Suburbanization, Demographic Change and the Consequences for School Finance

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Conference Draft: March 2010
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1. Introduction

During the 1930s and early 1940s, most industry was focused on supporting the war effort and little housing stock was being built. After World War II ended, a number of factors caused the demand for new housing to rise dramatically. Many marriages were postponed until servicemen returned home after the war, and following the war the number of young married couples increased dramatically, and with them the demand for housing. These new families were able to afford to purchase homes largely because the Servicemen's Readjustment Act of 1944, usually known as the GI Bill of Rights, allowed veterans to procure low-interest mortgages with no down payments. Indeed, from 1944 to 1952, the Veteran's Administration backed nearly 2.4 million home loans (U.S. Department of Veterans Affairs, 2009). The influx of black workers from the rural South also resulted in white families fleeing the central cities, where blacks generally settled, to newly built, race-restricted areas. The developing interstate highway system allowed these new families, who would become the parents of the Baby Boomer generation, to move away from the central cities but still be able to commute in for work. This movement to previously undeveloped areas allowed for easy mass production of affordable housing, and by 1955, suburban homes comprised more than 75% of all new housing stock in metropolitan areas (Jackson, 1987). The modern American suburb was born.

After moving to the suburbs, a substantial number of the Baby Boomers' parents aged in place, and, their children grown, may have begun to prefer a different mix of publicly provided goods. This would have put pressure on the mix of goods provided by local governments to change, causing conflict between the wishes of these aging adults and those of younger families moving into the suburbs. As the much larger Baby Boomer generation itself moves into grandparenthood, the potential consequences of this intergenerational conflict for the provision of locally provided public goods are even larger than in the postwar era. Exploring how the mix of goods and services provided by local governments changed as the parents of the Baby Boomers aged may give us some insights to what may happen as the Baby Boomers themselves age in place. Aging in place is particularly salient in an environment in which younger Americans are more racially and ethnically heterogeneous than are the older Americans. Indeed, demographers estimate that around 2012 non-Hispanic whites will account for less than 50 percent of births in the United States (Johnson and Lichter, 2010).

There is a substantial literature exploring how intergenerational conflict has affected the provision of public education. Most of these papers have focused on how an increase in the elderly population in an area affects school revenues, but the results of these studies have been inconclusive, and seem to vary with the level of aggregation and the empirical specifications used. In a panel of Texas counties, Miller (1996) finds that the fraction elderly have a significant negative impact on education spending, but the effect is statistically insignificant in a panel of 48 states. Poterba (1997) finds in a state-level panel that per-child education spending falls as the state's fraction elderly rises. However, the effect is not statistically significant if a measure of urbanicity is included. Poterba does find that the states where the elderly are "whiter" than school-aged children have significantly lower education spending. Ladd and Murray (2001) conduct an analysis similar to Poterba's, but at the county level with county and time fixed effects to capture within-state differences in education finance. They find the elderly to have no significant effect on school spending, but like Poterba, find that racial heterogeneity between the elderly and school-aged children negatively affects spending. Harris, Evans and Schwab (2001) conduct a school-district level analysis and find that a larger share of elderly in the district significantly lowers education spending, but that the magnitude of the effect is small. Fletcher and Kenny (2008) examine how an increase in a county's fraction elderly affects the identity of the median voter, and, like Harris, Evans and Schwab, find that more elderly are associated with a small but statistically significant decrease in education spending.

A few authors have directly examined how the elderly affect votes on school bond initiatives. Button (1992) performs a precinct-level analysis of the determinants of the fraction voting for education bond initiatives in six Florida counties with large elderly populations. He finds that precincts with a larger share of voters aged 55 or older had fewer voters choosing to approve the initiative. Brunner and Balsdon (2004) use survey data of individual voters on school bond initiatives in California to get direct evidence on how a voter's characteristics might be related to his choice at the ballot box, and find that the elderly were less likely than younger voters to support the initiatives.

A number of authors have suggested that while the elderly prefer less education spending than younger families because of intergenerational conflict, there are some factors that will still cause them support education. One such factor is the capitalization of better school quality into housing prices. In a school district-level analysis, Hilber and Mayer (2009) find evidence that there is greater capitalization of school quality into house prices, and thus more support for education spending by the elderly, when little land is available for development. As suburbs are developing, they are surrounded by easily developed land, and as the suburbs fill in this land becomes more scarce and expensive. This would suggest that as the suburbs age along with the people living in them, those people should become more supportive of education as time passes. The results supporting the capitalization of school quality into housing prices, and the role this may play in elderly support for school spending, mirrors the findings of Black (1999) and Figlio and Lucas (2004) that indicate that measured school quality is highly valued in the housing market. Reback (2009) demonstrates the importance of the tax price in determining the degree to which elderly residents support school spending, and suggests that state-financed targeted tax price subsidies to elderly homeowners may be an effective mechanism to reduce the likelihood of intergenerational conflict.

Other authors, including Fletcher (2004) and Berkman and Plutzer (2004) have looked at county-level migration patterns of the elderly to explain differences in school spending. These authors argue that those elderly aging in place will be more invested in the community and its youth, and this will be manifested by higher education spending in locations with more long-term elderly. The results of both of these studies suggest that more elderly aging in place are associated with increased school spending, while a higher fraction of elderly migrants is associated with decreased school spending. There is also some evidence that the relative age of the elderly inmigrants affects support for education spending, however. Tosun, Williamson and Yakovlev (2005) find that counties with a larger number of elderly between the ages of 55 and 74 moving into the county will increase education spending, while more elderly aged 75 or older moving in will depress it. If this effect is similar for those residents aging in place, we might expect to see support for education erode as time passes.

This paper takes on a somewhat different question from the literature on intergenerational conflict. Rather than looking contemporaneously at the level of school spending and the age distribution, we seek to map out the broad sweep of postwar suburbanization, identifying the areas where young families have settled, and documenting the degree to which they have aged in place. We use data from 20 Northeastern and Midwestern cities during the period of postwar suburbanization to explore how support for education changed as the Baby Boomers' parents aged in place, changing the age distribution of the suburbs. We find that an increase in median age in the suburbs is positively related to school revenues per pupil in 1970, when the Baby Boomers' parents were still relatively young, but that as families age even more in place, spending falls. This result, which is robust to a variety of specification checks, is particularly pronounced as the elderly residents who aged in place diverge ethnically from the young families who settled in the community.

2. The rise of the suburb in postwar America

In this paper, we concentrate on the American cities that were already beginning to suburbanize in postwar America, so that we can maximize the possibility of following the parents of the Baby Boom generation from young parenthood through retirement. The great majority of these cities were in the Northeast and Midwest; indeed, 21 of the 27 cities whose suburbs were partially tracted by the Census in 1950 were in these regions. We view suburban Census tracting as a proxy for suburbanization because the Census Bureau aimed to divide into tracts all urbanized areas with significant population surrounding a central city. We choose not to focus on Southern cities for several reasons. First, the prevalence of county-level school systems in the South are not ideal for the discussion of this topic. Second, Southern central cities made more use of suburban annexation relative to cities in the Midwest and Northeast that were more likely ringed by incorporated areas by 1950. Finally, the widespread de jure racial segregation of schools in the South covers much of our study period. Among Western cities, only Los Angeles's, Oakland's, San Diego's and Seattle's suburbs were significantly tracted in 1950, and mapping Census tracts in 1950 and 1960 to school districts in Los Angeles is much more challenging than in the Northeast and Midwest because of major changes in school district boundaries over time.[1] In our analysis, we also exclude New York City, because only a portion of New York's surrounding developed areas were included in the 1950 Census tracting. Therefore, our analysis focuses on the suburbs of 20 cities.

We begin by describing the development of the suburbs surrounding these 20 cities during the period from 1950 through 1990. The first five columns of Table 1 present the percentage of the total population in these metropolitan areas who reside in the central

[1] The tracted areas adjacent to Oakland, San Diego and Seattle in 1950 are in relatively large cities themselves, as opposed to the smallish suburbs on which we are concentrating, for the most part, in this analysis.

city (or cities, in a few cases, such as Minneapolis-St. Paul) in each of the first five postwar Census rounds. By design, all of these areas had at least some significant suburbanization in process by the time of the 1950 Census, but in all cases but one (Boston), the majority of the metropolitan population in areas tracted by the Census resided in the central city as of 1950. Excluding the Boston area, where two-thirds of the urbanized population resided outside of the central city in 1950, the fraction residing in tracted suburbs ranged from 11 percent outside of Minneapolis-St. Paul to 47 percent outside of Cincinnati.

Within just ten years, the fraction of the urbanized population in suburban areas rose considerably in most of these cities, and held steady only in the case of Kalamazoo. By 1960, the fraction of the urbanized area's population residing in tracted suburbs ranged from 24 percent in the areas surrounding Columbus to 74 percent in the areas surrounding Boston. Minneapolis-St. Paul's tracted suburbs, which accounted for just 11 percent of the urbanized population of the area in 1950, had 37 percent of the area residents in 1960. Cincinnati, the city with the most relatively populous suburbs other than Boston in 1950, experienced suburban population growth from 47 percent of metropolitan population in 1950 to 60 percent of metropolitan population in 1960. The pattern of suburbanization continued in 1970, with suburban population ranging from 52 percent of Milwaukee's metropolitan area to 84 percent of Hartford's metropolitan area.

After 1970, the growth of suburbanization continued, but at a slower pace, in these cities. By 1990, suburban population ranged from 59 percent of Milwaukee's metropolitan area to 87 percent of Hartford's metropolitan area. While the fraction of the metropolitan population continued to grow in all 20 areas, in only three cases (Flint, Indianapolis, and Minneapolis-St. Paul) did the proportion within the suburbs increase by more than ten percentage points between 1970 and 1990, as compared with the period from 1950 to 1970, when the smallest change (Boston) was 14 percentage points and 15 of the 20 cities experienced suburban population share increases of more than 25 percentage points.

Because this paper concerns the support for local public schools, our analysis is at the school district level. While the U.S. Census Bureau and the U.S. Department of Education had matched school district boundaries to Census tract boundaries as well as possible for 1970, 1980 and 1990, this matching had not previously taken place prior to 1970, during the time of the widespread suburbanization. We hand-matched school district boundaries using the earliest maps we could find in each case to Census tract maps from 1950 and 1960, following the rule that if a Census tract was split between multiple school districts, we assigned the tract to the school district that occupied the majority of the tract. We were able to match school districts to one or more Census tracts in 100 percent of the cases in which the geographical areas were covered by Census tracts in the relevant years. In a fraction of cases (18.5 percent of all school districts), historical Census tracts were large enough that they subsumed multiple school districts in their entirety (or at least the vast majority of the districts). In these cases, we assigned the Census tract populations to all of the relevant school districts, and in this paper we present the results of regression models in which we both include and exclude the school districts that we cannot uniquely match to Census tracts. All told, of the 1396 suburban school districts in the 20 metropolitan areas in our study, 1252 were in the metropolitan areas in the 1970 area definitions. Among these school districts, 1004 were in tracted suburban areas during the 1960 Census, and 818 of these districts could be uniquely matched to 1960 Census tracts. Of these school districts, 600 were in suburban areas tracted in the 1950 Census, and 510 districts can be uniquely matched to Census tracts in 1950.

The final three columns of Table 1 describe an area-by-area breakdown of the percentage of 1990-era metropolitan area school districts in tracted areas in the 1950, 1960 and 1970 Censuses. We look here at 1990-era school districts because our analysis follows school district spending from the time around the 1970 Census to the time around the 1990 Census. This table echoes the previous discussion that a large fraction of postwar suburbanization in these metropolitan areas had taken place by 1970. The final column reflects the fact that in many of these areas, by 1970 the metropolitan area had expanded spatially about as much as it would (though, of course, since metropolitan areas are defined at the county level, except in New England, rural portions of counties included in metropolitan areas continue to urbanize to this day.) In ten of the 20 metropolitan areas, 100 percent of the school districts in 1990 were included in the metropolitan area's boundaries by 1970.[2] The preceding two columns of Table 1 present the percentages of 1990 school districts that were in tracted areas in 1950 and 1960. In 1950, some present-day metropolitan areas were already heavily tracted; 54 percent of Boston's 1990-era school districts are in areas tracted in 1950, while 60 percent of Cleveland's 1990-era

[2] Kalamazoo, Columbus and Minneapolis-St. Paul have experienced the largest proportionate growth in metropolitan area boundaries since 1970.

school districts are in areas tracted in 1950. And the entire Philadelphia-Camden metropolitan area as of 1990 was tracted in 1950. By 1960, Chicago had joined Philadelphia-Camden as being entirely tracted, and St. Louis, Buffalo-Niagara Falls and Pittsburgh were close behind.

3. The American suburbs have aged in place

We consider 1970 the focal year for our analysis, for two reasons. First, by 1970, the widespread suburbanization of the cities included in our analysis had begun to slow. In addition, the Baby Boom generation, defined by the U.S. Census Bureau as having been born between 1946 and 1964, had all entered school by 1970. An additional argument for beginning with 1970 is convenience, as school district fiscal data are more readily available from 1967 to the present than they were prior to 1967; in our analysis, we adopt Harris, Evans and Schwab's (2001) use of 1972 Census of Governments school district fiscal data to correspond to 1970 Census of population data, 1982 fiscal data to correspond to 1980 population data, and 1992 fiscal data to correspond to 1990 population data.[3] We are grateful to Harris, Evans and Schwab for the use of the panel data set they constructed for 1970(2), 1980(2), and 1990(2), merging together Census of Population data with Census of Governments data at the school district level. Once we conducted the manual matching of school district boundaries to 1950 and 1960 Census tract boundaries, we were able to augment these data with 1950 and 1960 tract-level Census of Population records maintained by the National Historical Geographic Information System (NHGIS; Minnesota Population Center, 2004).

[3] Census of Governments fiscal data for school districts are available at five-increments in years ending with 2 and 7.

We begin our discussion by noting that, as of 1970, the American suburbs varied widely in their age distributions. Table 2 presents, by metropolitan area, both the percentage of school districts with a median adult age 45 or older in 1970, as well as the minimum, mean and maximum percentage of adults in the school district aged 55 or older in 1970. The table reports these statistics for two different groups of school districts: all districts within the 1990 metropolitan area boundaries and all districts within the 1970 metropolitan area boundaries.

One observes that there existed vast differences across metropolitan areas in the typical age of suburban residents in 1970. Following the 1990 definition of metropolitan areas, it is evident that while some areas had relatively old suburban residents -- 71 percent of Pittsburgh suburbs had a median adult aged 45 or older, as did 58 percent of Bridgeport's suburbs and 51 percent of St. Louis's suburbs -- some areas had very young suburban residents as of 1970 -- not a single suburb of Flint had a median adult aged 45 or older, and only 20 or 21 percent of Akron's, Dayton's and Indianapolis's suburbs had a median adult aged 45 or above. The contrast is even stronger if one restricts the analysis to the set of suburban school districts in the 1970 definition of metropolitan areas, where Bridgeport, Pittsburgh and St. Louis have the same percentage of school districts with a median adult aged 45 and over, while Flint, Kalamazoo and Minneapolis-St. Paul all had three or fewer percent of the suburban school districts with a median adult resident aged 45 or older.

Furthermore, *within* each of the 20 metropolitan areas, there existed dramatic variation in the age distributions of suburban school districts as of 1970. In only one metropolitan area (Philadelphia) was there at least one school district where the median adult was 55 or older, but in 11 metropolitan areas there was at least one school district where at least 40 percent of the adult population was aged 55 or older.[4] In every one of these 11 metropolitan areas, there was another school district where fewer than 18 percent of the adult population was aged 55 or older. While not reported in the table, the within-metropolitan area standard deviation in the percentage aged 55 and over ranges from 3 percentage points (Flint) to 8 percentage points (St. Louis), with most metropolitan areas having standard deviations in the 6 to 7 percentage point range. In summary, by 1970, when the majority of the Baby Boom generation was still in elementary or secondary school, there existed considerable variation within every metropolitan area in the relative age of the population of the school districts. If adults tend to age in place, this would indicate that some school districts in each metropolitan area would have their median adult be without children in school considerably sooner than would other school districts.

Why might there have been dramatic differences in the age distributions across suburbs in the same metropolitan areas? One possibility has to do with the nature of the housing stock in the suburbs. We propose that young families settled the new housing in the postwar suburbs, suggesting that suburbs with more new housing would have younger adults, in general. To investigate this possibility, we calculate the percentage of housing in 1950 that was built between 1940 and 1950 and the percentage of housing in 1960 that

[4] For ease of explication, the remainder of this discussion will be based on the 1970 definition of the metropolitan areas.

was built between 1950 and 1960, and aggregate upward from the Census tract data that we constructed in the 1950 and 1960 Censuses. In Table 3, we stratify each metropolitan area by the percentage of new housing in 1950 and again by the percentage of new housing in 1960. For each of the two Census years, we report the average median adult age in the suburbs, by five groups of suburbs: those in the bottom quartile in their metropolitan area in terms of the percentage of new housing; those between the 25th and 50th percentile of new housing; those between the 50th and 75th percentile of new housing; those between the 75th and 90th percentile of new housing; and those in the top tenth of their metropolitan area, in terms of the percentage of new housing in the school district. We observe that, in both Census years, the school districts with the largest percentage of new housing are the school districts with the youngest adults. In 1950, the suburbs with the least new housing had a typical median age of 42.8, while those with the most new housing had a typical median age of 38.3. In 1960, the suburbs with the least new housing had a typical median age of 45.6, while those with the most new housing had a typical median age of 39.0. Therefore, within a metropolitan area, the newest suburban developments also tended to be the youngest.

Table 3 also displays the range in the quantiles across the 20 metropolitan areas. It is evident that the metropolitan areas were adding new suburban housing at very different paces in the 1940s and 1950s. In the 1940s, for instance, the 25th percentile of the percent of newly-built housing was 50.3 percent in one metropolitan area (Dayton) and only 7.9 percent in a different metropolitan area (Syracuse). The 90th percentile of the percent of newly-built housing was 79.5 in one metropolitan area (Minneapolis-St. Paul) and only 24.8 percent in a different metropolitan area (Boston). In the 1950s, the 25th percentile of the percent of newly-built housing was 45.3 percent in one metropolitan area (Indianapolis) and only 10.8 percent in a different metropolitan area (Pittsburgh). The 90th percentile of the percent of newly-built housing ranged across metropolitan areas from 48.6 percent (Flint) to 81.5 percent (Minneapolis-St. Paul). Hence, while all metropolitan areas were suburbanizing during the postwar decades, some metropolitan areas were adding housing largely in most uninhabited suburbs while other metropolitan areas were adding housing in school districts with considerable amounts of existing housing.

It may also be the case that the school districts that were growing the most rapidly following World War II continued to be the ones to grow the most rapidly in the decade between 1950 and 1960. To investigate this possibility, we classify all school districts tracted in 1960 based on the share of their housing stock in 1960 that was new between 1950 and 1960 and based on the share of their housing stock in 1950 that was new between 1940 and 1950.[5] Table 4 presents a cross-tabulation of the two groups of school districts, in which we compare the within-metropolitan area quartile of new housing in 1950 to the within-metropolitan area quartile of new housing in 1960. As can be seen from the table, the school districts that were growing the fastest between 1940 and 1950 (in terms of housing stock) tended to be the districts that continued to grow the fastest

[5] We calculate this latter value using the 1960 Census so that we can construct these data for the 1004 school districts that were tracted in 1960 as opposed to solely the 600 school districts that were tracted in 1950. This calculation will not be exactly the same as the calculation based on 1950 Census data because it does not take into account existing housing that was demolished between 1950 and 1960. That said, the calculations based on 1960 Census figures for the percentage of new housing in 1950 are highly correlated with the calculations based on 1950 Census figures, so we include the larger sample for this comparison. The results of all of these comparisons are available on request.

between 1950 and 1960. Among the quartile of school districts with the most new housing between 1940 and 1950, 61 percent were in the quartile with the most new housing between 1950 and 1960 and only 2 percent were in the quartile with the least new housing. Likewise, the school districts that were growing the slowest between 1940 and 1950 tended to be the districts that continued to grow the slowest between 1950 and 1960. Among the quartile of school districts with the least new housing between 1940 and 1950, 65 percent were in the quartile with the least new housing between 1950 and 1960 and only 3 percent were in the quartile with the most new housing. Indeed, the correlation between the percentage of housing in a school district in 1950 built during the 1940s and the school district's percentage of housing in 1960 built during the 1950s is 0.71. In sum, the rapidly growing suburbs postwar continued to grow rapidly at least through 1960.[6] Given the available information, these rapidly growing new suburbs were likely populated by young families who may have then aged in place. We next seek to investigate whether there is evidence that individuals tended to age in place from the beginning of suburbanization.

Table 5 presents evidence of the relationship between the 1960 age distribution in the school district and the 1970 age distribution in the school district for those districts that were in tracted areas in the 1960 Census. One column lists the relationships for all such school districts, while the second column lists the relationships for only the 81.5 percent of the school districts tracted in 1960 where we can uniquely match school districts to Census tracts. The relationships are nearly identical across columns, and indicate a very

[6] Because we did not construct the school district Census sample for 1970, we do not have the means to carry forward similar comparisons through 1970, so we can only see what happened through 1960.

strong positive relationship between the median age in 1960 and the percentage aged 55 or older in 1970. Among those school districts with a 1960 median adult aged between 30 and 34, only 13 percent of adults ten years later were aged 55 and above. On the other hand, among the school districts with a median adult aged 45 to 49 in 1960, 33 percent of adults in 1970 were aged 55 and above, and among the school districts with a median adult aged 50-54, 41 percent of 1970 adults were aged 55 and above. The patterns based on 1960 age distributions persist all the way through 1990, the last year for which we make these calculations. As recently as 1990, thirty years later, the school districts with a median adult aged 30 and 34 had 21 percent of adults aged 55 and above while those with a median adult aged 45 to 49 had 33 percent aged 55 and above.

Table 6 presents the same relationship, but backed up ten years. As can be seen in the table, there is a strong positive relationship between school district population age in 1950 and school district population age in 1960, as well as a considerable positive relationship over the 20-year swath of time between 1950 and 1970. Among school districts with a median adult age between 30 and 34 in 1950, 15 percent of adults were aged 55 or above by 1960 (12 percent if we look at those uniquely identified in the Census) and 21 percent of adults were aged 55 or above by 1970. But for the school districts with a median age between 45 and 49 in 1950,[7] 34 percent of the adult population in 1960 was aged 55 or above (35 percent if we look at those uniquely identified in the Census), and 36 percent of the adult population in 1970 was aged 55 or

[7] We do not present data for the school districts with median adult age between 50 and 54 because there were so few of these districts (only three) in 1950. The group of districts with median age between 45 and 49 is the smallest set that we feel comfortable reporting.

above. And as before, even forty years later, in 1990, there is a 9 point difference in percentage of adults aged 55 or above between those with the lowest median adult age in 1950 and those with the highest median adult age in 1950. Therefore, there exists very solid evidence that the age distribution in a school district from 1960 or even 1950 may dictate the age distribution in 1970 and beyond. These results indicate that the young families that settled the suburbs in postwar America aged in place, and that conditions were ripe in the 1970s and 1980s for a change in the political power structure in suburban school districts regarding school spending.

4. The empirical model

We carry out two different basic empirical specifications to investigate the relationship between the age distribution in suburban school districts and the level of school revenues in these districts. We look both at the contemporaneous relationship between the age distribution in 1970 and the level of school revenues in 1972, as well as the relationship between the age distribution in 1970 and the change in school revenues between 1972 and 1992. We concentrate on two different definitions of per pupil revenues: per pupil total revenues and per pupil revenues from local sources. The latter specification is more likely to reflect local decision-making, though one should be careful to recognize that there could exist considerable measurement error in the definition of local revenues for schools. Many states require local property tax collections, say, and often redistribute some of these collections to other school districts. Nonetheless, these variables should at least reflect some aspects of spatial differences across school districts in the desire to fund local public schools.

Having demonstrated the strong evidence that suburban dwellers tend to age in place once settling the suburbs, we make use of this fact by instrumenting for 1970 age distributions with historical age distributions from 1950 or 1960 in the school district. We also control for metropolitan area fixed effects to reflect cross-area differences in the level of school revenues, so our analysis could be thought of as comparing within metropolitan areas. While our research question is quite different from that addressed by Harris, Evans and Schwab's (2001) -- we are explicitly interested in addressing the consequences of historical sorting and aging-in-place -- theirs is the closest to our analysis in the literature, and we adopt the set of covariates that they used in their analysis. Specifically, we control for median household income, the percent owner occupied, the percent nonwhite, the percent in poverty, the percent living in urban settings, the percent of adults with less than a high school education, the percent of adults with exactly a high school education, the percent of adults with fewer than four years of college education, the log of per pupil federal education revenues, and the log of school district population. Some specifications control for the 1970 Census values of these variables, while other specifications control for both the 1970 values and the 1990 values of these variables. As mentioned above, we make use of Harris, Evans and Schwab's merged Census of Governments-Census of Population dataset for 1970(2), 1980(2) and 1990(2), which we augment with Census data from the 1950 and 1960 Censuses made possibly by our hand-matching of school districts to Census tracts in the historical data, and then merging these Census tract data (recorded in the NHGIS database) with the more current Census data.

Table 7 presents summary statistics for our dependent variables of interest, our key explanatory variables and instruments, and our covariates from the 1970 and 1990 Censuses, for three populations: the set of school districts present in the 1970 definitions of the 20 metropolitan areas, the set of school districts in the tracted portions of the 1960 metropolitan areas, and the set of school districts in the tracted portions of the 1950 metropolitan areas. The fraction of school districts for which there are school finance and population data in Harris, Evans and Schwab's matched dataset of Census of Population and Census of Governments data is very high.[8] Of the 1252 school districts in the 1970 definitions of the metropolitan areas, 1171 (94 percent) are present in their matched dataset with likely reliable school finance data.[9] Of the 1004 school districts in tracted areas in 1960, 943 (94 percent) are in their matched dataset with reliable school finance data, and of the 600 school districts in tracted areas in 1950, 569 (95 percent) are in their matched dataset with reliable school finance data. Nearly 100 percent of school districts with 1970(2) school finance and population data also have 1990(2) school finance and population data.

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[8] Our population frame for identification of school districts to match to historical Census data is the Common Core of Data, collected by the U.S. Department of Education. We exclude vocational-technical school districts from our analysis. In addition, we include only one school district per geographical unit. In cases in which there is both a K-8 school district and a high school district, we include only the K-8 school district, as it typically covers a more geographically limited space than does the high school district.

[9] We adopt Harris, Evans and Schwab's convention of excluding the of observations with revenues per pupil greater than 150 percent of the 95th revenue percentile for each state in each data year, or less than 50 percent of the 5th revenue percentile for each state / year. This accounts for about one-quarter of the lost observations. The other lost observations are largely due to missing observations in the 1970 demographic data, as the 1970 Census extract only was constructed for school districts with over 1000 population. A third reason for lost observations in that a small fraction of school districts are missing 1972 finance data.

As can be seen in the descriptive data from Table 7, the 1970 Census attributes of the study population are relatively stable across most dimensions when comparing the full 1970 metropolitan population, the set of school districts in areas tracted in 1960, and the set of school districts in areas tracted in 1950. School districts in geographical areas that were tracted in 1950 tended to have modestly higher total and (particularly) local revenues in 1970 than did those tracted in 1960 or the full set of school districts. They also tended to have higher school district populations and were unsurprisingly more urban in both 1970 and 1990. In other dimensions, including the age distribution in 1970, the differences across the columns tend to be trivial.

5. OLS results

Table 8 presents the metropolitan area fixed effects regression estimates of the relationship between the log of per pupil total (or local) revenues in 1972 (or the change between 1972 and 1992) and a measure of the 1970 adult age distribution in the school district for the 1171 school districts that were part of the 1970 metropolitan area definition and had a valid measure of the dependent variable, as defined by Harris, Evans and Schwab (2001). For the purposes of convenience, we report only the key point estimate of interest -- the median adult age in 1970 or the percentage of adults aged 55 or over in 1970. All specifications include metropolitan area fixed effects and controls for the 1970 values of all the control variables listed in Table 7. Some specifications, when noted, also include controls for the 1990 values of the control variables as well. A full set of coefficient estimates for the first three specifications are reported in Appendix 1.

The first three specifications reported in Table 8 investigate the relationship between the school district age distribution and the 1972 values of school district revenues per pupil. As can be seen in the table, the older the residents are in 1970, the higher the level of revenues raised for schools, on a per student basis. The results are both statistically significant and meaningful in magnitude: Increasing the median adult age by five years is associated with a 3.5 percent increase in per pupil total revenues and a 7.5 percent increase in per pupil local revenues collected. Increasing the percentage of adults over age 55 by one standard deviation (7 percentage points) is associated with an 11 percent increase in per pupil local revenues. Hence, at least in the OLS regressions, the evidence suggests that a larger fraction of older residents does not reduce demand for school spending, and may in fact increase demand. That said, it may be the case that these results are present because very few school districts had a sufficiently large fraction of adults older than an age when children would likely be finished with K-12 schooling. Recall from Table 2 that the median adult was almost never over age 55 in the data in 1970, and in fact, as of 1970, the median adult was only aged 45 or above in 34 percent of cases.

What happens as this population ages over time? The next three columns of Table 8 present evidence on the relationship between 1970 age distribution and the change in log revenues from 1972 to 1992. As can be observed, the estimated relationship is now negative and statistically significant, and indicates that the older the school district was in 1970, the more likely it was to cut revenues (relative to peer school districts) over the next twenty years. These results are also large in magnitude, and suggest that adding five years to a school district's median age in 1970 is associated with a 3.5 percent relative reduction in the change in per pupil total revenues and a 5.5 percent relative reduction in the change in per pupil local revenues from 1972 to 1992, and a one-standard-deviation increase in the percentage of adults over age 55 in 1970 is associated with a 7.3 percent relative reduction in the change in per pupil local revenues over the two decades. The final three columns of Table 8 repeat this same exercise, but add in controls for all variables in 1990 as well as 1970. The results are virtually identical, indicating that these changes in spending are not due to changes in the school district's racial or ethnic makeup, adult education distribution, poverty rate or income levels, home-ownership rates, population, federal revenues or urban status.

During the 1970s and 1980s, however, a large number of states implemented policies that limited the degree to which localities could control their own school revenues. Prior research has shown that this era's tax and expenditure limitations (Figlio, 1997) and court-ordered school finance equalizations (Downes and Figlio, 1999; Murray, Evans and Schwab, 1998) have influenced the level of school spending and school services in a state. A large number of school districts in our dataset were subject to these school finance policies -- potentially binding tax and expenditure limitations in Massachusetts, Michigan, Missouri, New Jersey and Ohio and court-ordered school finance equalizations in Connecticut, Kentucky and New Jersey -- suggesting that our results involving the change in revenues per pupil over time might be partially influenced by school districts with less control over their own revenues and spending. Table 9 repeats the same nine specifications as were reported in Table 8, but where we have excluded the school districts in states with one of these major policy changes. As can be seen in the table, all of the results remain robust to this exclusion, and are somewhat larger in magnitude in some cases. We conclude that tax limitations and school finance reforms are likely not dramatically influencing the relationship between the age distribution and school district revenues. For the remainder of the paper, we present results from the full population of schools, which leads in general to more modest results than would occur were we to exclude the school districts with less control over their revenue-generation abilities.

6. Endogenous sorting and omitted variables

We are concerned that there may be unobserved factors that could lead a specific school district to have an older population and higher contemporaneous levels of per pupil revenues and spending, relative to observationally equivalent school districts in the same metropolitan area. In such a case, it may be the case that the positive coefficients in models looking at contemporaneous spending might be due to omitted variables and the negative coefficients in models looking at long differences in over-time spending may reflect regression to the mean in school revenue collections. We therefore conduct a series of instrumental variables analyses in which we instrument for our measure of the 1970 adult age distribution with measures of the 1960 or 1950 adult age distributions. We recognize that the same unobservable factors that led an individual to settle in a given location in 1950 or 1960 may still influence their demand for school spending in 1970 and their trajectory of desired school revenues over the subsequent twenty years, but we believe that such as instrumental variables strategy would help to reduce the possibility that our results are being driven by contemporaneous omitted variables or over-time regression to the mean in school revenues.

Table 10 presents results of the instrumental variables specifications in which we instrument for 1970 median adult age (or fraction aged 55 or older) using two instruments: the median adult age in 1960 and a dummy variable reflecting whether the school district was in a tracted area in 1960. We observe that the results are quite similar to those presented in previous tables. While the standard errors in the instrumental variables regressions are about twice the size of the OLS standard errors, the estimated relationships are in the same ballpark of magnitudes as previous reported and remain statistically significant at conventional levels. We note that the first stage explanatory power is extremely high -- the first stage F-statistic ranges from 39.2 to 91.6 depending on model specification -- which is consistent with our earlier finding that adults tend to age in place in suburbs, at least in this generation.

We note, however, that our instrument set includes a dummy variable for whether the school district was tracted in 1960. Because this fact may be related to the omitted variables that we hope to rule out, we repeat our instrumental variables analysis but now limit the population to the set of school districts that were uniquely identified in Census tracts in 1960. These results are presented in Table 11. The standard errors continue to increase marginally when the sample is reduced, but the magnitudes of the estimates and the level of statistical significance remain highly similar after making this sample adjustment.

A third instrumental variables specification, reported in Table 12, involves instrumenting for 1970 adult age distribution with the median adult age in 1950 and an indicator for whether the school district was in a tracted area in the 1950 Census. In this specification, the standard errors are larger still -- generally around three times the size of the standard errors in the OLS specifications. The reduction in precision relates to the weaker first-stage explanatory power -- though first-stage F-statistics remain strong, between 9.3 and 28.8 and invariably significant at the p=0.000 level. Moreover, the pattern of results and magnitudes remain basically unchanged, and the results remain statistically significant at conventional levels. In conclusion, the instrumental variables strategies employed -- instrumenting for 1970 age distributions with historical age distributions in the school district -- confirm our OLS findings that school districts with an older age distribution in 1970 had higher levels of contemporaneous per pupil revenues but cut their revenues over the next twenty years relative to comparison school districts.

Yet another possible concern may be that our covariates are not picking up enough of the localized amenities that might influence both the age distribution of a school district and the demand for school spending in that district. One possible way of controlling for these differences is to segment the suburbs of a given city into geographic areas based on different compass points. There is no inherently obvious way to do this, but given Baum-Snow's (2007) finding that the interstate highway system led to suburbanization, we coded all school districts in a metropolitan area into a set of segments based on the number of radiating interstate highways spread outward from the central city, and repeat our instrumental variables strategy (using the 1960 Census data as an instrument) but controlling for metropolitan area times compass direction fixed effects. These results, presented in Table 13, continue to echo all of our previous findings. As an alternative instrumental variables specification, reported in Table 14, we stratify all school districts by the percentage of adults in 1970 with at least a high school degree -- the median level of education among adults in 1970. When we divide each metropolitan area into quartiles based on the level of education of the adults in the school district, and control for education-specific-metropolitan area fixed effects (so that we are comparing school districts in a metropolitan area to others in the metropolitan area with the same education levels, and also still controlling for other observables) we find again very similar results. The evidence therefore continues to support the notion that school districts with relatively aged populations in 1970 supported school revenues more contemporaneously, but less over the next twenty years as a larger fraction aged out of the school-parent ages.

It is likely to be the case that political institutions will influence the degree to which the age distribution of a school district affects school district revenues and spending. In some school districts, local revenue and spending decisions are made via direct democracy, in which voters directly determine tax rates and spending levels. In other school districts, elected representatives suggest specific levels of spending and revenues to voters, who then approve these levels. In a third type of school district, voters have no direct say over the spending and revenue levels chosen by elected officials; their only recourse is to change the elected officials. While it is certainly the case that elderly voters could be more influential in selecting school board members as their numbers increase, it is reasonable to expect that elderly voters' ability to affect school district revenue and spending levels would be lower in school districts where voters do not directly approve or select spending and revenues.

7. Mechanisms for determining school revenues and spending

We therefore seek to determine whether the measured effects of the age distribution in 1970 differentially influenced the change in school revenues between 1972 and 1992 in school districts with more voter control relative to districts with less voter control over spending and revenues. Table 15 presents the results of the last specification from the preceding tables[10], in which we break down the school districts based on which of these three local governance structures are in place.[11] Among the locales in our study population, school districts in Connecticut, Michigan, Minnesota, New York, Ohio and Wisconsin, as well as some districts in New Jersey, are governed by direct democracy; school districts in Illinois, Massachusetts and Missouri require voter approval of school board-suggested revenues and spending; and school districts in Kentucky, Pennsylvania, and most districts in New Jersey have the least degree of voter control over local revenues and spending levels. We expect that this last group of school districts should have the smallest estimated effects of an aging population.

As can be seen in Table 15, this is precisely what we find. We observe that the negative relationship between school district age in 1970 and the change in local revenues from

[10] We present the results of a single model specification because our results are consistent across the different specifications presented earlier. Results of other model specifications are available on request.

[11] Reback (2009) also considers different forms of local governance structure in his analysis of local age distributions and tax prices.

1972 to 1992 is concentrated in the school districts with either direct voter determination of school district spending and revenues or those where voters approve spending and revenue levels suggested by elected or appointed officials. In both of these cases, the coefficient on percent over age 55 in 1970, instrumented by the age distribution in the school district in 1960, is around -1.9 and statistically significant. The coefficient is less than half this size and not statistically significantly different from zero in the places in which voters have no direct say over the level of spending or revenues. Therefore, we have some evidence of a potential political mechanism through which the intergenerational relationships described herein might operate.

8. Community heterogeneity and the consequences of aging in place

Much of the theory on the potential consequences of aging in place for the provision of local public schooling indicates that homophily could influence the degree to which childless elderly citizens might continue to support schooling. We therefore continue our analysis by investigating whether our instrumental variables estimates of the effects of the age distribution in 1970 on the change over the following two decades in the level of per pupil local revenues are influenced by the racial distribution of the school district. We characterize similarities between the elderly and the children of the school district on the basis of race: we calculate the ratio in 1990 of the percentage of all adult residents of the school district over age 55 who are white to the percentage of all school-aged children residing in the school district who are white. The higher this ratio, the more racially mismatched the children of a school district are from the likely childless elderly in the district. Every suburban school district in the 20 metropolitan areas had a ratio greater than 1.1 in 1970, illustrative of the widespread increase in racial and ethnic heterogeneity in the suburbs that has taken place since the founding of the suburbs, but this ratio varies considerably. The interquartile range of this ratio is from 1.24 to 1.32, and the right tail is thick, with a 95th percentile value of 1.45. These results should certainly be interpreted with caution, as the racial mismatch between elderly and young is likely to be endogenously determined, but the results can at least be seen as illustrative of a potential relationship.

The first three columns of Table 16 present instrumental variables regression results for the metropolitan area fixed effects models, as before, but now stratified by thirds of the distribution of this racial mismatch measure. The sample includes the set of school districts with Census tract data from 1960, but the results are very similar (as before) if we include those districts without 1960 Census tract data and include a dummy variable for untracted in 1960 as an additional instrument. The results suggest that the largest reductions in relative school revenues take place in the school districts where the racial mismatch between old and young is largest: the coefficient on the fraction over age 55 in 1970 is nearly twice as large for the top third of the racial mismatch distribution as for the bottom two thirds of the racial mismatch distribution.

We also stratify the school districts based on the over time *change* in this racial mismatch variable from 1970 to 1990, and report the results of this stratification in the second three columns of Table 16. The trend toward more heterogeneous suburbs continued strongly from 1970 to 1990, with 94 percent of all suburbs have a larger value of the mismatch ratio in 1990 than in 1970. The interquartile range of the change in the ratio is from 0.08 to 0.24. Here the differences in the estimated effects of aging in place are even more pronounced: the school districts that have been trending over time towards greater racial mismatch between the old and the young are the districts where the fraction who are old in 1970 has the largest negative relationship with the change over twenty years in log revenues per pupil. Because we do not have an instrument for racial mismatch, these results should not be seen as conclusive. That said, we are controlling for a large number of observables in both 1970 and 1990, so the factors that would be driving both the change in the ratio of elderly white percentage to school-white percentage and the age distribution in 1970, instrumented with 1960 age distribution, would have to be rather subtle. Nonetheless, these results provide suggestive evidence to indicate that racial mismatch might influence the effects of families aging in place on school spending.

An alternative approach to thinking about community heterogeneity is to consider the attributes of the housing stock as the suburb was developing. A school district with roughly homogeneous housing, in terms of size, might attract a more homogeneous population from a socio-economic standpoint as the community ages, while a school district with roughly heterogeneous housing might attract a more heterogeneous population. Due to our geographic matching of historical Census data to school districts, we can get some purchase on this idea. In the 1960 Census, housing units were classified as having one, two, three, four, five, six, seven, or eight-plus rooms, allowing us to calculate, as of 1960, a Herfindahl index of housing unit size in a school district. School districts vary considerably in the heterogeneity of the housing stocks as of 1960, with an interquartile range of this Herfindahl index from 0.19 to 0.25. The tenth percentile of this index is 0.18 and the 90th percentile is 0.30.

The final three columns of Table 16 stratify our instrumental variables model based on this measure of historical housing stock heterogeneity in a school district, in which we stratify the historical housing stock into thirds, from the least heterogeneous housing to the most heterogeneous housing, in terms of the number of rooms in the housing. While number of rooms in 1960 does not determine other aspects of housing quality, it should at least reflect some nature of variety of housing that could attract a heterogeneous set of new residents. As can be seen in the table, our results are concentrated in the third of school districts with the most heterogeneous housing -- that is, the school districts with the lowest values of the housing size Herfindahl index. We are continuing to investigate the mechanisms through which this result may operate, but the evidence suggests that elderly members of communities with more heterogeneous housing in 1960 -- likely implying more heterogeneous socio-demographics of the population -- support schools less, all else equal, than do elderly residents of school districts with more homogeneous housing stocks. As with the other models of community heterogeneity, this result is still merely suggestive, as the young families that settled school districts with heterogeneously sized housing in the 1950s and 1960s may be different, and have aged differently, from the young families that settled school districts with homogeneously sized houfing in the 1950s and 1960s. That said, this result provides more evidence that community heterogeneity could matter for the local financing of schools in an aging society.

9. Conclusion

This paper presents the first evidence to our knowledge that documents the role that the development of the suburbs in postwar America played in determining the age distribution of school districts in 1970 and beyond. We find strong evidence that the development dates of the suburbs and the resulting modern age distributions influence the level of school spending in these school districts. School districts encompassing suburbs that developed earlier and with consequently older populations tended to cut back on school spending, all else equal, faster between 1970 and 1990, once the Baby Boomer generation was out of school, than did those with later-developing suburbs. We also find suggestive evidence that the school districts where older residents and younger residents are more racially and ethnically mismatched are the places where this age distribution is the most salient. These results have clear implications for what may happen as the much larger Baby Boom generation ages, and suggest that the types of state-financed targeted tax price subsidies for elderly homeowners that Reback (2009) recommends may help to reduce inefficiencies in education provision in a graying America.

The heterogeneity in age distributions may also help to explain state interventions in school finance at the state level. In an aging America, an increasing fraction of citizens of a state may seek to influence the degree to which localities can tax residents without school-aged children. These policies may lead to further inefficiencies. While it is beyond the scope of the present paper to explain the presence and timing of these interventions in the context of demographic shifts, it is a question of ongoing research concern.

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Table 1: The development of the suburbs in postwar America

	% of MSA population in central city in:					% school districts: tracted in 1950	tracted in 1960	in MSA in 1970
Metro area	1950	1960	1970	1980	1990			
Akron	76	55	40	34	32	10	48	93
Boston	33	26	19	17	17	54	64	90
Bridgeport	71	47	35	32	31	17	50	100
Buffalo	72	46	41	35	33	35	89	100
Chicago	71	47	47	42	38	40	100	100
Cincinnati	53	40	36	27	28	38	38	100
Cleveland	67	52	40	33	31	60	74	100
Columbus	83	76	46	41	36	31	31	48
Dayton	69	52	37	30	27	21	33	100
Detroit	68	43	34	28	24	36	71	71
Flint	64	52	36	28	25	37	57	74
Hartford	61	25	16	14	13	12	47	84
Indianapolis	81	60	42	32	28	23	23	100
Kalamazoo	57	58	37	33	32	18	29	32
Milwaukee	77	62	48	42	41	31	53	89
Minneapolis-St. Paul	89	63	43	35	31	15	55	61
Philadelphia	67	63	43	38	35	100	100	100
Pittsburgh	58	35	21	19	18	48	98	100
St. Louis	56	32	24	20	17	34	82	97
Syracuse	65	46	31	26	25	43	76	100

Notes: These are authors' calculations based on Census tract data from the 1950 and 1960 Censuses and school district-level Census data from the 1970, 1980 and 1990 Censuses. School district-Census tract matches from 1950 and 1960 were conducted by the authors. School district counts are based on the 1990 Common Core of Data, and metropolitan area definitions reported by the U.S. Census Bureau. In the case of the Buffalo, Dayton, and Philadelphia metropolitan areas, a second city (Niagara Falls, Springfield, and Camden, respectively) was also considered a central city for the purposes of this analysis.

Table 2: Variation in age distribution among suburbs within a metropolitan area

Metro area	*All districts in MSA in 1990:* % with median age ≥ 45 in 1970	*% over 55 in 1970:* min	mean	max	*All districts in MSA in 1970:* % with median age ≥ 45 in 1970	*% over 55 in 1970:* min	mean	max
Akron	21	12	24	36	15	12	23	31
Boston	41	6	28	44	41	14	28	44
Bridgeport	58	16	28	33	58	16	28	33
Buffalo	42	20	28	36	42	20	28	36
Chicago	29	6	25	45	29	6	25	45
Cincinnati	39	12	28	41	39	12	28	41
Cleveland	44	16	28	41	44	16	28	41
Columbus	25	12	27	37	17	12	25	37
Dayton	20	11	25	46	20	11	25	46
Detroit	28	12	25	40	23	12	23	40
Flint	0	18	23	29	0	18	23	29
Hartford	35	16	27	42	32	16	26	42
Indianapolis	21	15	27	36	21	15	27	36
Kalamazoo	43	17	31	43	0	17	25	30
Milwaukee	28	16	28	43	24	16	27	43
Minneapolis	24	8	26	43	3	8	20	29
Philadelphia	40	7	28	51	40	7	28	51
Pittsburgh	71	16	31	42	71	16	31	42
St. Louis	51	14	30	45	51	14	30	45
Syracuse	28	18	30	40	28	18	30	40

Notes: These are authors' calculations based on Census age distributions in 1970. Metropolitan area definitions in 1990 and 1970 come from the U.S. Census Bureau.

Table 3: Age distributions in suburbs by percentiles of new housing stock in 1950 and 1960

Percentile of % new housing last ten years within metro area	*1950:* Mean (std. dev.) value for median age	Cross-MSA range in quantile	*1960:* Mean (std. dev.) value for median age	Cross-MSA range in quantile
0 - 25	42.8 (2.9)	(7.9, 50.3)	45.6 (2.8)	(10.8, 45.3)
25 - 50	41.8 (2.9)	(13.1, 57.5)	43.2 (3.2)	(18.8, 58.2)
50 - 75	40.9 (3.1)	(19.9, 63.9)	41.8 (3.0)	(35.2, 74.2)
75 - 90	40.9 (3.5)	(24.8, 79.5)	40.1 (3.4)	(48.6, 81.5)
90 - 100	38.3 (3.8)		39.0 (3.2)	

Notes: These are authors' calculations based on Census data from 1950 and 1960. 1950 and 1960 Census tracts were hand-matched to school districts by the authors.

Table 4: Cross-tabulation of quartiles of new housing stock in 1960 by quartiles of new housing stock in 1950

		1960			
		least new	25 - 50	50 - 75	most new
1950	least new	**65%**	24%	7%	3%
	25 - 50	21	**44**	23	11
	50 - 75	8	24	**40**	28
	most new	2	12	26	**61**

Notes: These are authors' calculations based on Census data from 1960, in which data are divided into housing units constructed between 1950 and 1960; those constructed between 1940 and 1949; and those constructed before 1940. The columns were determined based on the percentage of the total housing stock reflected in this first group. The rows were determined based on the ratio of the second group to the sum of the second and third groups. This is highly correlated with the related measure constructed using 1950 Census data, but this table has more observations since it is based on 1960 Census tract data. 1960 Census tracts were hand-matched to school districts by the authors.

Table 5: Mean fraction aged 55 and older by suburb's median age category in 1960

	all in 1960:	*uniquely identified in 1960:*		
Median age in 1960	1970	1970	1980	1990
30 - 34	13 (4)	13 (4)	17 (8)	21 (9)
35 - 39	21 (5)	20 (4)	25 (6)	28 (6)
40 - 44	26 (5)	27 (5)	30 (7)	31 (7)
45 - 49	33 (5)	33 (5)	34 (6)	33 (6)
50 - 54	41 (8)	41 (8)	36 (6)	33 (5)

Note: These are authors' calculations based on Census data from 1960 and the match between school districts and the 1960 Census. Standard deviations are in parentheses. "Uniquely identified" school districts are those whose boundaries conform closely enough to Census tract boundaries that it is possible to attribute 1960 Census data to a school district with high confidence.

Table 6: Mean fraction aged 55 and older by suburb's median age category in 1950

	all in 1950:	*uniquely identified in 1950:*			
Median age in 1950	1960	1960	1970	1980	1990
30 - 34	15 (5)	12 (5)	21 (8)	25 (11)	26 (11)
35 - 39	19 (5)	20 (5)	24 (6)	30 (7)	32 (7)
40 - 44	27 (6)	27 (5)	28 (6)	31 (7)	32 (7)
45 - 49	34 (5)	35 (5)	36 (6)	36 (5)	35 (5)

Note: These are authors' calculations based on Census data from 1950 and the match between school districts and the 1960 Census. Standard deviations are in parentheses. Only three districts had median ages in the 50 - 54 range in 1950. "Uniquely identified" school districts are those whose boundaries conform closely enough to Census tract boundaries that it is possible to attribute 1950 Census data to a school district with high confidence.

Table 7: Summary statistics of dependent variable and independent variables included in analysis

	Means (Standard deviations)		
Variable	All	Tracted 1960	Tracted 1950
Log per pupil total revenues (1972)	8.18 (0.32)	8.21 (0.31)	8.25 (0.31)
Log per pupil local revenues (1972)	7.70 (0.54)	7.74 (0.54)	7.87 (0.52)
Change in log of per pupil total revenues, 1972 - 1992	0.52 (0.30)	0.51 (0.31)	0.54 (0.32)
Change in log per pupil local revenues, 1972 - 1992	0.52 (0.45)	0.56 (0.46)	0.51 (0.47)
Fraction over 55, 1950			0.24 (0.06)
Fraction over 55, 1960		0.25 (0.07)	0.25 (0.07)
Fraction over 55, 1970	0.27 (0.07)	0.27 (0.07)	0.28 (0.07)
Fraction over 55, 1980	0.29 (0.07)	0.30 (0.08)	0.32 (0.07)
Fraction over 55, 1990	0.30 (0.07)	0.31 (0.07)	0.32 (0.07)
Median household income (thousands), 1970	11.92 (2.67)	12.45 (2.75)	12.70 (2.91)
Fraction owner occupied, 1970	0.76 (0.11)	0.76 (0.11)	0.75 (0.13)
Fraction nonwhite, 1970	0.04 (0.08)	0.04 (0.09)	0.05 (0.11)
Fraction in poverty, 1970	0.06 (0.04)	0.06 (0.03)	0.06 (0.04)
Fraction urban, 1970	0.69 (0.37)	0.77 (0.33)	0.87 (0.25)
Fraction of adults who were high school dropouts, 1970	0.41 (0.13)	0.40 (0.13)	0.39 (0.14)
Fraction of adults with 12 years of education, 1970	0.36 (0.06)	0.36 (0.05)	0.35 (0.06)
Fraction of adults with 13 - 15 years of education, 1970	0.11 (0.05)	0.11 (0.05)	0.11 (0.05)
Log of per pupil federal revenues, 1970	0.68 (1.12)	0.70 (1.15)	0.78 (1.18)
Log of population, 1970	9.51 (0.92)	9.61 (0.93)	9.81 (0.90)
Median household income (thousands), 1990	39.38 (12.51)	40.36 (13.13)	40.25 (13.13)
Fraction owner occupied, 1970	0.75 (0.11)	0.75 (0.12)	0.73 (0.13)
Fraction nonwhite, 1990	0.09 (0.13)	0.10 (0.14)	0.12 (0.17)
Fraction in poverty, 1990	0.06 (0.05)	0.06 (0.06)	0.06 (0.06)
Fraction urban, 1990	0.76 (0.34)	0.85 (0.28)	0.92 (0.20)
Fraction of adults who were high school dropouts, 1970	0.19 (0.09)	0.19 (0.09)	0.19 (0.09)
Fraction of adults with 12 years of education, 1990	0.33 (0.09)	0.32 (0.08)	0.31 (0.09)
Fraction of adults with 13 - 15 years of education, 1990	0.25 (0.04)	0.25 (0.04)	0.24 (0.04)
Log of per pupil federal revenues, 1990	0.15 (0.60)	0.16 (0.63)	0.16 (0.66)
Log of population, 1990	9.67 (0.86)	9.75 (0.87)	9.84 (0.86)
Total number of school districts	1252	1004	600
Sample size (total)	1171	945	569
Sample size (complete records)	1168	943	568

Table 8: OLS regression results for the relation between age distributions in 1970 and per pupil revenues

	Dependent variable								
Variable	Log per pupil total revenues (1972)	Log per pupil local revenues (1972)	Log per pupil local revenues (1972)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)
Median adult age in 1970	0.007 (0.002)	0.015 (0.003)		-0.007 (0.002)	-0.011 (0.003)		-0.006 (0.002)	-0.010 (0.003)	
Fraction of adults over 55 in 1970			1.562 (0.211)			-1.047 (0.206)			-1.143 (0.223)
Controls for 1970 variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls for 1990 variables	no	no	no	no	no	no	yes	yes	yes
Fixed effects	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA
Sample size	1171	1171	1171	1168	1168	1168	1168	1168	1168

Notes: All regressions include 1970 (and, in the last three columns, 1990) values of the covariates included in Table 7. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates.

Table 9: OLS regression results for the relation between age distribution in 1970 and per pupil revenues, excluding states with property tax limitations or court-ordered school finance reforms prior to 1990

Variable	*Dependent variable* Log per pupil total revenues (1972)	Log per pupil local revenues (1972)	Log per pupil local revenues (1972)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)
Median adult age in 1970	0.009 (0.002)	0.020 (0.004)		-0.007 (0.002)	-0.013 (0.004)		-0.007 (0.002)	-0.013 (0.004)	
Fraction of adults over 55, 1970			1.872 (0.297)			-1.450 (0.295)			-1.352 (0.301)
Controls for 1970 variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls for 1990 variables	no	no	no	no	no	no	yes	yes	yes
Fixed effects	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA
Sample size	590	590	590	590	590	590	590	590	590

Notes: All regressions include 1970 (and, in the last three columns, 1990) values of the covariates included in Table 7. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates.

Table 10: Instrumental variables regression results for relation between age distribution in 1970 and per pupil revenues, using 1960 median adult age and availability of 1960 Census data as instruments

Variable	*Dependent variable* Log per pupil total revenues (1970)	Log per pupil local revenues (1970)	Log per pupil local revenues (1970)	Change in log per pupil total revenues (1970 - 1990)	Change in log per pupil local revenues (1970 - 1990)	Change in log per pupil local revenues (1970 - 1990)	Change in log per pupil total revenues (1970 - 1990)	Change in log per pupil local revenues (1970 - 1990)	Change in log per pupil local revenues (1970 - 1990)
Median adult age in 1970	0.007	0.022		-0.012	-0.016		-0.015	-0.023	
	(0.004)	(0.006)		(0.004)	(0.006)		(0.005)	(0.007)	
Fraction of adults over 55, 1970			1.326			-0.978			-1.501
			(0.359)			(0.372)			(0.422)
Controls for 1970 variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls for 1990 variables	no	no	no	no	no	no	yes	yes	yes
First-stage F statistic	48.3	48.3	91.6	47.5	47.5	90.9	39.2	39.2	76.8
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fixed effects	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA
Sample size (total)	1171	1171	1171	1168	1168	1168	1168	1168	1168

Notes: All regressions include 1970 (and, in the last three columns, 1990) values of the covariates included in Table 7. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates. Instrumental variables are generated using 1960 Census tract data hand-matched by authors.

Table 11: Instrumental variables regressions of relation between age distribution in 1970 and per pupil revenues, using 1960 median adult age. Includes only districts that were uniquely tracted in 1960.

	Dependent variable								
Variable	Log per pupil total revenues (1972)	Log per pupil local revenues (1972)	Log per pupil local revenues (1972)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)
Median adult age in 1970	0.009 (0.004)	0.026 (0.007)		-0.012 (0.005)	-0.022 (0.007)		-0.018 (0.006)	-0.037 (0.008)	
Fraction of adults over 55, 1970			1.548 (0.393)			-1.225 (0.429)			-2.142 (0.470)
Controls for 1970 variables	Yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls for 1990 variables	No	no	no	no	no	no	yes	yes	yes
First-stage F statistic	81.3	81.3	143.0	79.2	79.2	141.5	61.5	61.5	127.3
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fixed effects	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA
Sample size (total)	772	772	772	770	770	770	770	770	770

Notes: All regressions include 1970 (and, in the last three columns, 1990) values of the covariates included in Table 7. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates. Instrumental variables are generated using 1960 Census tract data hand-matched by authors.

Table 12: Instrumental variables regressions of relation between age distribution in 1970 and per pupil revenues, using 1950 median adult age and availability of 1950 Census data as instruments

Variable	*Dependent variable* Log per pupil total revenues (1972)	Log per pupil local revenues (1972)	Log per pupil local revenues (1972)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)
Median adult age in 1970	0.013 (0.006)	0.034 (0.010)		-0.011 (0.007)	-0.024 (0.010)		-0.016 (0.010)	-0.040 (0.014)	
Fraction of adults over 55, 1970			1.594 (0.567)			-1.165 (0.571)			-2.172 (0.716)
Controls for 1970 variables	Yes	Yes	yes	yes	yes	yes	yes	yes	yes
Controls for 1990 variables	No	No	no	no	no	no	yes	yes	yes
First-stage F statistic	16.7	16.7	28.8	16.4	16.4	28.3	9.3	9.3	18.2
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fixed effects	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA
Sample size (total)	1171	1171	1171	1168	1168	1168	1168	1168	1168

Notes: All regressions include 1970 (and, in the last three columns, 1990) values of the covariates included in Table 7. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates. Instrumental variables are generated using 1950 Census tract data hand-matched by authors.

Table 13: Instrumental variables regressions of relation between age distribution in 1970 and per pupil revenues, using 1960 median adult age and availability of 1960 Census data as instruments, with fixed effects for the district's direction from the MSA's city center

	Dependent variable								
Variable	Log per pupil total revenues (1972)	Log per pupil local revenues (1972)	Log per pupil local revenues (1972)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)
Median adult age in 1970	0.009	0.024		-0.014	-0.023		-0.017	-0.030	
	(0.004)	(0.006)		(0.004)	(0.006)		(0.005)	(0.008)	
Fraction of adults over 55, 1970			1.419			-1.360			-1.804
			(0.369)			(0.385)			(0.443)
Controls for 1970 variables	yes	Yes	yes	yes	yes	yes	yes	yes	Yes
Controls for 1990 variables	no	No	no	no	no	no	yes	yes	Yes
First-stage F statistic	37.1	37.1	84.3	35.8	35.8	82.9	27.5	27.5	66.0
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fixed effects	MSA* direction	MSA* Direction	MSA* direction	MSA* direction	MSA* direction	MSA* direction	MSA* direction	MSA* direction	MSA* direction
Sample size (total)	1171	1171	1171	1168	1168	1168	1168	1168	1168

Notes: All regressions include 1970 (and, in the last three columns, 1990) values of the covariates included in Table 7. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates. Instrumental variables are generated using 1960 Census tract data hand-matched by authors. The number of "directions" in a metropolitan area is determined by the number of inter-city interstate highways radiating from the central city.

Table 14: Instrumental variables regressions of relation between age distribution in 1970 and per pupil revenues, using 1960 median adult age and availability of 1960 Census data as instruments, with fixed effects for MSA-specific educational attainment quartiles

Variable	*Dependent variable* Log per pupil total revenues (1972)	Log per pupil local revenues (1972)	Log per pupil local revenues (1972)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil total revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)	Change in log per pupil local revenues (1972 - 1992)
Median adult age in 1970	0.006 (0.004)	0.019 (0.006)		-0.012 (0.004)	-0.015 (0.006)		-0.015 (0.005)	-0.024 (0.007)	
Fraction of adults over 55, 1970			1.205 (0.364)			-0.920 (0.383)			-1.512 (0.438)
Controls for 1970 variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls for 1990 variables	no	no	no	no	no	no	yes	yes	yes
First-stage F statistic	50.7	50.7	93.1	49.9	49.9	92.1	38.8	38.8	73.3
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fixed effects	MSA* education quartile	MSA* education quartile	MSA* education quartile	MSA* education quartile	MSA* education quartile	MSA* education quartile	MSA* education quartile	MSA* education quartile	MSA* education quartile
Sample size (total)	1171	1171	1171	1168	1168	1168	1168	1168	1168

Notes: All regressions include 1970 (and, in the last three columns, 1990) values of the covariates included in Table 7. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates. Instrumental variables are generated using 1960 Census tract data hand-matched by authors. Equation quartiles are metropolitan area-specific.

Table 15: Instrumental variables regressions of relation between age distribution in 1970 and per pupil revenues, using 1960 median adult age, by statutory level of voter approval of school district budgets.

Variable	School districts with direct democracy	School districts with voter approval	School districts with no voter approval
Fraction of adults over 55, 1970	-1.991	-1.934	-0.881
	(0.627)	(0.633)	(1.003)
Controls for 1970 variables	yes	yes	yes
Controls for 1990 variables	yes	yes	yes
First-stage F statistic	30.2	40.3	13.1
p-value	0.000	0.000	0.000
Fixed effects	MSA	MSA	MSA
Sample size (total)	479	406	283

Notes: All regressions include 1970 (and, in the last three columns, 1990) values of the covariates included in Table 7. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates. The dependent variable is the change in the log of per pupil local revenues from 1972 to 1992. Instrumental variables are generated using 1960 Census tract data hand-matched by authors. Definitions of types of democracy are described in the text.

Table 16: Instrumental variables regressions of relation between age distribution in 1970 and per pupil revenues, using 1960 median adult age and availability of 1960 Census data as instruments. Results stratified by racial mismatch of school district in 1990.

	Stratified by ratio of percentage over 55 who are white to the percentage aged 5-19 who are white in 1990			*Stratified by the change in this ratio between 1970 and 1990*			*Stratified by the degree of heterogeneity of school district housing stock in 1960*		
Variable	Least mismatch	Middle mismatch	Most mismatch	Smallest change in mismatch	Middle change in mismatch	Largest change in mismatch	Most homogeneous housing	Moderately homogeneous housing	Most heterogeneous housing
Fraction of adults over 55, 1970	-1.361	-1.088	-2.067	-0.281	-0.572	-2.659	-1.020	0.043	-2.499
	(0.917)	(0.592)	(0.897)	(0.872)	(0.793)	(0.799)	(0.930)	(0.786)	(0.858)
Controls for 1970 variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls for 1990 variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
First-stage F statistic	19.0	37.5	32.6	30.4	30.3	30.4	17.8	38.4	12.3
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fixed effects	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA
Sample size (total)	294	302	298	296	299	299	325	316	300

Notes: All regressions include 1970 (and, in the last three columns, 1990) values of the covariates included in Table 7. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates. The dependent variable is the change in log per pupil revenues from 1972 to 1992. Instrumental variables are generated using 1960 Census tract data hand-matched by authors. The housing stock heterogeneity variable is the Herfindahl index of housing size, in number of rooms from 1 to 8+, in the school district in the 1960 Census.

Appendix A: Full coefficient estimates for the first three specifications from Table 8

Variable	*Dependent variable* Log per pupil total revenues (1972)	Log per pupil local revenues (1972)	Log per pupil local revenues (1972)
Median adult age in 1970	0.007	0.015	
	(0.002)	(0.003)	
Fraction of adults over 55			1.562
in 1970			(0.211)
Median household income	0.054	0.079	0.083
in 1970 (thousands)	(0.008)	(0.012)	(0.012)
Fraction owner occupied	-0.534	-0.992	-0.827
in 1970	(0.093)	(0.174)	(0.171)
Fraction nonwhite in 1970	0.237	0.274	0.405
	(0.118)	(0.197)	(0.204)
Fraction in poverty in 1970	0.122	-1.552	-1.809
	(0.307)	(0.604)	(0.610)
Fraction urban in 1970	0.003	0.068	0.090
	(0.024)	(0.039)	(0.039)
Fraction adult high school	0.676	1.065	1.038
dropouts, 1970	(0.291)	(0.462)	(0.450)
Fraction of adults with 12	0.258	0.141	0.454
years education, 1970	(0.273)	(0.422)	(0.415)
Fraction of adults with 13 -	1.749	3.288	3.204
15 years education, 1970	(0.660)	(1.043)	(1.012)
Log of per pupil federal	-0.012	-0.063	-0.056
revenues, 1970	(0.006)	(0.014)	(0.013)
Log of population, 1970	0.001	-0.001	-0.001
	(0.011)	(0.018)	(0.018)
Intercept	7.051	6.108	6.045
	(0.335)	(0.523)	(0.516)
Controls for 1970 variables	yes	yes	yes
Controls for 1990 variables	no	no	no
Fixed effects	MSA	MSA	MSA
Sample size (total)	1171	1171	1171

Notes: All regressions include metropolitan area fixed effects. Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates.