BUYING THEIR VOTES?
A STUDY OF LOCAL TAX-PRICE DISCRIMINATION

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Abstract:

A population's demographic composition may affect political support for public services. This paper empirically tests whether tax-price reductions offered to elderly homeowners moderate their effect on local public school revenues. The results reveal that an aging population structure substantially decreases school revenues, unless elderly homeowners receive state-financed reductions in their local tax-prices. Sizable differences hold when comparing U.S. school districts located across the border from each other in states with different tax-price reduction policies. Given the imminent aging of the population structure in many developed countries, governments' targeted tax reduction policies could have important effects on equilibrium school revenues.

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1. Introduction

Financial support for public schools in developed countries has recently been declining as governments face increasing pressure to balance their budgets by reducing expenditures on public services. Public school revenues may be particularly vulnerable in countries where elderly residents will compose a rising share of the population. While the percent of United States residents over the age of sixty-five was 12.4 percent in 2000, the U.S. Census Bureau (2008) predicts this will rise to 16.3 percent by 2020 and 20.7 percent by 2050. Recent growth in the upper-middle-aged population (ages 55-64) has occurred throughout the United States and, if current trends continue, communities with the largest growth in the elderly share (ages 65 and over) over the next thirty years will experience this growth primarily due to "aging-in-place" rather than residential migration (Frey, 2007). The typical school district will thus have an increasing share of adults who do not consume public schooling services. This trend could have two important implications for school districts: (1) decreased political support for school expenditures, and (2) a greater tax base *per student* due to a reduction in the relative size of the school-aged population. If the former effect dominates the latter, then local district revenues per student will decline.

This dynamic would be consistent with prior U.S. trends. Figlio and Fletcher (2012) find that most of the within-metropolitan-area variation in suburbs' age distributions in 1980 and 1990 can be traced back to these suburbs' age distributions when adults settled there in earlier decades. Those authors simulate the shares of elderly adults residing in various suburbs based on the aging-in-place of early residents, and their simulated elderly shares are negatively correlated with suburban school expenditures.

State or federal governments could potentially alter this dynamic by subsidizing local property tax reductions that are targeted toward elderly homeowners. Elderly homeowners receiving these reductions might support higher levels of local public school spending, because they can maintain high property values at a relatively low cost. In other words, elderly homeowners' preferred level of local tax revenues may be sensitive to their marginal local tax-price—the change in their tax payments required to increase local school district revenues by one dollar. By influencing elderly homeowner's preferred local tax rates, targeted tax-price

reductions may shift the identity of the local median voter and thus moderate how changes in demographics affect local public revenue.

This paper is the first to empirically examine whether targeted tax-price reductions moderate the impact of age demographics on local government revenues. Prior studies examined how the aging-in-place of local populations affects public school revenues (Figlio and Fletcher, 2012; Harris, Evans, & Schwab, 2001; Ladd & Murray, 2001), and this paper tests whether there is important within-sample heterogeneity in these effects. Using similar methods as these prior studies, the empirical models below isolate the exogenous component of changes in local age demographics by using lagged population shares as instrumental variables predicting future age demographics. To test for heterogeneous effects, I assembled a longitudinal data set concerning states' property tax reduction policies for elderly homeowners.

The results confirm earlier studies' findings that exogenous increases in the fraction of elderly residents (ages 65 and over), on average, decrease tax revenues in U.S. school districts. However, state-financed reductions in elderly homeowners' marginal local tax-prices significantly reduce the negative effect of the local elderly population share. This negative effect is only large in communities not offering any targeted local tax-price reductions to elderly homeowners. Significant differences in the effects of the elderly share across state policy regimes are robust to several alternative empirical specifications, including comparisons of school districts that are located near each other on opposite sides of state borders.

The next section discusses why elderly residents might favor or oppose high levels of local public school expenditures and reviews the empirical literature on this issue. Section 3 discusses several hypotheses concerning the impact of age demographics on local public school revenues. Section 4 describes the data, Section 5 describes the empirical methodology, and Section 6 describes the results. The paper concludes with a discussion of the implications of the imminent aging of the U.S. population for public school revenues.

2. Background

Public school expenditures typically command the largest share of a local government's budget, and yet, within the same community, there are households who do and do not consume

these services. Across U.S. school districts during the year 2000, the fraction of households containing children under the age of 18 ranged from 23 percent at the 5th percentile district to 47 percent at the 95th percentile district. There are at least two potential reasons for high levels of within-district heterogeneity in preferred levels of local pubic school revenues. First, the desirability of districts with high tax bases per schoolchild creates a natural moderating tendency whereby families will want to avoid being too concentrated in particular school districts because this would lead to congestion for consuming school resources.[1] Second, some households may prefer remaining in the same community after their children leave the nest. Empty-nest households that do relocate often have to cross state lines to find desirable housing with lower effective tax rates (Farnham and Sevak, 2008), and some households may not wish to make long-distance moves.

Surveys consistently find that parents of school children prefer higher levels of local spending on schools than those preferred by other residents in their communities.[2] This difference holds in spite of possible mitigating factors such as residents' altruistic attitudes towards local schoolchildren, their desire to invest in the school system as a means of maximizing their residential property value (Poterba, 1998; Fischel, 2001; Hilber and Mayer, 2009; Rockoff, 2010), or their desire to maintain school expenditures to attract a favorable mix of people living in their community.

Previous studies of the relationship between elderly representation and education expenditures have found a sizable negative correlation for state-level expenditures but a modest correlation for local expenditures. Poterba (1997) estimates a -0.25 elasticity of state-level public school spending per child with respect to the fraction of the population over the age of

[1] States typically require all communities to offer public schooling and typically mandate or guarantee a minimum amount of school revenues. This prevents communities from completely abandoning local financing of public schools and forcing families to use private schools. In Arizona, a state with inter-district open enrollment, one locality formed a new school district without any schools, so that the district's residents could pay other districts to cover the operating costs of educating their children while avoiding any taxes for school construction and maintenance (Steinhauer, 2007). State legislatures, however, have worked to close these types of loopholes and to force unincorporated areas with a critical mass of children to be part of a school district that operates schools.

[2] Examining individual-level survey data from different U.S. cities, Rubinfeld (1977), Lankford (1985), Tedin, Matland, & Weiher (2001), and Wyckoff (1984) all find that adults with children enrolled in the local public schools prefer higher levels of local public school operating expenditures or capital expenditures than other adults in their community. Examining Belgian data, Schokkaert (1987) finds that parents indicate a higher willingness to pay for child-oriented local services such as playgrounds, youth centers, and arts education programs.

sixty-four. Using district-level panel data, Harris, Evans, and Schwab (2001) estimate a similar state-level elasticity as Poterba, but estimate that the elasticity for local-level expenditures is much smaller (-0.10). Ladd and Murray (2001) use county-level panel data and estimate a negative, small, and statistically insignificant relationship between elderly composition and local education expenditures. The aforementioned study by Figlio and Fletcher (2012) finds a statistically significant negative effect of the elderly share in suburban school districts.[3]

Brunner and Balsdon's (2004) analysis of elderly Californian voters' survey responses suggests that these different elasticity estimates are due to differences in elderly residents' attitudes towards state-level versus local-level expenditures: elderly residents were much more willing to support local-level expenditures than state-level expenditures. The difference in elderly residents' attitudes between different levels of government expenditures may be due to their altruism towards younger members of the local community, (possibly including their own grandchildren), or due to the elderly residents' concern over their own house values. Hilber and Mayer (2009) find evidence that house price capitalization concerns may reduce elderly residents' opposition to local school spending: the fraction of residents who are elderly is not negatively associated with per pupil expenditures across districts where the supply of housing is relatively inelastic—i.e., districts where nearly all of the residential-use land has already been developed.[4]

Fletcher and Kenny (2008) consider the impact of elderly households on public school expenditures in a median voter framework and show that a change in the elderly share might shift the identity of the median voter with only a small impact on tax rates. Using county-level data, Fletcher and Kenny empirically test this model by shifting the median voter's tax-price and income as if the elderly prefer the lowest levels of spending. They find evidence consistent with

[3] Earlier studies that included the composition of elderly as a predictor of local public school revenues found both negative correlations (e.g., Inman, 1978; Romer, Ronsenthal and Munley, 1992) and positive correlations (e.g., Brazer and McCarty, 1987; Cutler, Elmendorf, and Zeckhauser, 1992).

[4] Fischel's (2001) home-voter hypothesis discusses how homeowners will often behave in a manner that maximizes their home's re-sale value. There is empirical evidence that house prices are linked to various school quality indicators such as school accountability ratings (Figlio and Lucas, 2004), test scores (Black, 1999; Downes and Zabel, 2002), local public schooling options (Reback, 2005; Brunner, Cho, and Reback, 2012), and state aid to schools (Dee, 2000).

a moderate, negative net effect of the elderly on spending per pupil, particularly because residents' incomes and tax-prices may be negatively correlated.

Policies reducing homeowners' relative tax burden could theoretically alter the impact of age demographics on local tax revenues. While other researchers have also recognized the potential importance of states' tax reduction policies targeted towards elderly residents (e.g., Bergstrom, Rubinfeld, and Shapiro, 1982; Poterba, 1997; Rockoff, 2010), the analysis below is the first study of the impact of age demographics on local tax revenues incorporating all states' targeted tax reduction programs.[5]

3. Research questions

To motivate the empirical work, this section discusses the dynamics of changes in local demographic composition on local tax revenues in a median voter framework. If tax-prices are independent of residential composition, then the direction of the change in revenues in this framework depends solely on whether the majority of residents prefer a higher tax rate than the previous local median voter. The presence of targeted tax-price reductions, however, can alter the local distribution of preferences. Some recipients of these reductions may have sufficiently elastic demand for local public revenues so that their preferred local revenue level shifts from below the median to above the median. The narrative below provides intuition concerning households' preferences, and Appendix A offers a more formal discussion of these issues. The narrative below focuses on the exogenous component of changes in local age demographics, as opposed to any residential mobility responses to policies. This narrative thus matches previous empirical studies exploiting the aging-in-place component of demographic changes (Figlio and Fletcher, 2012; Harris, Evans, & Schwab, 2001; Ladd & Murray, 2001).

[5] Berkman and Plutzer (2004) find that migrant elderly (those not residing in the same district five years earlier) only have a negative effect on spending if their state does not offer a circuit-breaker policy. However, their results are based on a cross-sectional regression and they only classify five states as circuit-breaker states, whereas the analyses below find 39 states with policies that discount the marginal tax-price specifically for elderly citizens. In two recent papers, Shan (2008; 2010) also incorporates a rich, newly-assembled data set concerning states' property tax reduction policies. Unlike this paper, her studies focus on the impact of these policies on labor supply (2008) and on residential relocations (2010). Using a simulated benefits approach, she finds that property tax reductions reduce residential mobility (2010) but do not affect labor market participation (2008). Given that Shan (2008) finds mobility effects, it is important to note that the empirical models below allow for differential rates of aging-in-place across states with different tax reduction policies.

Consider the local public school revenue preferences of people of various ages. These preferences will depend on how the potential consumption benefits of improved school services or higher house prices due to these improvements compare with the costs of a higher tax burden. Adults who are age 55 and over are far less likely than younger adults to consume local public school services.[6] So, if residents in each group are fairly similar along dimensions other than age, it should be the case that adults above the age of 55 typically prefer lower levels of local public school spending than younger adults. An exogenous increase in the share of adults who are ages 55 and older is expected to decrease local public school tax revenues.

Now consider the expected impact on local revenues from an exogenous change in older adults within specific age ranges: 55 to 64 or 65 and over. Very few adults ages 55 and over had school-aged children during this paper's sample period, so these adults should mostly be concerned with whether potential positive capitalization effects for their homes justify higher local tax rates. Capitalization concerns will be greatest for homeowners who expect to move in the very near future, who expect to take on a reverse mortgage in the near future, or who have higher mortality rates and care about the impact of their house value on the wealth of their estate. The highest residential relocation rates among homeowners 55 and older are among those in their late 50's and early 60's.[7] Until a U.S. resident reaches roughly age 75, the rise in his or her mortality rate is similar to or less than the decline in the mean residential relocation rate as a person ages.[8] On average, 55 to 64 year old homeowners should thus have greater capitalization concerns than 65 to 75 year old homeowners. They might also have greater capitalization

[6] Less than seven percent of heads-of-household between the ages of 55 and 64 had children under the age of 18 in 2006 (U.S. Census Bureau, 2007), and this rate was even lower during this paper's sample period.

[7] Between 2004 and 2005, the residential relocation rate was roughly 6.4 percent for people between the ages of 55 and 59, 5.6 percent for people between the ages of 60 and 64, 5.1 percent for people between the ages of 65 and 69, 4.1 percent for people between the ages of 70 and 74, and moderately below 4 percent for people above the age of 74 (U.S. Census Bureau, 2006). Burkhauser, Butrica, & Wasylenko (1995) find that elderly homeowners also had lower relocation rates than other homeowners during the 1970's.

[8] Based on statistics from the Center for Disease Control (2008) and the U.S. Census, in 2005 the crude morality rate was 0.7 percent for 55 to 59 year olds, 1.1 percent for 60 to 64 year olds, 1.7 percent for 65 to 69 year olds, 2.7 percent for 70 to 74 year olds, and 4.2% for 75 to 79 year olds. Comparing these rates with those listed in the previous footnote, relocations have a greater percentage point change as one moves from the 55-59 year old group to the 60-64 year old group, the change is roughly equal as one moves from the 60-64 year old group to either the 65-69 or 70-74 year old group, and then the mortality rate change is much larger than the relocation rate as one moves to groups above the age of 75.

concerns than homeowners above the age of 75.[9] If adults in these age groups are fairly similar along other dimensions, then the typical 55 to 64 year old resident will prefer greater local school spending than the typical older resident. Decreases in the share of adults below the age of 55 may have smaller effects on local spending if they are accompanied by increases in the share of adults ages 55 to 64 rather than increases in the share of adults over the age of 64.

Numerous states subsidize targeted local tax-price reductions for homeowners above the age of 64, however, which can change the relative preferred revenue levels among individuals in the various age groups. First, consider the case in which targeted tax-price reductions are fully subsidized by state revenues. The decrease in the tax-prices faced by elderly residents may increase these elderly residents' preferred levels of local revenues. An increased share of elderly residents may prefer higher revenues than those preferred by the median voter, softening the negative effect associated with a rising elderly population. Subsidized reductions have only a trivial effect on the local tax-prices faced by individuals not receiving these reductions.[10] The resulting net change in the effect of the "upper-middle-aged" (i.e., 55 to 64 year old) share on local tax revenues is thus theoretically ambiguous. On the one hand, the reductions might increase the preferred local tax rates of some upper-middle aged residents who expect to receive these reductions in the near future, particularly if there is some rigidity in local tax rates. On the other hand, some upper-middle aged residents might be shifted below the median in the local preference distribution due to the relatively high preferences of the reduction-eligible elderly residents.

Next, consider the case in which these targeted tax-price reductions are financed locally, so that an increase in the share of recipients automatically increases the tax-prices faced by the non-recipients. In this case, an increase in the share of residents ages 65 and older will not necessarily have a less negative effect on local revenues than it did in the absence of any

[9] The findings below fail to suggest strong *average* differences in the effects of the 65 to 74 age group versus the 75 and over group, though Hilber and Mayer (2009) find compelling evidence that the oldest people are the most sensitive to capitalization concerns. In their study, the oldest population shares have the strongest negative correlation with school spending in districts with relatively little developed land but not in districts where almost all of the land is developed.

[10] State revenues are used to pay for these local reductions so an increase in local reductions could have a small impact on state tax burden, but the effective change in local tax-price will be extremely small if the school district composes only a small fraction of the entire state's population.

reductions. Elderly residents may be more likely to prefer a higher level of revenues than those preferred by the median voter, but an increase in the share of elderly residents will also increase other residents' local tax-prices and thus lower their preferred spending levels. Due to this spillover effect, increases in the share of residents ages 65 and older should have a more negative effect on local revenues when targeted reductions are financed locally rather than financed from state revenues. In fact, due to this spillover effect, locally-financed reductions might not dampen the effect of the elderly share compared to no reductions at all.

In summary, there are several hypotheses concerning the impact of changes in age demographics on local revenues:

Hypothesis 1: An exogenous increase in the local share of adults aged 55 and over causes local tax revenues to decrease.

Hypothesis 2: In the absence of targeted tax-price reductions, an exogenous decrease in the share of adults under the age of 55 has a stronger negative effect on local tax revenues if it is due to an increase in the share of adults ages 65 and over rather than an increase in the share of 55 to 64 year olds.

Hypothesis 3: In states offering state-financed targeted tax-price reductions to residents over the age of 64, exogenous increases in the local share of adults over the age of 64 lead to less negative effects than in states without reductions.

Hypothesis 4: In states offering state-financed targeted tax-price reductions to residents over the age of 64, exogenous increases in the local share of adults over the age of 64 lead to less negative effects than in states offering locally-financed targeted rebates.

4. Data

The first set of longitudinal policy information gathered for this study was states' policies for reducing the relative marginal tax-price faced by elderly residents. The first four columns of Table 1 describe these policies by state as of 2002, derived from "Property Tax Relief Programs for the Elderly" (1975), "Property Tax Circuit-breakers: Current Status and Policy Issues" (1975), "Taxes by State" (2006), Sexton (2003), AARP reports (Baer, 1996, 1998a, 2000, 2003), Lyons et al. (2007), state legislation records, and interviews with state education officials. The

availability of information from the 1970's and from recent years enabled the construction of longitudinal information concerning state tax policies. This information has been verified using actual state legislation (from *LexisNexis* and state archives) and interviews with state officials. In 2002, 39 out of the 48 continental states had policies that reduced the marginal tax-price specifically for elderly homeowners, typically through either a reduction in assessed property values or a rebate based on a percentage of taxes paid beyond a certain level.[11] Three additional states, (California, New Mexico and Wyoming), offered targeted rebates that were unrelated to the magnitude of local expenditures, so these policies reduced taxes for the elderly but did not alter their marginal tax-price. The majority of states adopted their elderly tax rebate policies between the late 1960's and mid-1970's, coinciding with broader revolts against local property taxes. Of the 39 states reducing elderly homeowners' marginal tax-prices in 2002, only Louisiana had not adopted its program before this paper's earliest outcome year, 1982; Louisiana started assessed value freezes for elderly homeowners in 2000.

The second set of policy information used in this study is each U.S. school district's form of local democracy for determining local operating revenues. Appendix B describes the collection of these longitudinal data, and the last column of Table 1 lists the form of local democracy for determining local operating revenues in each state as of 2002. States using local representative democracy are the most likely to offer marginal tax-price reductions to elderly homeowners. These reduction policies might insulate local elected officials from excessive pressure from the elderly to restrain spending—consistent with Sass' (1991) argument that coalition-building is easier in representative democracy settings.

These policy data are combined with a district-level panel data set similar to the one used by Harris, Evans, and Schwab (2001). Their panel includes demographic data from the 1970, 1980, and 1990 Census, along with financial data from the 1972, 1982, and 1992 Census of Governments.[12] To update these data, I add demographic data from the 2000 Census and financial data from the 2002 Census of Governments (F-33 files).

[11] Kansas awards tax-price reductions to individuals ages 55 and over; while this lower age cutoff rate could possibly change the effects of the various demographic groups, all of the results below are robust to excluding Kansas districts from the sample.

[12] I thank Dr. Amy Harris for providing the data used in the Harris, Evans, and Schwab (2001), which are described in detail by Harris (1999).

Unlike most prior studies, this paper's sample excludes school districts with limited local discretion over local school revenues (i.e., the sample excludes California, Nevada, and New Mexico). I also incorporate data concerning school district re-organizations during this sample period. The main analysis below "pre-merges" data for observations from districts that subsequently merge by treating them as a single district throughout the sample period. I also test the sensitivity of the results to whether the dependent variable includes state-funded revenues or includes only locally-funded revenues. Using locally-funded revenues alone best fits the theoretical predictions concerning changes in local property taxpayers' commitments to financing public schooling. This variable might have sizable measurement error, however, because of potential inconsistencies in states' reporting practices for distinguishing locally-funded school revenues from state-funded school revenues. Examining changes in state-funded and locally-funded revenues combined may thus reduce some measurement error related to inconsistent reporting practices.

5. Methods

I use this district-level panel data set to examine the impact of changes in local age demographics on locally-funded public school district tax revenues per household. Examining local tax burden *per household* rather than local revenues *per student* facilitates the instrumental variable models below in which the school-aged population share is specified as an endogenously determined variable.[13] As seen below, results remain similar when the dependent variable is changed to the natural log of total revenues, with the natural log of the number of school-aged children specified as an endogenously determined variable.

Define $Pop\ 55–64_{jt}$ as the proportion of adults residing in district *j* who are between 55 and 64 years old in year *t*, $Pop\ 65–74_{jt}$ as the proportion who are between 65 and 74 years old, and $Pop\ 75\&OVER_{jt}$ as the proportion who are at least 75 years old, where an adult is a person above the age of 17. Define $\%SchoolAged_{jt}$ as the fraction of district *j*'s population that was

[13] Some previous studies instrument for the size of the school-aged population and also use the number of enrolled students in denominator of the dependent variable. This might bias the estimated effects of age shares. Holding the school-aged share constant, a greater elderly representation implies greater numbers of children per non-elderly adult, and more children per non-elderly adult may be correlated with unobserved socio-economic characteristics or unobserved tax preferences.

between the ages of 5 and 17 during year *t*. Let τ^{*}_{jt} equal the amount of real locally-funded public school operating revenue per household in district *j* for year *t*. Rather than controlling for district-level fixed effects, the models below use district-level first-differencing to examine district-level changes over ten year periods. Either approach would remove static district-level effects, but the first-differences model facilitates the specific tests below for heterogeneous slopes based on policies in place during specific time periods. The OLS model predicting changes in local tax revenues for district *j* in state *k* is thus:

$$(1)\quad \ln(\tau^{*}_{jt}) - \ln(\tau^{*}_{jt-10}) = \beta_1 (Pop55\text{–}64_{jt} - Pop55\text{–}64_{jt-10}) + \beta_2(Pop65\&OVER_{jt} - Pop65\&OVER_{jt-10}) + \beta_3(\%SchoolAged_{jt} - \%SchoolAged_{jt-10}) + \psi_{jkt-10}\beta_{4kt} + \eta_{j1990}\beta_{5kt} + (X_{jt} - X_{jt-10})\beta_6 + \varepsilon_{jt,}$$

where β_{4kt} captures state-by-year-by-income group fixed effects and β_{5kt} captures state-by-year-by-urbanicity fixed effects. The state-by-year by-lagged-income-group indicators, ψ_{jkt-10}, divide each state's districts into three equally sized groups based on districts' average median household income during the beginning of each ten year period. The state-by-year-by-urbanicity indicators, η_{j1990}, divide each state's districts into two groups based on whether the districts were located in an MSA (Metropolitan Statistical Area) based on classifications from 2001. The X_{jt} vector includes a set of district-level control variables potentially related to the demand for school expenditures. Similar to previous studies, X_{jt} includes the fraction of district *j*'s residents who are nonwhite, the fraction who own their residences, and the natural log of the population density in district *j*.[14]

It may be incorrect to interpret estimates from equation 1 as revealing the causal effect of elderly on expenditures. The district-level first differences model removes the impact of any static district-level factors, such as geographic location, but there may still be reverse causation whereby changes in expenditure levels affect residential sorting. Similar to prior work by Harris, Evans, and Schwab (2001) and Ladd and Murray (2001), the empirical models below use lagged population shares as instrumental variables predicting future shares. This strategy isolates a plausibly exogenous component of changes in local age demographics—the aging-in-place of

[14] These data come from the 1970, 1980, and 1990 Censuses, and are used to predict changes in district finance occurring over 1972-1982, 1982-1992, and 1992-2002 respectively; for notational convenience, both the financial data as well as demographic data occurring two years earlier are denoted as occurring in year *t*, (so that t=1972, 1982, 1992, or 2002).

local residents—as opposed to Tiebout (1954) sorting in response to changes in school districts' revenues and tax rates.

Unbiased estimates of the impact of aging-in-place in these models require two assumptions. First, the instrumental variables must truly be exogenous, meaning that households do not sort into school districts based on anticipated changes in local public school revenues over the next ten years. Myopia concerning future changes in local tax rates is a common assumption in the empirical public finance literature and is reasonable here; the models control for various fixed effects so that the lagged population age shares would only be endogenous if households pre-sorted based on their forecasts of idiosyncratic changes for particular school districts. Second, conditional on the included control variables, the lagged population age shares should not be highly correlated with any important omitted variables.

The aging-in-place model below modifies previous studies' models in two minor ways that, if anything, should make these assumptions even more credible. First, previous studies have generally focused on the effect of people aged 65 and over on school spending, but the models also consider the share of adults between the ages of 55 and 64. Second, the models allow for heterogeneous first stage coefficients by state and by year. In addition to adding a great deal of power to the first-stage predictions, this specification is critical for unbiased estimates in the models examining heterogeneous effects of demographic changes based on heterogeneity in states' policies. In other words, this specification allows the second stage estimates to abstract away from differential rates of aging-in-place across states with different policy regimes, because the first-stage predictions have already captured any differential rates of household relocation, mortality, etc.

Define P_{jt} as a vector of population age share variables for the following age ranges: (i) zero to four, (ii) five to seventeen, (iii) forty-five to fifty-four, (iv) fifty-five to fifty-nine, (v) sixty to sixty-four, (vi) sixty-five to seventy-four, and (vii) seventy-five and older. I conduct 2-stage Least Squares (2SLS) estimation for the following set of equations:

(2.1.a) $\textit{Pop55–64}_{jt} - \textit{Pop55–64}_{jt-10} = P_{jt-10}\phi_{1st} + \psi_{jk(t-10)}\,\phi_{2kt} + \eta_{j1990}\phi_{3kt} + (X_{jt}-X_{jt-10})\phi_4 + e_{1jt}$

(2.1.b) $\textit{Pop65\&OVER}_{jt} - \textit{Pop65\&OVER}_{jt-10} = P_{jt-10}\phi_{5st} + \psi_{jk(t-10)}\,\phi_{6kt} + \eta_{j1990}\phi_{7kt} + (X_{jt}-X_{jt-10})\phi_8 + e_{3jt}$

(2.1.c) $\textit{\%SchoolAged}_{jt} - \textit{\%SchoolAged}_{jt-10} = P_{jt-10}\phi_{9st} + \psi_{jk(t-10)}\,\phi_{10kt} + \eta_{j1990}\phi_{11kt} + (X_{jt}-X_{jt-10})\phi_{12} + e_{4jt}$

$$(2.2)\quad \ln(\tau^{*}_{jt}) - \ln(\tau^{*}_{jt-10}) = \beta_1(Pop55\text{–}64_{jt} - Pop55\text{–}64_{jt\text{-}10}) + \beta_2(Pop65\&OVER_{jt} - Pop65\&OVER_{jt\text{-}10}) + \beta_3*(\%SchoolAged_{jt} - \%SchoolAged_{jt\text{-}10}) + \psi_{jkt\text{-}10}\beta_{4kt} + \eta_{j1990}\beta_{5kt} + (X_{jt} - X_{jt\text{-}10})\beta_6 + \varepsilon_{jt.}$$

Table 2 displays the means and standard deviations of the predicted changes, actual changes, and levels of age demographics. Table 2 also displays means and standard deviations for changes in local public school revenues and for the control variables in the X_{jt} vector.

Additional models expand equations 2.1 through 2.2 to test the theoretical predictions concerning heterogeneous effects of age demographics based on states' targeted tax-price reduction policies. Omitted variables correlated with states' targeted tax-price reduction policies could bias these tests if these omitted variables also moderate the effect of demographics on financial support for schools. For example, the elderly population in the types of states adopting tax-price reduction policies may have been more altruistic toward schoolchildren even in the absence of these tax-price reduction policies. Although this is theoretically possible, several robustness checks suggest that omitted variables are unlikely to bias the tests for heterogeneous slopes. One continues to see differences in these slopes due to state-financed tax-price reductions when comparing districts located near the same state border. Differences in slopes are also robust to using districts' residents' age distributions in 1970 alone to instrument for changes in age distributions during the 1970's, 1980's, and 1990's, similar to one of the instrumental variable strategies recently used by Figlio and Fletcher (2012). A false finding of heterogeneous slopes here would require omitted variables that take on different importance for within-state variation in districts' revenues many years later, and in systematically different ways across the relevant groups of states. This seems unlikely.

6. Results

6.1 First stage equation

Lagged population shares are powerful predictors of future changes in age demographics within districts. The F-statistics for the test of joint significance of the instruments in equations 2.1.a, 2.1.b, and 2.1.c are, respectively, 22.9, 28.7, and 13.7, and the lagged population shares are always jointly significant at the .0000001 level. The full first stage estimates—with more than

1,000 state-by-year-specific slope estimates—are too numerous to display; Appendix C instead displays analogous estimates using uniform slopes for each lagged population share as done in previous studies (e.g., Harris, Evans, & Schwab, 2001, Ladd & Murray, 2001). These estimates confirm that population shares in a given age range increase after there was a high concentration of people slightly younger than that range.

6.2 Testing Hypothesis 1

Table 3 displays the baseline regression results for both the OLS and 2SLS models, with standard errors adjusted for clustering at the state level. The first three columns of Table 3 display results from models using a dependent variable that includes districts' state tax revenues along with their locally-funded revenues. The next three columns use only locally-funded tax revenues in the dependent variable.

The OLS results are consistent with Hypothesis 1—negative effects of the 55 and over population share on local school district tax revenues per household. A one percentage point increase in the 65 and over share is associated with more than a 1.10 percent decline in local revenues (column 4) or more than a 1.30 percent decline in state and local revenues (column 1). The 2SLS models' results are less conclusive; while the estimate slopes are all negative, some are statistically insignificant. In the 2SLS model with the full set of control variables, (column 2), a one percentage point increase in the 65 and older share causes a 0.83 percent decline in state and local revenues. This point estimate is slightly larger than the comparable estimate from Harris, Evans, & Schwab (2001).[15] Columns 3 and 6 display results from models which exclude the time-varying district control variables, X_{jt}. In case some of the effects of age demographics operate indirectly—through associated changes in residents' race, residents' income, or population density—these models produce estimates capturing a more complete effect of changes in age demographics. For these models, a one percent point increase in the 65 and over share leads to a one percent decline in state and local tax revenues per household (column 3) or a

[15] Harris, Evans, & Schwab's (2001) instrumental variable estimate suggests that a one percentage point increase in the fraction of *all residents* who are ages 65 and over is associated with a 0.817 percent decline in total revenues *per pupil*. On average, school districts have about 0.52 pupils per household and adults compose about 72 percent of the total population, so their estimate is roughly equivalent to a -0.59 (=-.817*.52/.72) percent decline in revenues per household.

0.63 percent decline in local revenues per household. The point estimates are larger and the standard errors of these estimates are smaller when state revenues are included in the dependent variable; as mentioned earlier, there may be some reporting error in the attribution of revenues to their sources. Fortunately, either type of dependent variable produces similar results for the remaining tests for heterogeneous responses described in section 6.3 below.

Changes in local revenues due to demographic shifts are also due to indirect effects operating through changes in school enrollments. Predicted changes in enrollments should be positively correlated with changes in state revenues, since enrollment changes typically alter state funding directly via pupil-weighted funding formulae. In 2SLS models, a one percentage point increase in the fraction of the population who is school-aged leads to a more than 1 percent increase in local revenues and a more than 1.5 percent increase in the sum of state and local revenues. This secondary effect is important to consider when assessing the overall impact of age composition on school revenues. The estimated effect of the school-aged share, however, is not significantly different across states with different tax-price reduction policies. Given that this effect is fairly uniform across states with different targeted tax reduction policies, this secondary effect is unimportant for the tests for heterogeneous slopes described below.

6.3 *Testing Hypotheses 2, 3, and 4*

To test Hypotheses 2, 3, and 4, Table 4 displays results from models with interaction terms based on whether elderly homeowners receive local tax-price reductions. I continue to adjust the standard errors in these two stage least squares models for clustering at the state level. The results in column 1 of Table 4 support the theoretical predictions and reveal important heterogeneity not captured in the national estimates of Table 3. In the absence of any price reductions, a one percentage point increase in the elderly share causes a 1.21 percent decline in local revenues per household, and this estimate is statistically significant at the .01 level. Consistent with Hypothesis 2, this is a significantly more negative effect than the impact of an increase in the upper-middle aged share ($p<.001$). The upper-middle-aged share in this case is associated with a positive effect on revenues, which suggests that upper-middle-aged residents in these communities may tend to have spending preferences slightly above those of the local

median voter. This finding is plausible given that parents of schoolchildren typically compose a large but minority share of the local adult population.

The results in column 1 also confirm Hypothesis 3—in communities offering state-financed tax-price reductions to elderly homeowners, the elderly share has a smaller effect on local school revenues (p=.021). In fact, the impact of the elderly share is statistically insignificant in these communities. The impact of the upper-middle-aged share remains statistically insignificant in these communities as well. The results in column 1 also confirm Hypothesis 4—the impact of the elderly share is more negative if the tax-price reductions are locally financed (p=.096). With locally-financed reductions, a one percentage point increase in the elderly share causes a 0.81 percent decline in local school revenues, though this estimate is not statistically significant in the model in Column 1.

Column 2 of Table 4 verifies that the empirical support for the hypotheses holds when the dependent variable includes both state and locally-funded revenues. The estimated impact of the elderly population share is more negative and more precisely measured than in Column 1. The differences in slopes remains large and statistically significant comparing districts with state-financed tax-price reductions with districts without any reductions (Hypothesis 3; p=.005). The difference in slopes is smaller and less significant comparing state-financed and locally-financed reductions (Hypothesis 4; p=.125).

In additional robustness checks, there continues to be strong support for Hypotheses 2 and 3 but milder support for Hypothesis 4. Column 3 of Table 4 displays results for a model that removes the denominator from the dependent variable (number of households) and instead controls for predicted changes in the size of the school-aged population. This model is most similar to previous studies examining changes in per pupil revenues, though, unlike those prior studies, it still allows the number of pupils to be endogenously determined. Once again, the strong negative impact of the elderly population is limited to places where elderly homeowners are not offered targeted tax-price reductions.

The theoretical framework in Section 3 assumed that residents vote directly on local tax revenues. It is unclear whether age demographics should matter more in a direct or a representative democracy context—this may depend on older people's democratic participation

rates and their sway over locally-elected officials. To explore this issue, the model in column 4 of Table 4 shows results limiting the sample to districts with direct democracy. The biggest change in the results in column 4 from those in column 1 is that the upper-middle-aged share no longer has a significant effect on revenues in places with locally-financed tax-price reductions.

Column 5 of Table 4 displays results when the first-stage models are altered so that the instrumental variables are districts' age shares from 1970. These 1970 age shares predict changes in age demographics across all future decades, with state-by-year specific first-stage slopes. This approach is more similar to Figlio and Fletcher's (2012) recent analysis of aging-in-place in the suburbs. The second-stage results in Column 5 suggest much larger estimated negative effects for the elderly population share, but districts with state-finance tax-price reductions continue to have a significantly smaller effect.[16]

The findings of heterogeneous slopes in Table 4 do not appear to be due to other types of policy differences across states. Additional analyses—not shown here in the interest of brevity—fail to show other types of heterogeneous effects of age demographics. There are not statistically significant differences between the effects of the elderly share in states offering tax reductions administered through traditional tax systems versus administered via mail-in rebate applications.[17] There is not any evidence of heterogeneous effects of the elderly share based on cross-state variation in the importance of itemized federal income tax deductions.[18]

States' tax reduction policies could still potentially be correlated with other state-level variables that lead to heterogeneous effects. For example, if states adopting state-financed

[16] The partial F-statistics for the first-stage equations in this model are 9.1 and 16.7 for changes in the elderly and upper-middle-aged shares respectively.

[17] The lack of a statistically significant finding here may be due to imprecision—only five states offered substantial, state-financed tax-price reductions through mail-in rebates—or due to offsetting factors. Researchers and advocacy groups have documented that some households are unaware of their eligibility for mail-in rebates and an even higher percentage of eligible households are aware of their eligibility but decline to submit an applications (Baer, 1998b). On the other hand, other types of reductions are often subtly incorporated into routine property tax bills or state income tax filings, so that some beneficiaries may be unaware of their discounted tax-prices. Psychological responses to various types of tax reduction mechanisms are an important topic for future research. This paper's finding of an effect of tax price reduction policies suggests that these reductions are salient among at least some of the recipients.

[18] I conducted a rough test for this type of heterogeneity using state-level deduction benefits reported by Loeb and Socias (2004), (excluding commercial and industrial deductions). Demographic effects are not significantly related to the state-level percentage of state and local public school revenues in 1989 that were effectively federally subsidized via federal income tax reductions.

targeted tax-price reductions have elderly homeowners who are especially altruistic, then one might mistakenly attribute the negligible effect of the elderly share in these states to their reduced tax-prices. Although it is difficult to completely rule out potential omitted state-level variables as being important sources of observed heterogeneous effects, many of these factors are likely to be similar across nearby communities. The next analysis thus focuses on within-region variation in policies.

Table 5 displays results of models that test for heterogeneous effects using only state policy variation across geographically proximate districts. These models control for uniform baseline effects of population shares for districts near the same state borders. These models allow for different effects of the upper-middle-aged share, elderly share, and school-aged population shares for districts that are near particular state borders. The models then test whether there are different slopes on different sides of these borders, depending on states' targeted tax-price reduction policies. To conduct this test, the models include interaction terms between population shares and whether (a) the state offers any targeted tax-price reduction or (b) the targeted tax-price reduction is financed locally. For the sake of comparison, the first column of Table 5 displays results from a model using the entire sample to identify these effects. Columns 2 through 4 display results from models that limit the identifying variation to districts within, respectively, 150, 100, or 75 miles of a state border.

The results in Table 5 again provide significant evidence that state-financed targeted tax-price reductions reduce the negative effect of the elderly population share on school revenues. Comparing districts within a wide (150 mile) radius of state borders actually leads to greater estimated differences in slopes across the policy regimes. This alone would suggest that there might be state-level differences causing the estimates in Table 4 to understate the importance of targeted tax rebates. Comparing districts within a smaller (75 or 100 mile) radius of state borders, however, returns the estimated differences in slopes closer to its original value based on all districts. None of the cross-state-border models produce statistically significant differences in slopes for locally-financed reductions compared to state-financed reductions; the magnitude of this difference in columns 2 and 3 is similar to that in column 1. The overall take-away message

from Table 5 is thus similar to Table 4: there is a less negative impact of the elderly share on revenues when elderly homeowners receive state-financed tax-price reductions.

7. Conclusions

Using two newly-assembled sets of policy information—data concerning states' local property tax reduction programs and data concerning the form of democracy used to determine local public school revenues—this paper uncovers heterogeneous effects of age demographics on local public school revenues. Given the importance of these policies, researchers may also wish to use these data to test for (or control for) heterogeneous effects in future studies investigating other topics related to political economy, public finance, demography, or the economics of education. These policies could potentially alter the impact of inter-governmental grants, changes in housing markets, or changes in state and federal tax codes. A general lesson from this paper is that state governments may wish to target policies toward certain groups of residents based on the resulting impact on local public services. This message echoes other studies' conclusions (e.g., Rockoff, 2010) but is often absent from public policy discussions.

This paper's results reveal that a rising elderly population share has a negative impact on locally-funded public school operating revenues, unless elderly homeowners receive substantial state-financed reductions in their marginal local tax-prices. The evidence is consistent with some elderly homeowners having sufficiently elastic demand so that their preferred local tax revenue levels shift from below the median to above the median in response to substantial reductions in their local tax-price. In an aging society, state-financed targeted tax-price reductions thus serve not only as inter-generational transfer programs but also as a means of preserving financial support for public schools. Elderly residents typically live in cheaper housing than the average resident, so reducing their tax-price may be a relatively inexpensive way to manipulate public school expenditures. The majority of states use eligibility restrictions to target their tax-price reductions specifically at low-income elderly; this is an even cheaper way of buying support for

local school spending, because these residents will be more likely to live in housing with low assessed values.

How does the cost of these reduction programs compare with the greater local tax revenues raised as the population ages? To investigate this question, I compare this paper's predictions for districts in the final sample wave (2002) with state revenue spent on these programs during the 2005 fiscal year. I chose 2005 because this was reasonably close to the final sample wave and these data were widely available—using Table 5 of Lyons et al. (2007) and responses from state officials, I found data on the total amount of state revenues used for targeted reduction programs in ten out of twelve states offering the most substantial state-funded tax-price reductions.[19] On average, elderly residents in these states received $143 per person to alleviate their local tax burdens, (per person as opposed to per recipient), and the total payout across all ten states was $270 million. The cost of these programs was less than the amount of local public school tax revenues preserved under a one standard deviation (3.3 percentage point) greater increase in the elderly share: based on the estimate in column 1 of Table 4, the targeted tax-price reductions would preserve more than $300 million in local revenues in these ten states compared to the average alternative policies found in other states. The cost of these programs remains lower than the induced local expenditures if one inflates projected costs to account for a proportional increase in the number of elderly households collecting tax reductions.

The imminent increase in the elderly share in the United States—a projected eight percentage point national increase by 2050 (U.S. Census Bureau, 2008) —is equivalent to more than a two standard deviation change for the districts in this paper's sample. When there is such a widespread aging of the population distribution, state-financed targeted tax-price reductions could be more effective at preserving financial support for schools than the state aid programs designed specifically to encourage public school expenditures. State aid might induce greater school spending if the aid is targeted to people who are very sensitive to their tax-price and would otherwise prefer spending levels below those of the local median voter. Block grants (e.g., foundation aid programs) from states do not reduce anyone's local tax-price, while

[19] Although Ohio and Tennessee offer state-financed tax-price reductions via reductions in assessed value, these reductions are very small: in the year 2002, they were equivalent to less than $20,000 in true market value.

matching grants (e.g., guaranteed tax base programs) reduce local tax-prices for everyone, regardless of their preferences. Card and Payne (2002) estimate that the increase in school spending due to states' school finance reforms between 1977 and 1992 was equivalent to 57 percent of the increase in state revenues from these reforms. In other words, for every additional state dollar spent directly on school finance, school expenditures typically increased by fifty-seven cents; for every state dollar spent on targeted tax-price reductions to elderly homeowners during the next forty years, school expenditures *might* increase by more than one dollar.

There are several important caveats for using this paper's estimates to predict how targeted tax reduction policies might affect future trends in U.S. public education spending. First, the full impact of age demographics on school revenues depends on how demographics affect the sum of local, state, and federal revenues, while the this paper's estimates examine only within-state variation in revenues. Murray, Rueben, and Rosenberg (2007) discuss how state-level education revenues could be threatened by the rising elderly population and elderly residents' preference for alternative types of state public expenditures. Second, this paper's estimates focus on the exogenous component of an aging local population—aging-in-place—but general equilibrium effects associated with aging populations also depend on residential mobility. Underlying mobility rates, mobility responses to property tax reductions (Shan, 2010), and the distribution of elderly people across school districts could each change as the population structure becomes much older. Ladd and Murray (2001) find evidence that "increases in the [state-wide] elderly share are accompanied by greater dispersal of the elderly among local school districts," and a greater dispersal of elderly households could ensure that few districts face very high tax-prices for local public school spending per student. Large changes in age demographics might also affect consumption patterns for private schooling, which could in turn affect both political support for and congestion of public schooling services. Finally, the estimates above pertain solely to public school operating revenues, and the elderly could have stronger effects on districts' ability to raise revenues for public school capital projects.

While these factors are important to consider, they do not necessarily alter the overall prognosis for public school spending per pupil. In most U.S. school districts, local residents ultimately control the last dollar spent in public schools. Even if an increase in the state-level

elderly share leads to a decline in state aid per pupil, local residents could raise additional local revenues per schoolchild to compensate for the decline in state aid. A statewide tax limit might be the best mechanism by which the elderly could constrain total spending on public education. A statewide tax limit may be desirable to upper-middle-aged and elderly homeowners, because it might alleviate their concerns about negative capitalization effects from their district unilaterally lowering public school spending.[20] To avoid major statewide tax limits, parents of schoolchildren could preemptively expand state-financed school district tax-price reductions to older homeowners. If these reductions were sufficiently widespread—with low age limits and/or high income limits for eligibility—then opponents of education spending would be less likely to reach a critical mass for the adoption of a statewide tax limitation for school districts. The incidence of taxes funding local public schools would simply shift towards the adults whose children directly benefit from these revenues—bringing the local property tax closer to a local benefits tax.

[20] Vigdor (2004) provides empirical evidence for this non-resident voter hypothesis, whereby households are more comfortable reducing educational spending throughout the region than unilaterally reducing their own district's spending. Ladd and Wilson (1983) find that elderly adults were more likely than others to support Proposition 2½, a statewide tax limitation in Massachusetts. As mentioned earlier, Brunner and Balsdon (2004) also find evidence that the elderly are more likely to favor local education spending than state education spending.

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Table 1: Elderly homeowner tax rebate policies and the forms of focal democracy for determining school operating revenue levels, state-level information for 2001-02 school year

State	Targeted program reducing elderly homeowners' marginal tax-price for local expenditures?	Minimum age for eligibility	Are Tax-price Reductions Fully Funded by the State?	Type of elderly tax reduction policy	Type of local democracy[a]
Alabama	Yes	65	No	Reductions in assessed value; tax exemptions for those under an income threshold	Mixed
Arizona	Yes	65	No	Credit as percent of taxes paid; Assessed value freeze	Direct
Arkansas	Yes	65	Yes	Reductions in assessed value	Direct
California	No	n/a	n/a	Rebate based on income	Limited[b]
Colorado	Yes	65	Yes	Reductions in assessed value	Direct
Connecticut	Yes	65	No	Rebate as percent of taxes paid, based on income	Direct
Delaware	Yes	65	No	Reductions in assessed value; local option of additional tax credits	Direct
Florida	Yes	65	No	Reductions in assessed value	Representative
Georgia	Yes	62	No	Freeze on assessed value	Representative
Idaho	Yes	65	Yes	Freeze on assessed value; Credit as percent of taxes paid	Direct
Illinois	Yes	65	No	Freeze on assessed value; rebate based on excess taxes paid	Mixed
Indiana	Yes	65	No	Reductions in assessed value	Direct
Iowa	Yes	65	Yes	Credit as percent of taxes paid, based on Income	Mixed
Kansas	Yes	55	No	Credit as percent of excess taxes paid, based on income	Mixed
Kentucky	Yes	65	No	Reductions in assessed value	Representative
Louisiana	Yes	65	No	Freeze on assessed value	Mixed[c]
Maine	Yes	62	Yes	Credit as percent of excess taxes paid, based on income	Direct or representative, varies by district
Maryland	No	n/a	n/a	n/a	Representative
Massach.	Yes	70 for assessed value reduction & 65 for tax credit	No	Reductions in assessed value; Income tax credit	Mixed
Michigan	No	n/a	n/a	n/a	Direct
Minnesota	No	n/a	n/a	n/a	Direct
Mississippi	Yes	65	No	Reductions in assessed value	Mixed
Missouri	Yes	65	Yes	Rebate based on excess taxes paid	Mixed
Montana	Yes	62	Yes	Credit based on excess taxes paid	Direct
Nebraska	Yes	65	No	Reductions in assessed value	Representative
Nevada	Yes	62	Yes	Rebate as percent of taxes paid, based on income	Limited

New Hampshire	Yes	65	No	Reductions in assessed value	Direct or representative, varies by district
New Jersey	Yes	65	Yes	Credit based on excess taxes paid; Freeze in assessed value via rebates	Direct or representative, varies by district[d]
New Mexico	No	65	n/a	Credit based on income	Limited
New York	Yes	65	Yes	Reductions in assessed value	Direct[e]
North Carolina	Yes	65	No	Reductions in assessed value	Representative
North Dakota	Yes	65	No	Reductions in assessed value	Direct
Ohio	Yes	65	Yes	Reductions in assessed value	Direct
Oklahoma	Yes	65	No	Credit based on excess taxes paid; Freeze in assessed value	Direct
Oregon	No	n/a	No	n/a	Direct
Pennsylvania	Yes	65	Yes	Rebate as percent of taxes paid, based on income	Representative
Rhode Island	Yes	65	No	Credit based on excess taxes paid	Direct or representative, varies by district
South Carolina	Yes	65	Yes	Reductions in assessed value	Direct
South Dakota	Yes	65	Yes	Rebate based on income and restricted to a maximum percent of taxes paid; Freeze in assessed value	Mixed
Tennessee	Yes	65	Yes	Reductions in assessed value	Mixed
Texas	Yes	65	No	Reductions in assessed value; Tax freeze for some	Representative
Utah	Yes	65	No	Rebate as percent of taxes paid, based on income	Mixed
Vermont	No	n/a	n/a	n/a	Direct or representative, varies by district
Virginia	Yes	65	No	Rebate as percent of taxes paid, based on income	Representative
Washington	Yes	61	No	Assessed value Freeze with additional assessed value reductions based on income	Direct
West Virginia	Yes	65	No	Credit based on excess taxes paid, based on income	Direct
Wisconsin	No	n/a	No	n/a	Direct
Wyoming	No	65	n/a	Rebate based on income	Representative

Notes to Table 1

(a) In mixed democracies, elected representatives determine the level of operating revenues unless the proposed level or proposed increase exceeds a certain threshold, in which case the local citizens vote directly on the proposal.

(b) Although California districts could not change their property tax rate to support local school operating expenditures, some California districts have passed local land parcel tax referenda to supplement local public school operating expenditures.

(c) Unlike other Louisiana parishes, the New Orleans school board could unilaterally increase the tax rate by more than 5 mills.

(d) Three urban NJ districts, (Newark, Jersey City, &Paterson), lack any local control, with state officials determining the size of their budgets.

(e) Elected officials determine revenues in the 'big five' NY districts: Buffalo, New York City, Rochester, Syracuse, &Yonkers.

Table 2: Summary statistics for the regression samples, Means with standard deviations below in italics

	Full Sample	Year 2002 only
Number of observations	32,997	11,237
PREDICTED TEN YEAR CHANGE IN…		
% of adults ages 55-64	-.007	.004
	.020	*.023*
% of adults ages 65 & over	.007	-.002
	.019	*.022*
% of population ages 5-17	-.025	-.0003
	.027	*.0186*
ACTUAL TEN YEAR CHANGE IN...		
ln(Real local revenue per household)	-.005	.087
	.525	*.475*
% of adults ages 55-64	-.007	.004
	.003	*.028*
% of adults ages 65 & over	.007	-.002
	.034	*.033*
% of population ages 5-17	-.025	-.0003
	.035	*.0262*
ln(population density)	.088	.092
	.235	*.187*
% nonwhite residents	.020	.030
	.052	*.060*
% of households who are homeowners	.006	.137
	.048	*.040*
LEVELS		
Real local revenue per household (year 2000 $)	7,211	7,276
	673	*629*
% of adults ages 55-64	.133	.131
	.028	*.025*
% of adults ages 65 & over	.188	.193
	.061	*.058*
% of population ages 5-17	.204	.196
	.033	*.030*

Table 3: The impact of age demographics on tax revenues per household

Model Type:	(1) OLS	(2) 2SLS	(3) 2SLS	(4) OLS	(5) 2SLS	(6) 2SLS
	State & Local Revenues	State & Local Revenues	State & Local Revenues	Local Revenues Only	Local Revenues Only	Local Revenues Only
Change in % of adults 55-64 years old	-0.95*** (0.30)	-0.62 (0.42)	-0.86** (0.37)	-0.64* (0.37)	-0.36 (0.49)	-0.60 (0.45)
Change in % of adults ≥65 years old	-1.30*** (0.11)	-0.83*** (0.24)	-1.00*** (0.19)	-1.10*** (0.18)	-0.41 (0.46)	-0.62 (0.39)
Change in % of pop. 5-17 years old	1.80*** (0.16)	1.54*** (0.28)	1.56*** (0.29)	1.05*** (0.20)	1.15*** (0.21)	1.07*** (0.23)
Change in ln(population per square mile)		-0.46*** (0.28)	—	-0.44*** (0.04)	-0.41*** (0.03)	—
Change in % nonwhite residents		0.21*** (0.07)	—	-0.18*** (0.08)	-0.15* (0.08)	—
Change in % homeowners		0.57*** (0.07)	—	0.31** (0.13)	0.29** (0.13)	—
Number of Observations	31,815	31,815	32,997	31,815	31,815	32,997
R-squared	0.24	0.24	0.22	0.26	0.25	0.22

Notes to Table 3: Each column represents the estimated coefficients from a separate regression controlling for state-by-year-by-prior- income-range fixed effects and state-by-year-by-urbanicity fixed effects. The dependent variable equals the change in the natural log of locally-financed public school operating revenues per household. For ease of interpretation in these semi-log models, "% of adults" denotes proportions (percentages divided by 100). Heteroskedastictiy-robust standard errors adjusted for clustering at the state level are in parentheses below each estimate. The two stage least squares models (2SLS) use state-by-year specific effects of initial age population structure in the first stage as instrumental variables predicting all of the explanatory variables listed above.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Heterogeneous effects of age demographics by local tax-price reduction policy

Dependent Variable:	(1) Local school tax burden per household	(2) State & local school tax revenues per household	(3) State & local school tax revenues	(4) Local school tax burden per household	(5) Local school tax burden per household
% of adults ≥ 65 years old					
(i) NO REDUCTIONS	-1.21*** (0.45)	-1.65*** (0.32)	-0.93*** (0.30)	-1.34*** (0.48)	-2.74*** (0.32)
(ii) STATE-FINANCED REDUCTIONS	0.09 (0.45)	-0.66*** (0.21)	0.07 (0.24)	-0.20 (0.50)	-1.20 (0.70)
(iii) LOCALLY-FINANCED REDUCATIONS	-0.81 (0.53)	-1.03*** (0.26)	-0.12 (0.35)	-0.49 (0.67)	-1.85** (0.78)
% of adults 55-64 yrs old					
(iv) NO REDUCTIONS	0.77* (0.40)	-0.14 (0.47)	0.82** (0.31)	0.85** (0.41)	0.78 (0.79)
(v) STATE-FINANCED REDUCTIONS	0.05 (0.25)	-0.49* (0.27)	0.36 (0.23)	0.10 (0.38)	-0.81 (1.04)
(vi) LOCALLY-FINANCED REDUCATIONS	-1.13* (0.66)	-1.16** (0.65)	-0.51 (0.59)	-0.32 (0.99)	-0.66 (1.24)
% of pop. 5-17 years old	1.09*** (0.23)	1.58*** (0.28)	-	1.31*** (0.35)	-0.33 (0.70)
ln(population 5-17 years old)			0.32*** (0.04)		
p-values for Hypothesis 2 (coef. in row i <coef. in row iv)	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**
p-values for Hypothesis 3 (coef. in row i<coef. in row ii)	**.021**	**.005**	**.005**	**.049**	**.009**
p-values for Hypothesis 4 (coef. in row iii<coef. in row ii)	**.096**	**.125**	**.320**	**.359**	**.740**
Type of Local Democracy for Determining Property Tax Revenues	Any	Any	Any	Direct Only	Any
Demographic Changes Predicted Based on __ Period Levels	Prior	Prior	Prior	Prior	Baseline (1970)
Sample Size	32,997	32,997	32,999	15,141	29,260

Notes to Table 4: Each column represents the estimated coefficients from the second stage equation of a two stage least squares model controlling for state-by-year-by-prior-income-range fixed effects and state-by-year-by-

urbanicity fixed effects. Each model uses first-differences based on 10 year changes in the values of the dependent and independent variables for the same school districts. State-by-year effects of school districts' initial age population structure enter the first stage equations to predict all of the explanatory variables listed above. The second stage dependent variable equals the change in the natural log of locally-financed public school operating revenues per household. For ease of interpretation in these semi-log models, "% of adults" denotes proportions (percentages divided by 100). Heteroskedastictiy-robust standard errors adjusted for clustering at the state level are in parentheses below each estimate. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5 Heterogeneous effects of age demographics by local tax-price reduction policy, comparing nearby districts across state borders

Identified from differences in slopes…	(1) across the country	(2) across neighboring states for districts within 150 miles of the relevant state borders	(3) across neighboring states for districts within 100 miles of the relevant state borders	(4) across neighboring states for districts within 75 miles of the relevant state borders
% of the population 65 & older				
*(any tax-price reduction)	1.32**	3.39***	1.78**	1.23**
	(0.64)	(1.12)	(0.81)	(0.68)
*(locally-financed tax-price reduction)	-0.92	-0.91	-0.81	-0.35
	(0.69)	(0.99)	(0.81)	(0.80)

Notes to Table 5: In each column, the sample contains all 32,997 district-level observations included in the previous tables' analyses. The second stage dependent variable equals the change in the natural log of locally-financed public school operating revenues per household. For ease of interpretation in these semi-log models, % denotes proportions (percentages divided by 100). Column 1 displays estimates from two stage least squares models, with heteroskedasticity-robust standard errors adjusted for clustering at the state level. The cross-state-border models in column 2 through 4 limit the identifying variation to districts located near each other in adjacent states. For these cross-state-border models, I use a two-step estimation procedure with bootstrapped standard errors based on 1,000 Monte Carlo simulations; this two-step procedure facilitates the continued use of state-specific slopes for predicted changes in age demographics. The models continue to include the same control variables as the models in Table 4 but they also allow the slope of the school-aged population to vary by the type of tax-price reduction offered by the state.

* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix A: Theoretical framework for equilibrium local public school revenues

The theoretical framework in this appendix builds on previous models (e.g., Yinger, 1981, Farnham and Sevak, 2006) and assumes that households are forward-looking concerning expected changes in house prices. Each household chooses to live in the district that maximizes their current indirect utility, which is a function of local amenities, public services, and the costs of residing in that district.

Household *i*'s annual indirect utility from living in house *j* in year *t* is given by $V_{ijt}(\boldsymbol{G_{jt}}, \boldsymbol{A_{jt}}, \boldsymbol{P_{jt}}, \boldsymbol{T_{ijt}}; \boldsymbol{X_{it}})$, with local and state government services captured by variables in the $\boldsymbol{G_{jt}}$ vector, local amenities captured by variables in the $\boldsymbol{A_{jt}}$ vector, local prices for housing and non-housing goods are captured by variables in the $\boldsymbol{P_{jt}}$ vector, local and state taxes are captured by variables in the $\boldsymbol{T_{ijt}}$ vector, and $\boldsymbol{X_{it}}$ is a vector of variables describing the characteristics of household *i*, including income, number of children, age(s) of members, etc. Assume that all households are homeowners rather than renters, and assume that households have rational expectations and are risk neutral. Suppose that there are transactions costs, K_{ijk}, associated with household *i* changing from residence *j* to residence *k*. Define δ_i as the discount rate of household *i*. Each household will choose a residence which maximizes some linear discounted combination of the expected indirect utility from living in the house from now until year T, when a higher indirect utility (V^*_{ikT}) may be achieved by selling house *j* and moving to house *k*. In particular, each household will choose residence *j* to maximize:

$$\text{(B.1)} \qquad W_{ij} = E\left[\sum_{t=1}^{T_i} \frac{1}{(1+\delta_i)^t} V_{ijt}(\boldsymbol{G_{jt}}, \boldsymbol{A_{jt}}, \boldsymbol{P_{jt}}, \boldsymbol{T_{ijt}}; \boldsymbol{X_{it}})\right] + \frac{1}{\delta_i(1+\delta_i)^{T_i}} V^*_{ikT}(\boldsymbol{G_{kT}}, \boldsymbol{A_{kT}}, \boldsymbol{P_{jT}}, \boldsymbol{T_{ikT}}, \boldsymbol{K}_{ijk}; \boldsymbol{X_{iT}}),$$

so that an equilibrium is reached where housing markets clear and government budgets are balanced.[21] Over time, households may choose to move residences given changes in variables from any of these

[21] Nechyba (1997) proves the existence of a market equilibrium in this general type of household location model, though Nechbya's model makes a standard assumption that households are myopic in that they expect to live in their chosen residence forever barring a change in prices.

vectors, including changes in the household's own characteristics or external shocks due to changes in relative prices, tax rates, amenities, or government spending levels.

Consider the specific components of the indirect utility function that are related to the local financing of public schools. For simplicity, assume that all housing within the same school district is identical, so that the index *j* now refers to any residence in school district *j*. Households in district *j* face the same assessed housing value, h_{jt}, which is a function of mean contributions to local public school property tax revenues, τ_j.

For households who are currently consuming public school services, the derivative of either right-hand side term in equation A.1 with respect to τ_j may be positive or negative. The benefits of consuming greater services may exceed the cost of higher tax payments, and there might be positive capitalization effects associated with higher spending. For households who do not consume public school services, however, $E\left[\sum_{t=1}^{T_i}\frac{1}{(1+\delta_i)^t}\frac{dV_{ijt}}{d\tau_j}\right]$ is unambiguously negative. The only consideration for these households' preferred local tax revenues is whether the discounted cost of higher tax payments is less than the expected present value of potential positive capitalization effects for their homes; these homeowners will favor an increase in τ_{jt} iff: $-E\left[\sum_{t=1}^{T_i}\frac{1}{(1+\delta_i)^t}\frac{dV_{ijt}}{d\tau_j}\right] < E\left[\frac{1}{\delta_i(1+\delta_i)^{T_i}}\frac{dV^*_{ikT}}{d\tau_j}\right]$.

Tax-price reductions will make $\frac{dV_{ijt}}{d\tau_j}$ more positive for any household *i* receiving them. If these tax-price reductions are financed locally, however, they will also make $\frac{dV_{ijt}}{d\tau_j}$ more negative for any household not receiving these reductions.

A portion of residents will age-in-place in their school district, creating shifts in age demographics. This portion may vary across regimes with different tax and targeted tax-priced reduction policies. This paper's empirical tests examine whether the predicted changes in age demographics due to aging-in-place are related to actual changes in local spending via political participation.

Consider a simple median voter model in which the local property tax level is determined by majority-rule voting, all residents vote, residents have single-peaked preferences, and residents vote directly over a full range of potential property tax rates and cast these votes independently of their votes for any other issue or election. For a representative school district, denote $F(\tau)$ as the cumulative distribution function of households' preferred level of τ, the level of local tax revenues per household used to fund public schools, with $\tau \in [\tau^{\min}, \tau^{\max}]$. Majority voting is used to determine the level of local tax revenues, τ^*, and the district adopts the median voter's preferred τ, such that $F(\tau^*)=.5$.

Suppose there are various groups of households that tend to favor relatively high or low levels of local revenues. Residents may be placed in one of N mutually-exclusive groups: $(Q_1,Q_2,\ldots,Q_N)$. There are three key insights for motivating this paper's hypotheses. First, if one group's members are more likely than another group's members to prefer higher spending than that preferred by the median voter, then exogenous increases in the former group's share via decreases in the latter group's share will likely lead to higher local spending. This motivates Hypotheses 1 and 2. Second, targeted tax-price reductions to elderly homeowners increase their $\frac{dV_{ijt}}{d\tau_j}$. Compared to the case in which there are not any targeted tax-price reductions, this increases the likelihood that an elderly homeowner's preferred local spending level is above the preferred level of the median voter. This motivates Hypothesis 3. Third, if the targeted tax-price reductions are locally financed rather than financed by the state, then this will make $\frac{dV_{ijt}}{d\tau_j}$ more negative for any household not receiving these reductions. Non-recipients will thus have a decrease in their preferred level of local spending in response to an exogenous increase in the share of residents receiving tax-price reductions. This motivates Hypothesis 4.

Appendix B: Description of Data Collection for School Districts' Local Forms of Democracy

This appendix describes the assembly of district-level longitudinal policy information concerning the forms of local democracy for determining local tax rates financing local public school operating revenues. My research assistants and I first examined *Public School Finance Programs in the U.S. and Canada* (e.g., U.S. Department of Education, 2001) and surveyed the contributing experts on each state's education finance system. When more information was needed, we also surveyed officials from states' departments of education. To accurately situate this information in a historical perspective, we examined whether statewide forms of local democracy would have changed after major school finance reforms and we compared the current form of democracy in each state with local referenda frequency information published by Hamilton and Cohen (1975). In places with slight intra-state variation in the form of local democracy, state officials told us which districts were exceptions. In most New England states with substantial intra-state district variation, districts use the same form of local democracy as the local municipalities that they served, so we were able to identify whether districts' used direct or representative democracy using Saiz's (2005) data from New England municipality interviews with local school officials. In one case, Rhode Island, we surveyed administrators in each school district to learn the district-level form of democracy. The resulting data set (available from the author upon request) contains indicator variables for the form of local democracy used in every school district in the United States from 1972 to 2002.

While we were able to identify statewide changes in the form of local democracy, it is possible that district-level changes are a source of measurement error in these data. Anecdotally, it seems that few districts unilaterally change their form of local democracy over time.

Appendix C: Simplified Versions of the First-stage Equations Predicting Changes in Population Shares

	Percent of Adults, Ages 65 and over	Percent of Adults. Ages 55 to 64
Age Demographics from 10 Years Earlier		
Percent of population below age 5	-0.034***	-0.06***
	(0.013)	(0.009)
Percent of population ages 5-17	-0.153***	-0.024***
	(0.006)	(0.004)
Percent of adults ages 45-54	0.152***	0.431***
	(0.007)	(0.005)
Percent of adults ages 55-59	0.352***	-0.757***
	(0.010)	(0.007)
Percent of adults ages 60-64	0.419***	-0.763***
	(0.011)	(0.008)
Percent of adults ages 65-74	-0.384***	0.178***
	(0.008)	(0.006)
Percent of adults ages 75&up	-0.278***	0.005
	(0.007)	(0.005)
Number of Observations	32,906	32,906

* significant at 10%; ** significant at 5%; *** significant at 1%