively high redistribution payment shares as well as high percentages of households without school children. Outer-ring districts have relatively low levels for both of these variables. See Figures A3 and A4 in the technical appendix.

Who are the suburban households without public school children? The most obvious members of this group are households with older heads. The share of households with a head age 60 years or older, *share_60+*, maps across school districts in much the same way as *share_nopub*. The Pearson correlation between *share_nopub* and *share_60+* is 0.71 (p-value = 0.000).

Surprisingly, we find little evidence that areas with greater house value heterogeneity show a greater reliance on redistribution payments. Because property taxes are roughly proportional to housing values, heterogeneity in housing values within a school district implies that some households in that district pay more in property taxes than others. Thus, it is reasonable to expect that a high inter-quartile ratio in housing values would translate into a high redistribution share. The Pearson correlation behind these variables, however, is very small (–0.02, p-value = 0.847). Although households with valuable homes pay more in property taxes, they also tend to have children in local public schools. On net, areas with greater heterogeneity in housing values do not have higher redistribution shares.

C. A Traditional Incidence Analysis

The estimates developed above make it easy to generate a set of traditional incidence analyses of redistributional payments. Table 3 presents the distribution of property tax redistribution payments and benefits by income quartiles. Payment shares are largely flat for the three lowest quartiles, but rise to about 36 percent for the highest quartile. However, when expressed as a "redistribution tax rate" on each quartile's total income, the redistribution payments are quite regressive, falling from an average rate of 5.2 percent for the lowest quartile to 1.3 percent for the highest.

The distribution of benefit payments across income classes closely mirrors the distribution of public school enrollment across the same income classes. The lowest income quartile has the fewest children in the public schools and the lowest share of benefits. However, if benefits are expressed as a "redistribution benefit rate" on income, they are highly progressive, falling from almost 4 percent for the lowest quartile to only 1 percent for the highest.[17] Subtracting the redistribution tax rate from the redistribution benefit rate gives the net benefit rate. Overall, this rate must be 0 percent since, by definition, total household-to-household redistribution benefits equal total redistribution payments. For the lowest quartile this rate is –1.2 percent, rising to about 0.6 percent for the middle two quartiles and turning negative again at –0.3 percent for the highest quartile. Compared to explicit redistribution programs such as the Earned Income Tax Credit (Liebman, 1998), education property tax redistribution is not highly progressive.

Because education property taxes are based on house values, it is useful to observe how redistribution payments and benefits vary with home value. Table 4 shows that,

[17] As noted above, our estimates assume households receiving benefit payments get household-to-household redistribution payments, state funds, and other local funds in proportion to their total benefits.

Table 3

Distribution of Redistribution Payments and Benefits by Income Quartiles (%)

Income Class ($Thousands)	Households	Income	Public School Students	Redistribution Payments	Redistribution Benefits	Redistribution Tax Rate	Redistribution Benefit Rate	Redistribution Net Benefit Rate
Q1 (< 42)	25.34	7.52	15.61	21.20	16.17	5.22	3.98	–1.24
Q2 (42–68.5)	24.66	15.72	25.51	20.42	25.96	2.41	3.06	0.65
Q3 (68.5–104)	25.14	24.46	30.95	22.41	30.92	1.70	2.34	0.64
Q4 (> 104)	24.86	52.29	27.93	35.96	26.95	1.27	0.95	–0.32
Total	100.0	100.0	100.0	100.0	100.0	1.85	1.85	0.00

Notes: Paying and receiving households within each quartile are distinct groups. The data include owner-occupied households only.
Source: Data taken from the 2000 PUMS and the authors' estimates.

Table 4

Distribution of Redistribution Payments and Benefits by Home Value Quartiles (%)

House Value Class ($Thousands)	Households	Home Value	Public School Students	Redistribution Payments	Redistribution Benefits	Redistribution Tax Rate	Redistribution Benefit Rate	Redistribution Net Benefit Rate
Q1(< 112.5)	26.49	11.57	21.86	11.99	22.70	0.80	1.52	0.72
Q2 (112.5–162.5)	27.91	20.09	26.50	21.25	26.81	0.82	1.03	0.21
Q3 (162.5–225)	22.94	23.05	23.87	23.54	24.11	0.79	0.81	0.02
Q4 (> 225)	22.66	45.29	27.77	43.23	26.38	0.74	0.45	–0.29
Total	100.0	100.0	100.0	100.0	100.0	0.77	0.77	0.00

Notes: Paying and receiving households within each quartile are distinct groups. The data include owner-occupied households only.
Source: Data taken from the 2000 PUMS and the authors' estimates.

across housing value quartiles, the share of education redistribution payments rises proportionally with house values, yielding a flat rate of about 0.8 percent. Across these groups benefit shares again reflect the distribution of children in public school. Only the highest house value class has a negative net benefit rate. All other classes realize positive net benefits. Like systems of state equalization (Murrary, Evans, and Schwab, 1998), education property tax redistribution is progressive with respect to household wealth in real property. In any case, it is important to emphasize that within each house value class (or income class), net tax payers and households with net benefits are distinct subgroups, with the former almost exclusively made up of households without children in the public schools.

The last point is underscored if we look at the distribution of redistribution payments and benefits across households grouped by number of children in the public schools. Table 5 shows that only 0.1 percent of all redistribution payments are made by households with at least one child in the public school. Virtually all households with children in the public schools receive education redistribution benefits.

More interesting, perhaps, are the distributions of redistribution payments and benefits across households grouped by age of head. Table 6 shows that the oldest quartile of households (with heads over 61 years old) generates almost a third of the payments but garners a very small share of benefits (approximately 3 percent). The third oldest quartile also contributes considerably more than it receives in subsidies. The youngest two quartiles gain much more in educational benefits than they pay in taxes.

These distributions across age groupings give us some insight into the life cycle characteristics of education redistribution. Redistribution benefits first rise and then

Table 5

Distribution of Redistribution Payments and Benefits by Number of Children Enrolled in Public Schools (%)

Public School Student Class	Households	Public School Students	Redistribution Payments	Redistribution Benefits
Q1 (students = 0)	69.0	0.0	99.9	0.0
Q2 (students = 1)	13.9	25.3	0.1	22.5
Q3 (students = 2)	11.8	42.9	0.0	43.5
Q4 (students > 2)	5.3	31.9	0.0	33.9
Total	100.0	100.0	100.0	100.0

Notes: Paying and receiving households within each quartile are distinct groups. The data include owner-occupied households only.
Source: Data taken from the 2000 PUMS and the authors' estimates.

Table 6

Distribution of Redistribution Payments and Benefits by Age of Household Head (%)

Age Class	Households	Public School Students	Redistribution Payments	Redistribution Benefits
Q1 (< 39)	23.3	28.5	19.9	28.1
Q2 (39–49)	26.4	52.8	16.9	53.3
Q3 (49–61)	24.1	15.8	30.1	15.6
Q4 (> 61)	26.2	2.9	33.1	3.0
Total	100.0	100.0	100.0	100.0

Notes: Paying and receiving households within each quartile are distinct groups. The data include owner-occupied households only.
Source: Data taken from the 2000 PUMS and the authors' estimates.

fall with age. This same pattern is likely followed over many households' life histories. However, caution should be exercised in interpreting these data. Households do not remain immobile throughout their lifetimes. The snapshot presented here reflects both in-migrations by younger households and relocations by older households. While the pattern is suggestive, a fuller understanding of these phenomena requires longitudinal data and is beyond the scope of this study.

V. RENTAL UNITS AND OTHER SOURCES OF EDUCATION REDISTRIBUTION

Thus far, we have only considered redistribution payments made by homeowners. However, a large number of suburban Chicago households (approximately 25 percent) rent their dwellings. About three-quarters of these households (as compared to two-thirds of homeowners) have no children in the public schools. Still, renter households account for a little more than 19 percent of all public school children in the suburbs. The question naturally emerges as to the extent of education redistribution payments made by renters.

In Table 2 we estimated the education property tax payments made on rental properties to be 7.8 percent of all education expenditures. This estimate is based on a simple capitalization of self-reported monthly rents to estimate the value of rental structures.[18] This figure is then used to estimate assessed values and education property taxes.

[18] The PUMS reports data on monthly rents. We capitalize annual rents into market value using a 10 percent capitalization rate.

Assuming these estimates are roughly accurate, we still face the considerable problem of who pays these taxes, building 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 (Carroll and Yinger, 1994; Zodrow, 2001). 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 expenditures received by the households living in that dwelling? This difference, when positive, we define as "rental redistribution payments."

We estimate that total rental redistribution payments are $645 million or about 73 percent of the total rental education property tax payments of $880 million. These payments, like those of homeowners, are primarily generated from the three-quarters of rental households without children in public schools. Rental households with public school children, like owner households with public school children, benefit from education expenditures much more than they pay in estimated education tax payments on their dwellings. These education tax payments account for approximately 43 percent and 45 percent of total expenditures received by owner households with public school children and renter households with public school children, respectively. If renters are paying their property taxes, then the extent of redistribution through property taxation finance of education expenditures is similar for renters and owners.

Another major source of funding for suburban Chicago public schools is aid from the state of Illinois. We get figures on state aid for each school district from the I-Learn data. State aid is aimed at compensating for low levels of local tax bases.[19] Interestingly, state aid finances less school district expenditure than redistributional payments by homeowners (19.2 percent as compared to 24.5 percent). In this sense education property tax payments are a larger redistribution program than state financing of education.

We also 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 equal to 25 percent of suburban education expenditures. The largest component of this residual is likely education property taxes on commercial and industrial structures.

VI. CAPITALIZATION

The discussion to this point has avoided any consideration of the capitalization of local taxes and expenditures. Tiebout (1956) assumes homogeneity in public service demands across a community's households. With such complete homogeneity, local taxes are simply the price of local public goods, so capitalization is not an issue and redistribution does not occur. However, as emphasized throughout this paper, demographic heteroge-

[19] The exact formula is available from the Illinois Comptroller's Office, http://www.ioc.state.il.us/index.cfm/linkservid/4F5F7D34-BD60-4606-82045F32EEACEB96/showMeta/0/.

neity is a very real characteristic of suburban communities. Indeed, heterogeneity is a necessary condition for the existence of any redistribution through local school systems. As demonstrated above, the key difference from this perspective is whether suburban households have students enrolled in the local school system. The question becomes how any tax and expenditure capitalization affects the level of education redistribution payments made by households without students in the schools. To a lesser extent the same question may be asked with respect to properties of differing values.

Analysis of this issue is very much complicated by the fact that all suburban communities in a metropolitan area like Chicago must provide public schools for children. It has been recognized that residential choices are constrained by these and other types of legal requirements (Farnham and Sevak, 2006) and that mobility rates are particularly low for the elderly (Shan, 2010; Venti and Wise, 2001). Under these circumstances it is difficult to identify the marginal mover whose preferences might be expected to strongly influence the capitalization of school taxes and expenditures.

We do not attempt to resolve the theory and empirics of this problem in the present paper. However, we do observe the following: there is good evidence that holding services constant, suburban tax rate differences are almost completely capitalized into house values (Palmon and Smith, 1998). On the other hand, where tax rates are similar, the quality of local education is at least partially capitalized, although estimates of such capitalization effects seem to be declining as research techniques become more sophisticated (Black, 1999; Bayer, Ferreira, and McMillan, 2007). Against this background it would be plausible to hypothesize that, on net, some portion, but not the majority, of redistribution payments are offset by capitalization.[20]

It should be noted that even if redistribution payments are fully capitalized in housing values, those payments are still being made. What changes is their incidence. Rather than falling on current residents without children in the school system, these payments would fall on the initial landowners, who received a lower price than they would have obtained under full Tiebout sorting.

VII. DISCUSSION

The estimates provided in this paper suggest that suburban public school financing involves considerable redistribution. In particular, suburban households without children in the public schools heavily subsidize the in-kind educational services received by those with children enrolled in the public schools. These payments do not fit neatly into traditional descriptions of homogeneous suburbs, nor do they seem to be offset by any process of housing value capitalization. These estimates also suggest that redistri-

[20] This discussion refers to school quality rather than expenditures per student, the variable used in calculating contributions. Recent research finds that, while quality and expenditures are correlated, capitalization seems to focus on quality more than expenditures (Downes and Zabel, 2002). It follows that at any given level of quality capitalization, redistribution payments will be offset to a lesser extent if the school system is relatively inefficient in generating quality.

bution of this type is consistent with a life-cycle hypothesis in which many households pay into the redistribution pool early and late in their lifetimes while drawing out of it while middle-aged. Thus, over a lifetime, many households may make no or only modest redistribution payments.

Be that as it may, it is difficult to understand why annual redistribution payments are so high. Although a contributing household may have good reasons behind its choice of location,[21] it may be strongly constrained by exogenous limits on its choice set. In many states, choices are constrained by state legislation (Farnham and Sevak, 2006), as local areas are generally required by states to provide public primary and secondary education.

Even in the absence of constraints, households without public school children may find heterogeneous communities attractive. Households with very young children or those planning to have children may seek to establish themselves in a community with good schools before their children actually are ready to attend. Similarly, older households whose children have finished local public education may be tied to their community by any number of personal connections and friendships (Berkman and Plutzer, 2004).

Ultimately, we hope that these various explanations for the education property tax redistribution could be incorporated into a more complete model of residential sorting. The extension of such models to include these phenomena would be a logical next step in their development. An important complication facing any such extension of sorting models is the need to rethink the process of capitalization. While the taste for amenities in residential markets has often been modeled as varying across segments of the population, schooling is unusual since it is a benefit for one group and only a cost for another.[22] Under these circumstances, traditional hedonic models of capitalization are not well suited to the present problem. In general, these models show positive capitalization of school expenditures with negative capitalization of school taxes (Fischel, 2005). But in heterogeneous communities, the expected nature of capitalization is far from obvious, reflecting our inability to explain fully the sources of heterogeneity. Until progress is made on these theoretical and empirical questions, we speculate that for the most part public education redistribution payments are not strongly offset by capitalization.

It is our expectation that redistribution of this type looms large in the overall redistribution system of the United States. This paper has made a first rough effort to measure its size. The magnitude and character of such intra-community redistribution, as well as the optimal mix of local property-tax-based redistributions and other sources of school support, deserves more careful scholarly attention in the future.

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[21] See Ross and Yinger (1999) and Bayer, Ferreira and McMillan (2007) for recent work on residential sorting behavior.

[22] It is sometimes argued (Fischel, 2005) that households without children in public schools benefit from good schools because good schools raise property values. This statement is misleading. Only if such a household is already in a given school district when quality is improved will that household garner a gain from that improvement as its house value increases. If a household without children attending public school buys into the community with expensive high-quality schools, it must pay more while it lives there and will not recoup these costs until it moves.

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APPENDIX: ESTIMATING EQUALIZED ASSESSED VALUE (EAV) AND EXEMPTIONS

Equalization refers to Illinois' effort to guarantee that the assessed value in a county be approximately equal to 33 percent of the market value of that county's properties. The exception to this rule is Cook County where we estimate a 24 percent rate. This is because Cook County applies different assessment rates based on various property classifications. For Cook County, the Chicago Civic Federation (2008) reports the following two ratios for the year 2000: 0.517 (= Housing Assessed Value/Total Property Assessed Value) and 0.716 (= Housing Market Value/Total Property Market Value). The Civic Federation figures are based on data from the Illinois Department of Revenue. The ratio of these two ratios, 0.722, is equal to the ratio of (Housing Assessed Value/Housing Market Value)/(Total Property Assessed Value/Total Property Market Value). By law the state adjusts all assessments in Cook County so that the second term, (Total Property Assessed Value/Total Property Market Value), is equal to 0.333. Hence the first term, (Housing Assessed Value/Housing Market Value), is equal to 0.333*0.722 or 0.241. This is the effective assessment rate for Cook County housing. The before-equalization statutory assessment rate for housing is 0.16. The calculations above assume that the state equalization factor achieved its goal of an overall equalized assessment rate of 0.333.

The EAV is calculated by multiplying home value by the appropriate equalized assessment rate. Here, house value is discounted by 11 percent 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. We calculate the discount factor using the Standard & Poor's Case-Shiller housing price index for 2009 for the Chicago area.[23]

The only exemptions included are the standard household exemption applicable to all households ($4,500 in Cook County and $3,500 elsewhere) and the senior exemption ($2,500 for Cook County and $2,000 elsewhere), which we included only if the age of the household head is 65 or older. We have no way of adjusting for any residential tax increment financing (TIF) districts in Chicago suburbs. Residential TIFs are relatively rare outside the City of Chicago and should not appreciably influence our results. The available data do not allow estimates of various inflation limits, but their effects at this time before the large housing price run-up of the last decade are assumed to be small.

[23] Standard and Poor's, "Case-Shiller Home Price Index," http://www2.standardandpoors.com/spf/pdf/index/CSHomePrice_History_052619.xls.