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ABSTRACT

The existing literature on the relationship between the share of elderly in a community and the support for local public education has led to mixed results to date. One potential reason behind this is that the share of elderly in a community is endogenous, and it is very difficult to disentangle the effects of individuals aging in place from that of dynamic Tiebout sorting. The point of this paper is to carefully document the degree to which aging in place has occurred in the American suburbs, and to estimate the degree to which it has influenced school finance once the initial settlers of these suburbs were no longer the parents of school-aged children. We hand-match data from the 1950 and 1960 Censuses of Population and Housing to more recent data to link postwar suburban development to later school finance. Using a novel method for identifying the causal effects of aging in place, we find that the share of elderly adults who age in place is negatively related to the level of support for public schooling, and that this is particularly true for school districts in metropolitan areas where the school-aged population is more heavily nonwhite relative to the elderly population.

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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 percent of all new housing stock in metropolitan areas (Jackson, 1987). In fact, more houses were built in the United States in the ten years following World War II than in the first 45 years of the 20th century (U.S. Department of Labor, 1960). 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).

The point of this paper is to carefully document the degree to which this aging in place has occurred, and to estimate the degree to which it has influenced school finance in the American suburbs once the initial settlers of these suburbs were no longer the parents of school-aged children. Using a novel method for identifying the causal effects of aging in place, we find that the share of elderly adults who age in place is negatively related to the level of support for public schooling, and that this is particularly true for school districts in metropolitan areas where the school-aged population is more heavily nonwhite relative to the elderly population.

2. Contributions to existing literature

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 noted that while the elderly prefer less education spending than younger families because of intergenerational conflict, there are some factors that might 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 related but somewhat different question from the literature on intergenerational conflict. The results from the existing literature regarding the relationship between age distributions and school revenues and spending could be due to the aging in place of the community, but age distributions could also be endogenous with respect to school revenues and spending due to Tiebout (1956) sorting. 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 rather than sorted on variables salient to education spending. We use data from the suburbs of 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. Of course, the difficult question is whether changes in the demographics of a community are due to aging in place versus dynamic Tiebout sorting.

We are able to make substantial progress toward disentangling the effects of aging in place from the confounding effects of dynamic Tiebout sorting by making two major new contributions to this literature. First, we make use of statistical life tables published by the U.S. Department of Health and Human Services (2006) to forecast when individual adults of given age at a certain time were most likely to die. We can therefore identify the component of a school district's changing demographics due to aging in place, as opposed to Tiebout sorting, by assuming that every adult at a certain point in time would remain in the same house until they die and then would be randomly replaced by a newcomer. When we do this exercise, we find that aging in place is much more important than is Tiebout sorting in explaining over-time changes in a school district's age distribution.

Our second major contribution is to try to determine the degree to which the early age distribution (circa 1960) of the population in a given suburb is itself related to initial

Tiebout sorting. We find that, as of 1960, there is little relationship between the age of a school district's residents and the population's income or education level. As nobody has previously matched Census data to school districts prior to 1970, we hand-match 1960 Census tracts to school districts so that we can link the initial attributes of suburban communities to their later demographic changes and school finance. The result of these two innovations is that we can make a considerably more credible claim regarding the causal effects of aging in place per se on school district finances. When doing so, we find that an increase in the fraction of adults aged 65 and older is negatively related to school revenues per pupil. These results have substantial consequences for the future of school finance in the United States, as the much larger Baby Boomer generation is now apparently aging in place.

3. The relationship between school district age distribution and school finance

Our identification strategy requires using historical data to forecast the age distributions that will occur as suburban school districts age over time. Because Census data at the school district level have never been collected for years prior to 1970, it was necessary to hand-match school district boundaries to Census tracts in the pre-1970 years. This is only possible, however, in a subset of metropolitan areas in which the Census collected tract information in the years prior to 1970. As some of our models require data as far back as the 1950 Census, we therefore limit our analysis to metropolitan areas with Census tract data in 1950. 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.

[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.

In order to know the degree to which our results may be representative of a larger set of school districts than those in the 20 metropolitan areas for which we have hand-matched school district boundaries to Census tracts, we begin our analysis by estimating as best we can the same model specifications as those reported by Harris, Evans and Schwab (2001). Harris, Evans and Schwab carefully matched Census of Governments data from 1972, 1982 and 1992, which contains school district financial information, to the three closest decennial Censuses of Population (1970, 1980 and 1990), at the school district level. We are grateful to Harris, Evans and Schwab for sharing their data with us. They estimated their model for the balanced panel of school districts with valid data in all three rounds of data[2], and excluded school districts with implausibly large or implausibly small values of the fiscal variables that they considered.

To benchmark our analysis against the school district-level analyses in the literature, we begin by estimating the closest equivalent that we can to Harris, Evans and Schwab's most-preferred specification, model 2 in Table 4 (p.464). They estimate a balanced panel of school district log total revenues per pupil, over the three rounds of data, with school district fixed effects and state-by-year fixed effects as well as controls for the percentage of housing units that are owner-occupied, the percentage of population that is nonwhite, the percentage of population below the poverty line, the log of median household income, the log of federal revenues per capita, the percentage of the over-25 population that is a high school dropout, high school graduate, or has some college, the log of district

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[2] The 1970 Census data were much less comprehensive at the school district level than were the 1980 and 1990 data. Harris, Evans and Schwab (2001) provide a careful delineation of exactly where they lose observations, and we followed their description of their inclusion criteria as well as we could.

population, and interactions between whether the state's school finance system had been overturned by the courts as of the date in question and dummies for the quintile of median family income in 1970. The variables of primary interest are the share of the population aged 65 or older and the share of the population aged 0 to 19. Harris, Evans and Schwab weight the school districts by district enrollment, and we do the same for consistency. Table 1 presents summary statistics for our dependent variables of interest, our key explanatory variables and covariates from the 1970 - 1990 Censuses.

All of our analyses in this paper have the log of total per pupil revenues as the dependent variable; our results are very comparable if we use the log of per pupil local revenues instead. We report the results using only one dependent variable to save space. Our replication of Harris, Evans and Schwab's (2001) findings is reported in the first column of Table 2. We obtain very similar findings to those reported in their paper: our coefficient on the fraction of the population aged 65 or older is slightly lower than theirs (-0.852 as compared with -0.886) and our coefficient on the fraction of the population aged 0 to 19 is slightly higher than their estimate (-0.985 as compared with -0.907), but the results are fundamentally extremely similar. Because we employ the more conservative robust standard errors, our standard errors are nearly three times as large as theirs, but both point estimates remain very strongly statistically significant.

In addition to having a smaller sample size due to using data from just the suburbs of 20 metropolitan areas, our preferred model makes several additional refinements to the Harris, Evans and Schwab approach. For one, we are concerned about the endogeneity of the time-varying district variables. Much of the energy in the paper is spent addressing the endogeneity of the key variables -- those representing the age distribution -- but in addition, we worry about the inclusion of covariates reflecting owner-occupancy, racial composition, education levels, household income, etc., that are likely to be endogenous with school district revenues and spending. In addition, we prefer a political economy model in which we look more at the decision-making units in a school district, so we reformulate the two age variables as the fraction of *adults* aged 65 or older (as opposed to fraction of population aged 65 or older) and the fraction of households with children (as opposed to the fraction of the population aged 0 to 19). The remaining columns of Table 2 consider what happens as we change the model specification and study sample along these lines.

As we move from the first column (Harris, Evans and Schwab's model specification) to the second column (the specification excluding the covariates most likely to be endogenous), we observe that the point estimates of the age variables of interest remain very similar -- the coefficient on the fraction of the population aged 65 or older decreases slightly and the coefficient on the fraction of the population aged 0 to 19 increases slightly. We therefore believe that the inclusion of the potentially endogenous covariates does not influence the key findings of interest, and all subsequent model specifications exclude these covariates. Moving from the second column to the third column (the alternative measure of the age variables) yields substantively similar findings; the coefficient estimates are smaller but the units have changed. A one standard deviation increase in either variable is related to a similarly-sized change in the dependent variable.

As a consequence, we conclude that our choices of definitions of the key age variables do not influence the estimated relationships of interest in a meaningful way.

Having moved from Harris, Evans and Schwab's preferred specification to our preferred specification (different definitions of age variables and fewer potentially endogenous covariates), we can now see what happens when we restrict the sample size to school districts in the suburbs of our 20 metropolitan areas -- only about one-tenth of the total number of school districts in the balanced panel. 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 results available upon request, we find that our results do not substantively vary whether or not we include or exclude the school districts where Census tracts are too large to uniquely identify the school districts. 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 fourth column of Table 2 presents the analog to the model in the third column of Table 2, except that only the school districts in tracted suburban areas in the 1960 Census in our metropolitan areas are included. This sample provides the foundation for our analysis. We include only 964 of the 1004 school districts in tracted suburban areas in our analysis because 40 of the 1004 school districts did not meet the criteria for inclusion in Harris, Evans and Schwab's balanced panel. As can be seen in the fourth column, the coefficients and standard errors are both proportionately larger in the more limited sample as compared with the full sample of school districts. Therefore, there is reason to believe that the relationship between age and school finance may be somewhat more extreme in the sample for which we can construct our instrumental variables analysis -- though the results are still qualitatively similar across columns. Finally, because some of our analysis involves only data from 1980 and 1990, we repeat the same specification but limit the sample to just those observations for school districts in our data in the years 1980 and 1990. Those results, reported in the fifth column of Table 2, present similar estimates to those seen in the fourth column.

We consider two other refinements to our model, both involving finer degrees of geography-time-specific fixed effects. It 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 the specification from column 4 (that is, the specification using suburban data from 1970, 1980 and 1990), but controlling for metropolitan area times compass direction times year fixed effects. These results, reported in column 6, are very similar to those reported in column 4.

As an alternative specification, 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 by year fixed effects (so that we are comparing school districts in a metropolitan area to others in the metropolitan area with the same education levels in the same year, and also still controlling for other observables.) These results, reported in column 7 of Table 2, remain quite similar to those reported in column 4.

In summary, across a wide range of fixed effects model specifications, including restricting our analysis to the school districts in the metropolitan areas with early Census tracting, we find broadly consistent evidence that school district revenues per pupil are inversely related to both the fraction of adults (or fraction of the total population) over age 65 as well as the fraction of households with children (or the fraction of the population aged 0 to 19.) These results are consistent both with a political economy story regarding the elderly having lower levels of support for public schooling, as well as a congestion story in which the more children for any given tax base, the more broadly the revenues and expenditures are spread across pupils. The key question, however, is whether these results suffer from endogeneity bias. The fixed effects regression results reported in Table 2 (and in the prior literature) could actually be due to reverse causation -- perhaps older people have been Tiebout sorting into lower-spending school districts. The elderly population of a suburb could be present because those individuals moved into the suburbs as young adults and aged in place. Alternatively, the characteristics of a particular suburb could lead to dynamic sorting, where households with similar characteristics --- such as age --- would tend to move to the same areas. It will be very important to disentangle the effects of aging in place from the confounding effects of dynamic Tiebout sorting. The principal purpose of this paper is to propose several novel attempts to separate the two confounding phenomena.

4. Aging in place versus dynamic Tiebout sorting

An aging in place story would indicate that young families tend to have children, settle down in the suburbs, and stay in their homes. Therefore, the first place to start in an investigation of the degree to which aging in place explains over-time changes in a school district's age distribution is to present information describing the extent to which these potential relationships are true. We begin by investigating the probability that a household with a head of any given age would have children. To do this, we use data from the Integrated Public-Use Microdata Series (IPUMS) to identify the fraction of suburban households with children, by age of the head of household, in the 1970, 1980 and 1990 Census years. As can be seen in Figure 1, the overwhelming majority of younger families -- those with household heads younger than 45 -- who live in the suburbs have children. This was even more the case in 1970, but even in 1990, when fewer suburban households had children at nearly all age groups, the pattern is that young suburban families have children at home. And in fact, the fraction of suburban families with children at home remains robust even into the older age brackets: For example, about 25 percent of those aged 55 to 59 (20 percent in 1990) and over 10 percent of those aged 60 to 64 had children at home in these years.

But are the suburbs largely populated by families with children, who then settle down? Figure 2 reports the fraction of suburban heads of households who are relative newcomers (those who lived in their current home for five or fewer years) by age of household head, in the 1990 Census.[3] As can be seen, most young families have moved into their current residence relatively recently, but by age 45 or so, the fraction who are newcomers begins to plateau, and by the time the household is elderly, fewer than 20 percent of households were new to their home within the five previous years. Importantly, however, in the younger age groups, it is apparent that suburban families without children are more transient than are those with children at home: For age groups younger than 50, suburban families without children are about ten percentage points more likely to be newcomers in their homes than are suburban families with children. By age

[3] Similar patterns are observed in the 1970 and 1980 Censuses.

50, however, the two relationships begin to converge. These results present additional suggestive evidence that suburban residents were more likely to settle down once they had children at home, and then after the children left home they were unlikely to leave.

This last point is particularly clear when one observes Figure 3, which presents the distributions of length of tenure at the current residence, by age, in the suburbs of the 20 metropolitan areas in this study, as reported in the 1990 Census. Young households have lived in the suburbs for a much shorter period of time than their older counterparts: more than three quarters of households aged less than 30 have lived in their current home 5 or fewer years, compared to the one third of households aged 65 and older living in their current suburban home for more than 30 years.

In order to think about the comparison between dynamic Tiebout sorting and aging in place in the suburbs, it is first important to understand the development of the suburb in postwar America. We therefore 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 3 present the percentage of the total population in these metropolitan areas who reside in the central 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.

The final three columns of Table 3 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.[4] The preceding two columns of Table 3 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 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.

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

It is apparent from Table 3 that the suburbs in any given metropolitan area developed at different times, and one would therefore expect that by 1970, the first year for which we have both financial and population data, there would be considerable heterogeneity in the age distributions across the suburbs of a metropolitan area. And, indeed, this is what appears to be the case. Table 4 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 65 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. No school districts had more than 30 percent of adults aged 65 and older, and in only one metropolitan area (Philadelphia) was there at least one school district where the median adult was 55 or older. However, in 7 metropolitan areas there was at least one school district where at least 25 percent of the adult population was aged 65 or older, and 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.[5] 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 65 and over ranges from 2.4 percentage points (Bridgeport) to 6.2 percentage points (Minneapolis/St. Paul), with most metropolitan areas having standard deviations in around 4 percentage points. 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.

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

One question, of course, is whether individuals actually age in place. It is apparent from Table 5 that individual suburbs that were relatively old in 1970 remained relatively old in later years as well, a pattern consistent with aging in place of suburban residents. The suburbs of each MSA in our sample are rank-sorted by the 1970 decile of average age. As the 1970 deciles increase, the percentile rankings in the later years are almost monotonically increasing as time passes. The suburbs that were relatively young in 1970 remained relatively young in 1980 and 1990, and the suburbs that were relatively old in 1970 remained relatively old in 1980 and 1990. While there has been some convergence over time -- the youngest decile in 1970 averaged being at the 13.8th percentile in 1980 and the 20.4th percentile in 1990, while the oldest decile in 1970 averaged being at the 85th percentile in 1980 and the 76.5th percentile in 1990 -- the rank-ordering over time remains strongly consistent. These results are consistent with a story of aging in place. However, they are also consistent with a story of dynamic Tiebout sorting, in which suburbs with a particular age distribution may be more likely to attract similar-aged newcomers.

Therefore, it is necessary to forecast what the age distribution would have been were *everyone* to solely age in place over time. In a world with no dynamic Tiebout sorting based on age, each household living in a school district would remain in their home until they die, and at that point would be replaced by a newcomer household of the average age of all newcomers in the metropolitan area. We computed the average age of newcomer households -- which we define as those who moved to their current house within the past two years -- in each metropolitan area in 1980 and 1990 using IPUMS data; the average newcomer age ranged from 31.9 to 36.1 in 1980 and from 34.4 to 37.2 in 1990.[6] We use the life tables for adults of various ages in 1970 reported by the Social Security Administration (2005) to predict when the adults would die; for example, the life tables indicate that 8.7 percent of adults in youngest-decile school districts in 1970 would die by 1980, while 20.0 percent of adults in oldest-decile school districts would die by 1980. By 1990, 19.1 percent of adults in the youngest-decile school districts would have died, according to the 1970 life tables, while 36.8 percent of adults in the oldest-decile school districts would have died. We assume that if the last person in a household died in 1974, he or she would be replaced by a new averaged-aged newcomer household in 1974 -- we use the next Census year to ascribe the age -- at which point that household would begin to age in place.

Table 6 presents the predicted degree to which the hierarchy of age distributions in suburban school districts would have changed if only aging in place and replacement with average-aged newcomers taken place (which we'll call "random replacement.")[7] One observes that with aging in place there would have been some compression in the distribution of ages across school districts in a metropolitan area. (This would happen because older school districts are more likely to have higher death rates with replacement by average-aged newcomers.) For instance, the typical top-decile school district in 1970 would rank at the 84th percentile in 1980 and the 75th percentile in 1990 were there to be

[6] In practice, the calculations change only trivially if we instead ascribe the same newcomer age to all metropolitan areas.

[7] Average-aged newcomers have some probability of death prior to 1980 and 1990 as well, and those predicted to have died are then replaced in our calculations with new average-age newcomers in the year of death.

only aging in place with random replacement. The ninth decile school district in 1970 would rank at the 76.6th percentile in 1980 and the 70th percentile in 1990. As can be seen, the typical gap between the aging-in-place predictions and the realized predictions is very small -- only 3.5 percentiles in 1980 and 3.7 percentiles in 1990. Excluding the two youngest deciles, where there has been even more compression than what would have been predicted by aging in place alone and are older than what would have been predicted (perhaps because very young adults are less settled than older adults), the typical gap is smaller still -- only 2.7 percentiles in both 1980 and 1990. It is clear that the realized age distributions comport very closely with the age distributions that would have been predicted were the residents in 1970 simply aging in place over time. The correlation between the average realized age in 1980 and the average predicted age in 1980 based on aging in place is 0.78, and the correlation between the average realized age in 1990 and the average predicted age in 1990 based on aging in place is 0.70. This is a very high degree of correlation, and the reality of the correlation is likely higher still since our calculations are based on predicted deaths rather than actual deaths. Regardless, these calculations provide strong evidence that, while dynamic sorting might affect the over-time stability in suburban age distributions, aging in place is the major driver.

Table 7 provides more evidence that dynamic sorting is not a major determinant of suburban age distributions. In the first panel, Census tracts as of 1990 are rank-sorted by the fraction of the households in residence for more than one year that are aged less than

30.[8] For each of these quartiles, the fraction of the newest households --- those moving in one year previously or less --- in each age group are shown. If dynamic sorting is important, then new residents should be sorting into locations where the current residents are of the same age, so in the first panel we would expect to see much larger fractions of those aged less than 30 as we move down the table. In fact, the increase is quite small, rising only five percentage points from the suburbs with the fewest to the most young residents. A similar pattern can be seen in panel B, where the fraction of newcomers aged 65 and older rises by less than three percentage points from the first to the last row.[9] Note that the fraction of the youngest newcomers also rises somewhat as we move to the last row of the table.

5. Instrumental variables results

Given that we can strongly predict the age distribution of a school district over time using forecasts assuming that adults age in place and are randomly replaced when they die, and that aging in place appears to be the most important determinant of over-time changes in the age distribution in a school district, we propose that predicted age distributions based on the 1970 age distribution and aging in place with random replacement can be used as instruments for the actual age distributions in 1980 and 1990. This instrumental variables approach would rule out the changes in school district ages over time that are due to dynamic Tiebout sorting and concentrate only on the changes over time predicted based

[8] These data are not observed at the school district level of aggregation, so the best that we can do is the Census tract.

[9] Similar patterns can be seen in tables where tracts are rank-sorted by percentage of current residents in different age groups. These tables are available on request from the authors.

on "natural" patterns. We therefore repeat the regressions from Table 2, but using the 1970 or 1960 age distributions to predict the fraction elderly and fraction of children in the district in later years. The results of these instrumental variables regressions are shown in Table 8. Here, we can only look at the 1980 and 1990 Census years because the 1970 Census year is used to generate the instruments for later years. For presentation convenience, we report only the key parameter estimates in this table, but we control for all of the same covariates as in column 5 of Table 2.

As can be seen in the first two columns of Table 8, the instruments -- predicted fraction of adults aged 65 and up and predicted fraction of the households with children -- predicted using the 1970 age distributions[10] have very strong first-stage explanatory power. The partial R-squared is 0.47 for share of adults aged 65 and older and 0.41 for share of households with children, and the F-statistic is 847 and 668, respectively. The second stage results have signs consistent with those in Table 2, although the magnitudes and standard errors are both considerably larger than before. Therefore, there is still strong evidence that as a community ages in place, the level of school revenues per pupil declines.

Of course, if the age distributions in 1980 and 1990 are endogenous with respect to education revenues, the age distributions in previous years may be endogenous as well. We suspect that while the postwar boom in suburbs was occurring during the 1950s and

[10] We use the share of householders in each age group with children generated from the 1980 and 1990 IPUMS data for the suburbs of the 20 metropolitan areas, and predict the number of householders in each age group using the same methods used to predict the percentage of adults aged 65 and older.

early 1960s, sorting was more exogenous, and we therefore repeat the same analysis using age distributions predicted based on the 1960 Census data that we hand-matched to school districts. (This has the added advantage of being able to use predicted age distributions in 1970, 1980 and 1990, as opposed to just 1980 and 1990.) Table 9 presents these instrumental variables results. As can be seen, the first stage results remain extremely strong, and the pattern of coefficients and statistical significance in the second stage remains consistent.

6. Tiebout sorting by age prior to 1960?

It may still be the case that the age distribution as of 1960 might reflect Tiebout sorting, and older families that sorted into certain suburbs at the beginning of postwar suburbanization may, for some reason, have been on a different trajectory of demands for public schooling as they aged in place than would have younger families. Predicting age distributions throughout the following several decades would thus be more satisfying if the suburbs with older residents and the suburbs with younger residents in 1960 were otherwise similar demographically. We therefore stratify school districts by their position in the within-metropolitan area age distribution, and see whether the average income or education levels of the adults in the school district are related to their ages.

Table 10 displays the educational attainment (percent with less than a high school degree) and log of average family income in these suburbs, by age decile of the residents. As we move from the youngest to the oldest suburbs, there is some variation in the values of these variables, but they show no discernable pattern. The top two age deciles have the highest levels of family income, but this may be due to the natural pattern of increasing income with age, rather than Tiebout sorting; indeed, when we regression-adjust log of average family income for household age and metropolitan area fixed effects, we see that there is no residual relationship between school district age and residual income. These results suggest that school districts with older residents do not have systematically different types of residents -- at least along the lines of income and education.

What, then, could explain why some school districts have older residents than others, as of 1960? Our proposition is that young families settled the new housing in the postwar suburbs, suggesting that suburbs with younger adults would also have newer housing stock, in general. To investigate this possibility, we include in Table 10 the percentage of homes (as of 1960) built in the 1950s and the percentage of homes (as of 1960) built postwar. We observe that the suburbs with the youngest adults are the suburbs with the newest housing stock. As we move from the suburbs with the youngest adults to the oldest, the fraction of homes built in the previous decade falls dramatically: 62 percent of homes were built in the previous decade for suburbs with the youngest residents, while less than 22 percent were built in the previous decade in the suburbs with the oldest residents. Similarly, the fraction of homes built postwar falls from 76 percent to 34 percent as we move from the suburbs with the youngest to the oldest residents. Therefore, within a metropolitan area, the youngest suburban developments also tended to be the newest. While we do not have information about why exactly one suburb developed five or ten years before another suburb in a metropolitan area, there is therefore strong evidence that (1) the earlier-developing suburbs had older residents as of

1960, but (2) these suburbs with older residents do not appear to have residents with different levels of income and education. This presents at least some evidence that the 1960 age distribution, and the nature of the housing stock as of 1960, may be exogenous to future school district finances.

As an additional approach, we can go one step further and assume that someone of average age purchased a house when it was built, aged in place until they died, when another average-aged person (at the time) purchased the house and aged in place until they died, and so on. In order to have some elapsed time between housing building and the fiscal variables (because the fiscal variables could contemporaneously affect the timing of new construction) we capture the age distribution of the school district's housing stock as of the 1960 Census. This requires merging together the 1950 and 1960 Censuses, because the 1960 Census only identifies structure age as built in the 1950s, built in the 1940s, or built before 1940, while the 1950 Census identifies housing structures as built in the 1940s, built in the 1930s, built in the 1920s, or built before 1920. So long as we assume that no housing present in 1950 was torn down between 1950 and 1960[11] we can combine these two years of Census data for the school districts tracted as of the 1950 Census and have a full set of housing age by decade from pre-1920 through the 1950s.[12] Using these data, we can predict the age distributions in 1970, 1980 and 1990 based solely on the distribution of housing ages as of 1960.

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[11] Our best calculations indicate that only about two percent of the 1950 housing stock in the suburbs was torn down between 1950 and 1960, making this a reasonable assumption.

[12] About five percent of the suburban housing stock in our metropolitan areas present in 1960 was built before 1920. Data from the U.S. Department of Labor (1960) on housing starts by year suggests that the average house in this category was built in 1904, so we use that as our date for the pre-1920 housing stock

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 age distributions in 1970 - 1990 with the age of the housing stock in 1960 in our regressions. The instrumental variables regressions shown in Table 11 are identical to those shown in Table 8 and 9, except that here we use the age of the housing stock in 1960 to predict the fraction of adults aged over 65 and the fraction of households with children in 1970, 1980 and 1990. As before, the first-stage F statistics on the excluded instruments are very large with a p value of 0.000 in all cases. The signs of the coefficients in the second stage equation are the same as before, although they are much smaller in magnitude, more similar to the point estimates shown in Table 2. Because the standard errors are large, the estimated effects of the fraction over age 65 and the fraction of households with children are not statistically significant in this instrumental variables specification (though the estimated effect of the fraction of households with children is close to statistical significance) but we view these results as roughly consistent in theme with those found above.

7. 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

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in a suburb. We use housing start data to choose the most likely housing build date for the subsequent decades as well; typically this is the midpoint of the decade, except in the 1930s, when the Depression meant that few houses were built in the early part of the decade (so the typical house was built in 1937) and the 1940s, when most houses were built postwar (so the typical house was built in 1947).

analysis by investigating whether our instrumental variables estimates of the effects of the age distribution on the level of per pupil local revenues are influenced by the potential racial distribution of the school district.

Because racial composition of a school district is endogenous, we measure the potential for racial mismatch at the metropolitan area level. For each of the three years, we create a mismatch variable measured as the share of the school-aged population that is nonwhite divided by the share of the elderly population that is nonwhite. The mean of this variable is 2.33 and the standard deviation is 1.02; a higher value of this variable would indicate that the children in a metropolitan area are relatively more likely to be minorities than are the elderly people in the metropolitan area. We repeat our instrumental variables regression specification reported in Table 9, but this time we also interact the two variables of interest, as well as the two instruments, with this metropolitan area-level racial mismatch variable.

The results of this specification are reported in Table 12. As can be seen from the table, the estimated effects of more elderly adults is strongly related to the level of racial mismatch in the metropolitan area. At the mean level of racial mismatch, the estimated coefficient on the share of adults aged 65 and above is -0.246. At one standard deviation of racial mismatch above the mean, however, the corresponding estimated effect would be -1.175. The coefficient on the interaction between the share of households with children and the racial mismatch variable is also negative, though is only statistically significant at the 11 percent level. Therefore, our estimates indicate that school districts with increasing shares of elderly adults are more likely to cut their revenues and spending when the children are relatively nonwhite than they are when the school-aged children are relatively white. Given the changing demographics of the United States, this finding underscores the potential role that the increasingly large share of elderly adults in some school districts may play.

8. Conclusion

While there exists considerable evidence regarding the degree to which the age distribution of a community is associated with its support for public schooling, it is notoriously difficult to ascribe causality to this relationship. The fundamental challenge is that a negative relationship between the fraction elderly in a community and support for public schooling may be due either to aging in place -- which is what has been implied but untested by the prior literature -- or to dynamic Tiebout sorting in which elderly residents who do not wish to fund schools move to communities with other elderly residents. While both stories are consistent with this relationship, they have very different implications for the effects of demographic change on the provision of local public schooling.

This paper introduces a novel approach to causally linking school spending to changing demographics of a community. We begin by forecasting how the age distribution in a school district would change if the only factor at work were aging in place, and demonstrate that aging in place is the leading explanation for over-time changes in school district demographics. We further seek to predict age distributions in the future using data from a time when the American suburbs were, for the most part, brand new. We show that as of 1960, suburbs populated by older residents were no different from those populated by younger residents, in terms of income and education levels, and that the principal determinant of the age of residents in 1960 was the age of the housing stock. 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 sooner, all else equal, once the Baby Boomer generation was out of school, than did those with later-developing suburbs. These estimated effects are particularly strong in the metropolitan areas where minorities comprise a relatively large share of the school-aged population. 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. While our results are not definitive -- there could still be some remaining endogenous sorting into the early postwar suburbs -- our analyses go a long way toward cementing the conclusion that as a suburb ages, its support for schooling falls.

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: Summary statistics of dependent and independent variables included in balanced panel analysis

Variable	*Means (Standard deviations)* 1970	1980	1990
Log per pupil total revenues	8.02 (0.29)	8.23 (0.27)	8.53 (0.29)
Log per pupil local revenues	7.30 (0.60)	7.40 (0.63)	7.64 (0.67)
Fraction over 65	0.11 (0.04)	0.13 (0.05)	0.15 (0.05)
Fraction aged 0-19	0.39 (0.05)	0.33 (0.04)	0.30 (0.04)
Natural log of median household income	10.34 (0.30)	10.30 (0.28)	10.29 (0.33)
Fraction owner occupied	0.74 (0.10)	0.75 (0.09)	0.74 (0.10)
Fraction nonwhite	0.09 (0.15)	0.10 (0.16)	0.12 (0.17)
Fraction in poverty	0.16 (0.11)	0.13 (0.07)	0.13 (0.08)
Fraction of adults who were high school dropouts	0.52 (0.13)	0.37 (0.12)	0.27 (0.11)
Fraction of adults with 12 years of education	0.31 (0.08)	0.37 (0.08)	0.36 (0.08)
Fraction of adults with 13 - 15 years of education	0.09 (0.04)	0.13 (0.05)	0.22 (0.06)
School finance system overturned by this date	0.02 (0.15)	0.08 (0.28)	0.21 (0.41)
Log of per pupil federal revenues	0.97 (1.46)	0.49 (1.02)	0.46 (1.03)
Log of population	8.95 (1.15)	9.08 (1.16)	9.12 (1.21)
Total number of school districts	9113	9113	9113

Sources: Authors' calculations based on data provided by Harris, Evans and Schwab (2001).

Table 2: Fixed effect regression results for the relation between fraction of adults aged 65+, fraction children and log per pupil total revenues

	(1) Harris, Evans and Schwab specification	(2) Eliminating potentially endogenous covariates	(3) Same as (2) but with alternative measures	(4) Same as (3) but only in suburbs of 20 MSAs	(5) Same as (4) but 1980, 1990 only	(6) Same as (4), but with MSA x direction FEs	(7) Same as (4), but with MSA x education FEs
Fraction of population aged 65 and older	-0.852*** (0.276)	-0.774*** (0.240)					
Fraction of adults aged 65 and older			-0.374** (0.186)	-0.504** (0.242)	-0.586** (0.259)	-0.525** (0.243)	-0.443* (0.251)
Fraction of population aged less than 20	-0.985*** (0.154)	-1.088*** (0.288)					
Fraction of households with kids			-0.249*** (0.065)	-0.491*** (0.125)	-0.433*** (0.146)	-0.483*** (0.136)	-0.457*** (0.138)
Fixed effects	School district, state x year	School district, state x year	School district, state x year	School district, state x year	School district, state x year	School district, MSA x direction x year	School district, MSA x equation quartile x year
Observations	27339	27339	27339	2892	1928	2892	2892
Adjusted R squared	0.886	0.880	0.879	0.870	0.911	0.882	0.883

Notes: Heteroskedasticity-robust standard errors are in parentheses beneath parameter estimates. Models also include all covariates described in the text.

Table 3: The development of the suburbs in postwar America

	% of MSA population in central city in:					% school districts: tracted	tracted	in MSA
Metro area	1950	1960	1970	1980	1990	in 1950	in 1960	in 1970
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 4: Variation in age distribution among suburbs within a metropolitan area

	All districts in MSA in 1990:				*All districts in MSA in 1970:*			
	% with median	*% over 65 in 1970:*			% with median	*% over 65 in 1970:*		
Metro area	age ≥ 45 in 1970	min	mean	max	age ≥ 45 in 1970	min	mean	max
Akron	21	5	11	19	15	5	11	15
Boston	41	3	14	26	41	6	14	26
Bridgeport	58	7	13	17	58	7	13	17
Buffalo	42	8	14	20	42	8	14	20
Chicago	29	2	11	24	29	2	11	24
Cincinnati	39	5	14	23	39	5	14	23
Cleveland	44	7	13	22	44	7	13	22
Columbus	25	6	14	20	17	6	12	20
Dayton	20	4	12	26	20	4	12	26
Detroit	28	4	12	22	23	4	11	22
Flint	0	7	11	16	0	7	11	16
Hartford	35	6	13	23	32	6	12	22
Indianapolis	21	6	14	21	21	6	14	21
Kalamazoo	43	7	16	27	0	7	11	15
Milwaukee	28	6	14	26	24	6	13	25
Minneapolis	24	3	14	26	3	3	9	17
Philadelphia	40	3	14	30	40	3	14	30
Pittsburgh	71	7	15	24	71	7	15	24
St. Louis	51	6	15	25	51	6	15	25
Syracuse	28	8	15	21	28	8	15	21

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 5: Persistence of age patterns over time within a suburban school district

Within-MSA age decile in 1970	Average age in 1970	Average age in 1980 [likelihood of average aged household having kids]	Average realized within-MSA percentile in 1980	Average age in 1990 [likelihood of average aged household having kids]	Average realized within-MSA percentile in 1990
Youngest	40.5	41.2 [82%]	13.8	43.1 [71%]	20.4
2	42.4	43.0 [80]	27.3	44.4 [67]	32.2
3	43.5	43.4 [79]	32.6	44.7 [65]	37.0
4	44.3	44.3 [77]	43.6	45.5 [63]	47.3
5	45.0	44.3 [77]	43.1	45.2 [64]	43.1
6	45.5	44.8 [76]	50.0	45.8 [61]	51.2
7	46.2	45.5 [74]	58.9	46.2 [59]	57.1
8	47.0	46.3 [73]	69.7	47.0 [57]	67.2
9	47.8	47.0 [70]	77.5	47.4 [55]	70.7
Oldest	49.2	48.0 [66]	85.0	48.0 [52]	76.5

Note: Figures calculated by authors. School districts were rank-ordered within metropolitan areas using data from the 1970 Census.

Table 6: Actual and predicted age distributions over time for school districts ranked by within-MSA decile of age distribution in 1970

Within-MSA age decile in 1970	Average realized within-MSA percentile in 1980	Average predicted within-MSA percentile in 1980, if no dynamic sorting	Predicted rate of household head deaths, 1970 to 1980	Average realized within-MSA percentile in 1990	Average predicted within-MSA percentile in 1990, if no dynamic sorting	Predicted rate of household head deaths, 1970 to 1990
Youngest	13.8	7.4	8.7%	20.4	10.8	19.1%
2	27.3	20.1	10.7	32.2	26.8	22.4
3	32.6	30.3	11.9	37.0	37.9	24.4
4	43.6	45.0	12.8	47.3	49.6	26.1
5	43.1	50.7	13.8	43.1	52.6	27.5
6	50.0	55.1	14.6	51.2	55.1	28.7
7	58.9	61.3	15.5	57.1	58.6	30.2
8	69.7	70.4	16.6	67.2	65.7	31.8
9	77.5	76.6	17.7	70.7	70.0	33.6
Oldest	85.0	84.0	20.0	76.5	75.0	36.8

Note: Figures calculated by authors. School districts were rank-ordered within metropolitan areas using data from the 1970 Census. Predictions without dynamic sorting assume that all householders will remain in their homes until they die, and then are replaced by the average-aged new suburban householder in the given metropolitan area in the 1980 or 1990 Census. We predicted death rates in each school district using life expectancies by age in 1970 calculated from "Life Tables for the United States Social Security Area, 1900-2100," Social Security Administration, 2005. We measured the average age of new suburban householders in each of twenty metropolitan areas by calculating the average age in the metropolitan area of householders new to their homes in the suburban portions of the metropolitan areas within the last two years, using data from the 1980 and 1990 five percent Census microdata sample from the IPUMS. The correlation between average realized age in 1980 and average predicted age (based on 1970 age distribution, with random replacement) in 1980 is 0.78. The correlation between average realized age in 1990 and average predicted age in 1990 (based on 1970 age distribution, with random replacement) is 0.70.

Table 7a: Age distributions of newest households by quartile of the Census tract's fraction of long-term residents aged less than 30, 1990 Census

Quartile of fraction aged less than 30	*Mean (std. dev.) fraction of newest residents aged:* less than 30	30 - 44	45 - 64	65 and older
1	0.446	0.322	0.186	0.045
	(0.221)	(0.189)	(0.150)	(0.083)
2	0.462	0.317	0.181	0.041
	(0.162)	(0.138)	(0.102)	(0.053)
3	0.493	0.299	0.171	0.038
	(0.163)	(0.137)	(0.106)	(0.054)
4	0.498	0.295	0.168	0.039
	(0.173)	(0.148)	(0.126)	(0.069)

Table 7b: Age distributions of newest households by quartile of the Census tract's fraction of long-term residents aged 65 and older, 1990 Census

Quartile of fraction aged 65 and older	*Mean (std. dev.) fraction of newest residents aged:* less than 30	30 - 44	45 - 64	65 and older
1	0.456	0.340	0.175	0.029
	(0.192)	(0.164)	(0.134)	(0.063)
2	0.473	0.316	0.174	0.037
	(0.181)	(0.158)	(0.113)	(0.055)
3	0.487	0.296	0.175	0.042
	(0.178)	(0.152)	(0.116)	(0.063)
4	0.479	0.282	0.182	0.057
	(0.193)	(0.154)	(0.138)	(0.085)

Table 8: Instrumental variables regression results, predicting 1980 and 1990 age variables using 1970 Census data

	First stage results Fraction of adults aged 65+	Fraction of households with kids	*Second stage results*
Predicted fraction of adults aged 65+	0.639*** (0.018)	-0.807*** (0.039)	
Predicted fraction of population aged 0 - 19	0.088*** (0.018)	0.398*** (0.039)	
Fraction of adults aged 65+			-2.489*** (0.764)
Fraction of households with kids			-1.484*** (0.409)
F for excluded instruments	847.02	668.12	
Partial R squared	0.470	0.412	
Observations	1928	1928	1928

Note: Robust standard errors in parentheses. Regressions also include controls described in text. The simulated age distributions are based on 1970 Census data using the procedure described in the text.

Table 9: Instrumental variables regression results, predicting 1970, 1980 and 1990 age variables using 1960 Census data

	First stage results		*Second stage results*
	Fraction of adults aged 65+	Fraction of households with kids	
Predicted fraction of adults aged 65+	0.4058*** (0.0167)	-0.5890*** (0.0357)	
Predicted fraction of population aged 0 - 19	0.0006*** (0.0002)	0.0032*** (0.0004)	
Fraction of adults aged 65+			-1.413** (0.700)
Fraction of households with kids			-0.737** (0.353)
F for excluded instruments	350.47	317.46	
Partial R squared	0.273	0.254	
Observations	1893	1893	1893

Note: Robust standard errors in parentheses. Regressions also include controls described in text. The simulated age distributions are based on 1960 Census data using the procedure described in the text.

Table 10: Relations between age of suburban households, age of housing stock, income and educational attainment in 1960

Within-MSA age decile in 1960	Average age in 1960	Percent with education <=11 years	Log of average family income	Log income adjusted for age and metro area	Percent of homes built in 1950s	Percent of homes built after 1940
Youngest	39.8	47.9%	8.98	0.01	62.2%	75.6%
2	41.6	52.0	9.00	0.02	57.5	72.9
3	42.5	52.4	8.99	0.01	53.6	68.4
4	43.4	52.0	9.01	0.01	48.5	63.2
5	44.1	51.2	9.03	0.02	41.1	55.8
6	44.7	53.2	8.99	-0.03	38.0	52.8
7	45.5	54.4	8.98	-0.04	33.4	47.7
8	46.1	52.8	9.01	-0.03	29.3	43.5
9	47.0	49.1	9.08	0.03	27.2	38.7
Oldest	48.4	48.2	9.08	0.01	21.7	33.6

Note: Figures calculated by authors. School districts were rank-ordered within metropolitan areas using data from the 1960 Census, following the authors' hand-matching of Census tracts to school districts. Log income adjusted for age and metropolitan area is the residual of a regression of log of average family income on average adult age and metropolitan area fixed effects.

Table 11: Instrumental variables regression results, predicting 1970, 1980 and 1990 age variables using 1960 Census housing construction age distributions

	First stage results		*Second stage results*
	Fraction of adults aged 65+	Fraction of households with kids	
Predicted fraction of adults aged 65+	0.593*** (0.063)	-0.199 (0.126)	
Predicted fraction of population aged 0 - 19	-0.166*** (0.027)	0.933*** (0.053)	
Fraction of adults aged 65+			-0.525 (1.106)
Fraction of households with kids			-0.665 (0.440)
F for excluded instruments	303.19	485.75	
Partial R squared	0.241	0.337	
Observations	1944	1944	1944

Note: Robust standard errors in parentheses. Regressions also include controls described in text. The simulated age distributions are based on 1960 Census data using the procedure described in the text.

Table 12: Instrumental variables regression results, predicting 1970, 1980 and 1990 age variables using 1960 Census data, accounting for racial mismatch

	First stage results				*Second stage results*
	Fraction of adults aged 65+	Fraction of households with kids	Fraction 65+ x mismatch	Fraction with kids x mismatch	
Predicted fraction of adults aged 65+	0.319*** (0.048)	-0.646*** (0.102)	-1.042*** (0.149)	1.082*** (0.259)	
Predicted fraction of adults 65+ x mismatch	0.034** (0.017)	0.018 (0.036)	0.765*** (0.053)	-0.902*** (0.093)	
Predicted fraction of Households with kids	-0.000 (0.000)	0.004*** (0.001)	-0.001 (0.001)	0.005** (0.002)	
Predicted fraction kids x mismatch	0.0002* (0.0001)	-0.000 (0.000)	0.002*** (0.000)	-0.000 (0.001)	
Fraction of adults aged 65+					1.874 (1.983)
Fraction of adults aged 65+ x mismatch					-0.910** (0.460)
Fraction of households with kids					0.926 (0.956)
Fraction of households with kids x mismatch					-0.401 (0.247)
F for excluded instruments	177.10	160.19	162.50	101.69	
Partial R squared	0.276	0.256	0.259	0.179	
Observations	1893	1893	1893	1893	1893

Note: Robust standard errors in parentheses. Regressions also include controls described in text. The simulated age distributions are based on 1960 Census data using the procedure described in the text.

Figure 1: Fraction of households with children, by age, 1970/1980/1990 Censuses

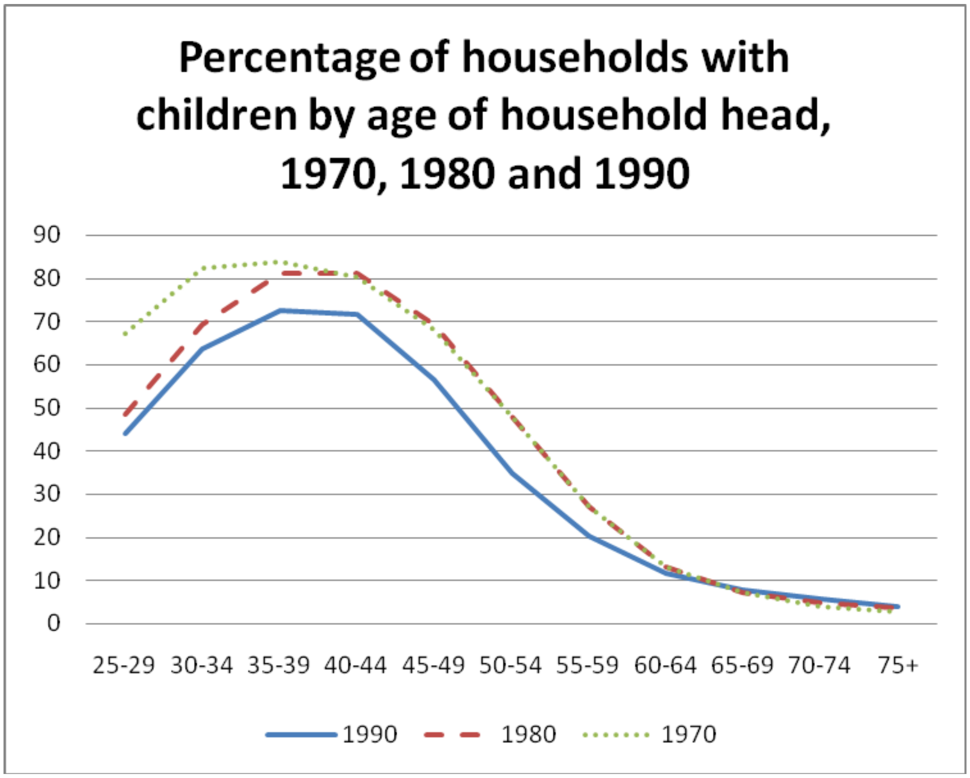

Figure 2: Fraction of households that are newcomers, by age

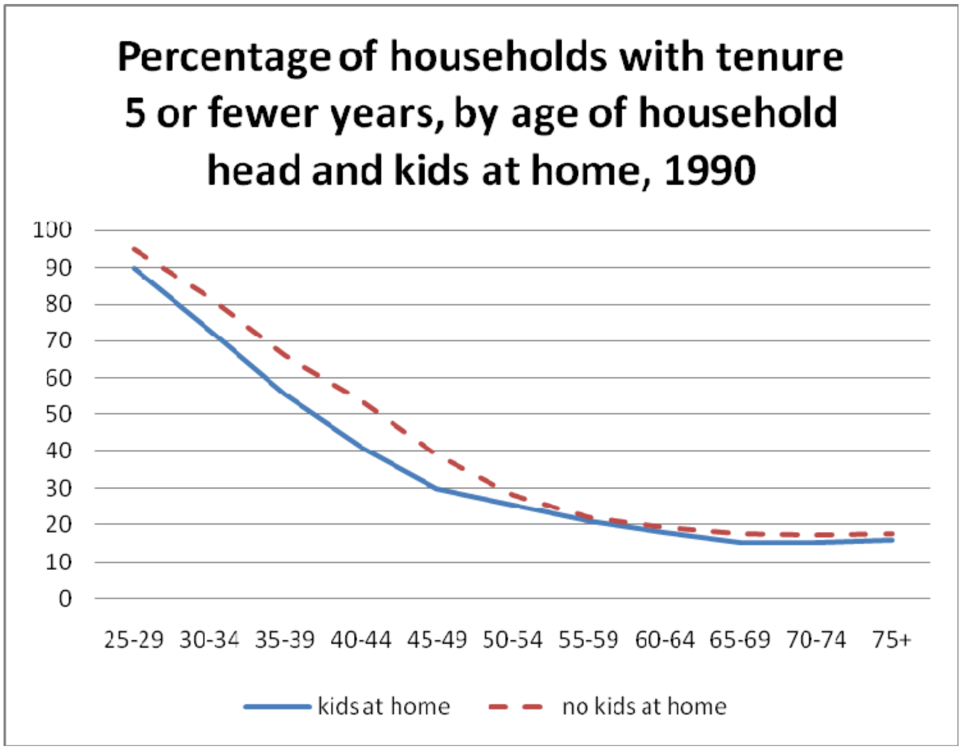

Figure 3: Duration of residence by age, 1990 Census