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ABSTRACT

Many local jurisdictions offer property tax exemptions or similar concessions to older citizens. Such exemptions represent substantial intergenerational transfers and may have important implications for local public finances. The consequences of age-based property tax exemptions depend upon the extent to which they influence households' location decisions, housing tenure decisions, and housing consumption. We provide the first evidence on (long-term) changes in household composition and housing consumption attributable to local, age-based property tax exemptions. We construct a unique database of local property tax exemptions in Georgia covering 100 years of county, school district, and selected city property tax laws. We use these data to estimate the effect of age-based property tax exemptions on the number of older homeowners from 1970-2010 attributable to the exemption. Using a "quadruple-difference" estimation strategy, we find a significant increase in older homeowners attributable to the combined effect of age-based property tax exemptions on location decisions and housing tenure. We also find evidence that age-based property tax exemptions increase housing consumption among older households. Finally, we estimate a sorting model to estimate the equilibrium effects of different tax policies.

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A data appendix is available at http://www.nber.org/data-appendix/w25468

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1. Introduction

As the largest single source of revenue for state and local governments in the United States, property taxes are a primary funding mechanism for local public goods and services. Yet this tax base has eroded over time, as local governments enact exemptions, abatements, and other concessions (Augustine et al. 2009). Age-based property tax exemptions are part of this trend. Across the United States, many local jurisdictions offer property tax exemptions or similar concessions to older citizens, especially from taxes supporting school districts. Such exemptions first attracted the attention of tax professionals some fifty years ago (e.g., Chen 1965), but they have become much more widespread in recent decades. For example, in the state of Georgia, in 1970 only about 5% of the population lived in a local jurisdiction with some kind of age-based property tax exemption, whereas today it is more than 80% (though they vary in generosity and the population covered).

Such exemptions are controversial. For example, in suburban Atlanta, Cobb County has made headlines in recent years for its generous exemption from the education property tax for seniors at a time when schools' budgets have been severely squeezed (Davis 2010, Downey 2013). Defenders of age-based exemptions argue that housing makes up a larger share of the budget for older households, that many older households paid into the community for many years, and that most presently do not have children in the schools. From this perspective, exemptions effectively reduce the public service subsidies from older households (Shan 2010, Gallagher et al. 2017). Additionally, age-based exemptions may help older residents remain in their homes and preventing unwanted moves by owners that value their homes more than the marginal homebuyer (Shan 2010). Critics point out that, on the other hand, most older households do not have mortgages, that they benefit from the increased housing values associated with strong schools and other public services, that other households with no children in the schools are not exempted, and that today's seniors benefited when they were younger from receiving the payments of the previous generation of older households.

In addition to their direct effect on the tax base, age-based property tax exemptions may also have unintended consequences in the form of changes in jurisdictional household composition and changes in housing values. These changes could, in turn, have a "dynamic scoring" effect on local public finances. That is, the effect of senior discounts on local public finances may be different in the long run if the discounts increase the share of older homeowners. Recently, Gallagher et al. (2017) examined the effect on local school finances of an exogenous increase in the population of older households. They consider two effects, the tax base effect, which represents the transfer of resources from households without school-age children, and the tax rate effect, as the political process generates lower tax rates (for all households) in jurisdictions with more older households. They find the former effect dominates. However, they do not consider the effect of age-targeted tax exemptions, which essentially represent a way to reduce the tax base effect.

The decrease in the cost of homeownership in a particular location granted by age-based property tax exemptions potentially influences eligible households through three channels. First, age-based exemptions could affect the location decision of older homeowners, as they have an incentive to move to areas with more generous exemptions (or refrain from moving away). Second, such exemptions similarly could affect the tenure decision of older homeowners, as they have more incentive to own their property than to rent. Third, at the intensive margin, the tax subsidies could induce older homeowners to consume more housing, much like the mortgage income tax deduction (Hanson 2012). Tiebout sorting and migration studies provide mixed evidence regarding the effect of taxes and public goods on the location decisions of older households, but there is substantial evidence that households generally move in response to changes along these dimensions. There is less evidence on the potential for age-based exemption-induced increases on the extensive margin in the number of households owning a home and on the intensive margin in the size of the house, or amount of housing capital.

Relatively little is known about the extent to which older households' location decisions, housing tenure decisions, and housing consumption decisions respond to changes in *local* property taxes. Indeed, we could find no evidence of existing research that considers the tenure decision and very little on the consumption decision.

Most of the attention has been on location decisions. However, the existing sorting and migration studies of older households focus on between-state migration in response to state-level

differences in taxes and public goods. Conway and Rork (2006) examine interstate migration of older households and find little effect of state taxes on estates, inheritances, and gifts. Similarly, Conway and Rork (2012) find little effect of age-based income tax breaks. On the other hand, Onder and Schlunk (2010) find that older households are more likely to move to states that provide sales tax exemptions on items more frequently purchased by older households than young households. Gale and Heath (2000) explicitly model the endogeneity of elderly migration and state fiscal policy in their analysis and find that states with higher average property taxes have less net in-migration.

Several papers have used Health and Retirement Survey (HRS) data on self-reported property tax payments when considering migration decisions. Seslen (2005) examines the effect of property taxes on the decision of older households to downsize and finds little evidence that property taxes influence the decision to move or liquidate their housing. Farnham and Sevak (2006) find that recent empty-nesters reduced their exposure to property taxes when moving across state lines, but not when moving within states, suggesting that households may consider this factor when making a move. Shan (2010) uses more recent data from the HRS and instruments for property tax payments with variation in state-provided property tax relief programs. She finds that higher property taxes do increase the housing mobility of older households, causing them to downsize or move to states with lower property taxes, with state-provided property tax relief programs diminishing that mobility. Whether similar policies at the local level would specifically attract older households is an open question.

To our knowledge, we are the first to provide evidence on the effect of local age-based property tax laws on local changes in household types through the location and tenure decisions of older households as well as the effect on housing consumption. To do so, we construct a unique database of local property tax exemptions in Georgia. Our local exemption data cover 100 years of county, school district, and selected city property tax laws. We use these data to estimate the effect of age-based property tax exemptions on the (absolute or percentage) change in the number of older homeowners from 1970-2010 that is attributable to the exemption.

We use a "quadruple-difference" estimation strategy that uses counterfactual information from jurisdictions without exemptions as well as young owners and older renters in the treated counties to identify the effect on older renters. Essentially, we estimate difference-in-differences,

looking at changes in the demographics of counties that adopt age-based property taxes relative to changes in counties that didn't. However, relative to a standard difference-in-differences model, we allow the residuals to be correlated with differential trends in renters and younger owners, identifying the effect off of older owners relative to these other groups.

In addition, we estimate the change in counties' mean housing values using a triple-difference strategy. The strategy is similar to the demographic model, but ignores renters. Finally, we implement a more structural approach to estimate the effect of the policies on local populations.

We find a significant increase in older homeowners attributable to the combined effect of age-based property tax exemptions on location decisions and housing tenure. A ten percent increase in county households residing in a jurisdiction with age-based exemptions causes a 4-6 percent increase in the number of older homeowners, net of the change in untreated counties, relative to the change in older renters and younger households in treated counties. These estimates are generally stable over a range of specifications, including controls for the intensity of the exemption. Explicitly modeling substitution pattern with a structural model, we find both older and younger owners are attracted by the policy. We further find that in a counterfactual world where Cobb County (with Georgia's most generous exemptions for the elderly) had not enacted the policy, the population of older homeowners would be lower by an amount equal to 3-5% of the County's population. Finally, we find that exemptions induce increases in housing consumption by older households. However, these results are not robust to models that control for county-specific time trends by age-tenure as well as decade-by-age and decade-by-urban status effects, which may be too demanding of the data.

The paper proceeds in the next section by outlining our empirical strategy. We detail the local property tax exemptions and describe the Georgia Property Tax Data Base in Section 3. Section 4 summarizes trends in the data, while Section 5 presents our main results. Section 6 provides some concluding remarks.

2. Empirical Strategy

As noted above, we expect age-based property tax exemptions to affect the locational decisions of older households, their housing tenure, and their housing consumption. Unfortunately, we do not observe moves (by age and tenure) directly, but only repeated snapshots of the population by age and tenure and the owner-occupied housing stock by age. Accordingly, we group the first two as

a combined effect at the extensive margin, which we call the *older homeowner effect*. We consider these effects separately from the *housing consumption effect* at the intensive margin.

2.1 The Older Homeowner Effect

If age-based property tax exemptions affect the locational decisions of older homeowners and their housing tenure decisions, we would expect to find more older homeowners in counties with more generous exemptions, relative both to older renters and to younger homeowners, ceteris paribus. To minimize possible threats to identification caused by unobservables coincident to the adoption of age-based property tax exemptions and to migratory and housing decisions, we use a "quadruple-difference" strategy. In particular, we define four categories of household demographic types: older homeowners, older renters, young homeowners, and young renters. We then estimate the logged number of households of demographic category *i* living in jurisdiction *j* at decade *t* (from 1970 to 2010) by:

$$
\begin{aligned}
(1) \qquad \ln y_{ijt} = \; & \gamma_0 + \gamma_1 1(Older)_i + \gamma_2 1(Owner)_i + \gamma_3 [1(Owner) \times 1(Older)]_i \\
& + \gamma_4 Treatment_{jt} \\
& + \gamma_5 [1(Older) \times Treatment]_{ijt} \\
& + \gamma_6 [1(Owner) \times Treatment]_{ijt} \\
& + \gamma_7 [1(Owner) \times 1(Older) \times Treatment]_{ijt} + \alpha_j + \mu_t + \varepsilon_{ijt},
\end{aligned}
$$

where $Treatment_{jt}$ is one of the age-based treatment variables discussed in more detail below, which indicate whether county *j* has an aged-based exemption at time *t*, $1(Older)_i$ is a dummy variable for whether treatment group *i* is for households aged 65 and older, $1(Owner)_i$ is an indicator variable equal to one if treatment group *i* involves homeowners, α_j is a vector of county fixed effects, and μ_t is the vector of time fixed effects.

Our coefficient of interest is γ_7, the coefficient on the interaction term $[1(Owner) \times 1(Older) \times Treatment]_{ijt}$. This term represents a "quadruple-difference." To see this, note that if we omitted the terms for γ_5, γ_6, and γ_7, the standard difference-in-differences (DD) estimate would be γ_4, the coefficient on our treatment variable, which differs by jurisdiction and time (as represented by fixed effects α_j and μ_t). The DD therefore is identified from the before/after and between-county variation in treatment. However, because we have specified heterogeneous effects

along the age and tenure dimensions, in our model γ_4 represents the DD for young renters. In total, Equation (1) estimates four difference-in-differences, as summarized in Table 1 by the four upper-left cells. Our strategy compares the difference between the DD for older owners and older renters (i.e. $\gamma_6 + \gamma_7$) to the difference between the DD for younger owners and younger renters (i.e. γ_6). This quadruple difference is γ_7. Equivalently, we could define this as the difference between the DD for older owners and younger owners (i.e. $\gamma_5 + \gamma_7$) to the difference between the DD for older and younger renters (i.e. γ_5). Again, the difference is γ_7.

This empirical strategy requires fairly weak assumptions to interpret γ_7 as the causal effect of the property tax exemptions on older homeownership in the treated counties. In particular, it allows for the possibility that changes in age-based property tax exemptions occur at the same time as other unobserved changes that influence population, homeownership, or even particular age groups. It simply requires that any unobservable changes coincident to the policy (in time and space) do not attract older owners, relative to older renters, differently than they attract younger owners, relative to younger renters. This requirement is weaker than the assumption that such effects are identical for our four demographic groups. Finally, we assume that any *one* county's age-based property tax exemption does not have a significant effect on the outcomes of other counties. (We do not need to rule out general equilibrium effects as a whole from the policy: only general equilibrium effects from one average county.)

We also present estimates that rely on even weaker assumptions. Specifically, our base models, presented below, augment Equation (1) with yearXolder and yearXowner effects. Too, we present estimates that include exemption-year and exemption-county interactions. This controls for the potentially heterogeneous effects of a law on a particular county (independent of the demographic group) and likewise in a particular decade. We also present results from a specification that adds exemption-year, exemption-county, county-age, county-owner, owner-year, and year-age-urban status interactions to Equation (1).[1] This model controls for potentially heterogeneous effects of the law in a particular county or decade as well as county-level demographic

[1] Counties are defined as urban if their USDA rural-urban continuum code was 1-3 in 1974.

trends, and any general rural-urban migration tendencies by age group in a particular decade. Finally, as an alternative, we consider models in which the dependent variable is the percentage change in the population of the demographic group, essentially allowing for county-by-demographic-group time trends (which now absorb the average percentage change for each group). These models are quite demanding of the data, as they require picking up "tilting" in the population growth curves at the time of adoption, even when responses may be sluggish.

2.2 The Housing Consumption Effect

In addition to these locational and tenure effects, we also consider the effect of the policy on housing consumption using mean housing values by age. However, because our housing value data is available for owner-occupied units only, we substitute a "triple-difference" strategy for the quadruple-difference strategy outlined above, essentially dropping all terms involving renters. Specifically, we estimate the logged mean aggregate value households of demographic type *i*, $i \in \{Young, Older\}$, living in jurisdiction *j* at time *t*, y_{ijt}, by:

$$\ln y_{ijt} = \pi_0 + \pi_1 1(Older)_i + \pi_2 Treatment_{jt} + \pi_3 [1(Older) \times Treatment]_{ijt} + \alpha_j + \mu_t + \varepsilon_{ijt}. \quad (2)$$

Our parameter of interest is π_3, the difference in the mean home value of older households after the implementation of age-based property tax exemptions compared to the difference in mean home values for young households in treated counties relative to this difference in untreated counties. We can interpret π_3 as the causal effect of the policy on older homeowners' housing consumption in treated counties under the assumption that any unobserved changes in treated county home values either caused by or coincident to the exemption do not differentially affect homeowners on the basis of age. Furthermore, if older homeowners and younger homeowners in the same county are participating in the same housing market, then we can interpret π_3 as the effect of increased housing consumption (i.e. an effect on the quantity of housing demanded), rather than a price effect. (Note however, that we cannot rule out the possibility that any increase comes from the selection of a changing set of older households, due to the older homeowner effect.)

Again, we also present estimates that control for potentially heterogeneous effects in each county and decade by replacing the county and decade fixed effects with exemption-year and exemption-county interactions. We also present results from a specification that add exemption-

year, exemption-county, county-age, year-age, and year-urban status interactions to control for potentially heterogeneous effects of the law in a particular county or decade as well as county-level age trends and any rural-urban migration tendencies by age group in a particular decade. Finally, we consider percentage changes in housing value as the dependent variable, again essentially controlling for county-by-age time trends in housing consumption.

2.3 A Structural Model

The strategy outlined in Sections 2.1 and 2.2 is useful for determining a causal effect of the tax policies on populations. However, both because of the differencing strategy and because it does not explicitly model substitution patterns, the causal strategy is less useful for predicting the actual effects of tax policies on local populations. To overcome this problem, we add more structure, modeling people's choices using a simple sorting model (e.g. Kuminoff, Smith, and Timmins 2013). Allowing for heterogeneity by age, we assume each household chooses tenure τ and location j (2xJ choice alternatives) based on its utility. In particular, we assume choices are based on the following random utility model:

$$
\begin{aligned}
(3) \qquad u_{ij\tau t} = \; & \beta_1 Treatment_{jt} + \beta_2\left[1(Older_i) \times Treatment_{jt}\right] + \beta_3 Own_\tau \\
& + \beta_4[1(Older_i) \times Own_\tau] + \beta_5\left[1(Own_\tau) \times Treatment_{jt}\right] \\
& + \beta_6\left[1(Older_i) \times 1(Own_\tau) \times Treatment_{jt}\right] + \alpha_j \\
& + \beta_{7t}\left[1(Older_i) \times 1\left(Urban_j\right)\right] + \varepsilon_{ijt}.
\end{aligned}
$$

That is, we assume people have utility for a county/tenure pair that can be explained by the county's treatment status (or factors correlated with the treatment), whether the choice alternative represents owning or renting, an interaction for between treatment and owning, and a county fixed effect. We allow for heterogeneity in tastes for these factors by older/younger households, which we incorporate through interaction with an older dummy. We are unable to estimate separate dummies by age, but do interact tastes for an urban county by age, and allow these differential tastes for urban to vary over time.

Due to data limitations, we do not include housing prices. However, these can be thought to be absorbed in the county dummies and in β_1. As long as older and younger households face the same prices within a county, missing housing prices should not bias the estimates of β_6. The

random component of utility is assumed to be distributed iid logit. Thus, the model can be estimated using a conditional logit model.

3. Data

This section introduces the data used in our analysis, including the data we collected on local tax exemptions in Georgia.

3.1 The Georgia Property Tax Database

We collected and coded data on local residential property tax laws in Georgia, creating the Georgia Property Tax Database.[2] This database details the variability in homestead exemptions across local jurisdictions in Georgia as well as the variability within a jurisdiction by individual characteristics, including age, disability status, veteran status, and income. This unique data set covers a one hundred year period, from 1913 to 2013.[3] We include four types of jurisdictions in the database: (i) all 159 counties; all school districts, which we subdivide into (ii) all 159 county-level school districts and (iii) the state's 26 independent school districts; and (iv) select municipalities, including the top 30 most populated cities in Georgia plus others with an independent school district.

The database provides information on up to eight local property tax rules and eight state rules for each jurisdiction and year, with details on the demographic group to whom the property tax provision is targeted, including age and income limits (and combinations of the two).

The data are organized using the following conceptual framework. In the absence of any local property tax concessions, the total ad valorem property tax for a household of demographic type *i* living in jurisdiction *j* (levied by jurisdiction *j*) is given by:

$$T_{ij} = \left(\tau_j^{MO} + \tau_j^{B}\right)\beta_j V, \tag{4}$$

[2] A summary and discussion of the data used here has previously been published in Banzhaf, Mickey, and Patrick (2016), from which this summary draws heavily. The Georgia Property Tax Database is housed at Georgia State University's Fiscal Research Center. For documentation and information about obtaining the data, see http://frc.gsu.edu/data-collections/.

[3] Although the first recorded property tax exemption in the state is a state level exemption in 1938, we confirmed the absence of property tax exemption laws during the period from 1913-1938.

where V is the fair market value, β_j is the assessment ratio in jurisdiction j, and τ^{MO} and τ^{B} are, respectively, the property tax rates for maintenance and operations and for bonds.

Exemptions and concessions may reduce the some households' total ad valorem tax by altering the taxable value or the tax rate. Incorporating various exemptions and other concessions into Equation (4), the ad valorem tax for a household of demographic type i living in jurisdiction j becomes:

$$T_{ij} = \theta_{ij}^{MO}\tau_j^{MO}\left(\phi_{ij}^{MO}\beta_j V - \left(\delta_{Sij}^{MO} + \delta_{Lij}^{MO}\right)\right) + \theta_{ij}^{B}\tau_j^{B}\left(\phi_{ij}^{B}\beta_j V - \left(\delta_{Sij}^{B} + \delta_{Lij}^{B}\right)\right), \quad (5)$$

with the restriction that $T_{ij} \geq 0$. This expression uses the following notation:

- θ_{ij}^{MO} and θ_{ij}^{B} are the proportions by which the M&O and bond millage rates, respectively, are prorated (0 being a full exemption) for individual i in jurisdiction j;
- ϕ_{ij}^{MO} and ϕ_{ij}^{B} are the respective proportionate adjustments to the assessment ratio;
- δ_{Sij}^{MO} and δ_{Sij}^{B} are the respective dollar amounts of the state exemption, which in some cases may differ by jurisdiction and individual; and
- δ_{Lij}^{MO} and δ_{Lij}^{B} are the respective dollar amounts of an applicable local exemption.

Using these definitions, $\beta_j V$ is the assessed value and $\phi_{ij}^{MO}\beta_j V - \left(\delta_S^{MO} + \delta_{Lij}^{MO}\right)$ is the net assessed value. By some definitions only the δ terms would be considered exemptions, but as a convenient short hand we refer to the full range of concessions (including θ and ϕ as well as δ) as "exemptions."

Merged with data on millage rates (available 1990-2013), these data allow one to simulate how much property tax an individual household of a given demographic category would pay in property taxes in a given jurisdiction, in a given year, on a property with a specified assessed value (assuming the household takes advantage of all exemptions available). For example, suppose in a particular county that $\tau_j^{B} = 0$ so we need only be concerned with taxes on M&O. Suppose a house has a fair market value of V = \$200,000 and has an assessment ratio $\beta_j = 0.4$. Suppose all households regardless of demographic group receive the state exemption of δ_{Sij}^{MO} = \$2,000. Suppose that households under age 65 can take an additional local exemption δ_{Lij}^{MO} = \$10,000 but households

over age 65 can *instead* take a proportionate adjustment on its property taxes of θ_{ij}^{MO}=0.5. Finally suppose the millage rate is τ_j^{MO} = 20 mills, or 2 percent. Using Equation (5), a younger taxpayer would pay 20*(0.4*$200,000 – $2,000 – $10,000)/1000 = $1,360. In contrast, an older taxpayer would pay 0.5*20*(0.4*$200,000 – $2,000)/1000 = $780.

3.2 Treatment

As discussed above, our unique data include details on local property tax exemptions for county, county schools, city schools, and selected cities. The unit of observation for our outcomes is the county. We must therefore aggregate our jurisdiction-level exemptions data to the county level. In practice, we use two measures of treatment across jurisdictions within a county.

The first measure is a simple housing unit weighted average of indicator variables denoting any treatment in the county and selected cities at time *t*. The county indicator equals one if either the county or the county school district has an aged-based property tax law. The city indicator equals one if either the city or its independent school district has such a law. We then aggregate these dummies up to the county level. If no jurisdiction (for which we have exemption data) within county *j* has an age-based exemption at time *t*, then this measure is equal to 0. This measure is equal to 1 if either the county or the county school district has an age-based property tax exemption at time *t*, with no income test. In cases where there are city but no county-wide age-based exemptions, we use the housing unit weighted average of the city and county indicators, giving a measure on the unit interval. Additionally, in cases where there is an income test, we further assigned the treatment to the unit interval, using the proportion of the state's population meeting the income test in that year. (Using the state's population assures that the treatment is exogenous to the local demographic composition.) Thus, for example, if the county jurisdictions had no age-based exemption but the county had a city, with half the county's population, with an exemption that included an income test which half the state's population would meet, we would assign the county a treatment value of 0.25 = 0.5*0.5.

Our first measure has a straightforward interpretation as the weighted average of households in county *j* at time *t* that reside in a jurisdiction with an age-based property tax exemption (i.e., the housing unit weighted dosage of any treatment in the county). However, it does not adjust for the intensity of the treatment. For example, the treatment indicator equals one for a county

with a county school district exemption and no county government exemption. If the county government adopts an age-based exemption in the subsequent period, then this measure does not change to reflect the increase in benefits associated with the county exemption.

In order to represent the intensity of age-based property tax exemption in each jurisdiction, we also consider the housing unit weighted ratio of simulated average property taxes for households under 65 and over 65. We first simulate the average tax for households aged under 65 and over 65 for each jurisdiction and year in our sample, as described in more detail below. We then find the county average for each age group as the housing-unit weighted average across the county and any included cities. Our final measure is the negative of the ratio of the over-65 average simulated property tax bill to the under-65, such that the measure is on [-1, 0] and increasing in the discount for older households.

We simulate the average tax for households in each covered taxing jurisdiction as follows. First, we randomly sampled 1,000 households residing in Georgia from the IPUMS micro data for each of the years 1970, 1980, 1990, 2000, and 2010. Next, we calculate each individual's property taxes, for each of the tax jurisdictions, after applying the various state and local property tax exemptions for which the household is eligible, and combining property taxes across jurisdictions (county, city, school district) into the property tax bill. In calculating these taxes, we assume each household takes the most generous exemption from the state or the local jurisdiction for which they meet the eligibility criteria. In other words, if the household is a veteran and over 65 living in a jurisdiction with property tax exemptions for both, then we assume that the household takes the more generous of the two exemptions. We allow the combination of two exemptions as long as the specific exemptions allowed it. That is, we calculate the household's property tax in each jurisdiction assuming that the household understands the optimal exemption choices for minimizing their property tax bill and that households take the necessary steps to take advantage of the optimal choice.[4]

[4] One potential concern is that households do not actually take the steps necessary to realize their exemptions. As discussed in Banzhaf, Mickey, and Patrick (2016), our analysis of the take-up rate in the Georgia county offering the most generous exemption indicates that approximately 96% of households get their exemption. However, we acknowledge the potential for error in that calculation as well as the possibility that take-up rates are a function of the generosity of the benefit. We believe take-up rates between

Because house values, assessment ratios, and millage rates are likely endogenous in our context, we use "typical" values for these variables across all jurisdictions. We calculated the typical house value for each decade by aggregating county value level data and taking the mean. The assessment ratio to determine the taxable amount for a house value was standardized to 40%, the legal ratio set by the state[5]. We set the typical millage rate as the housing-unit weighted mean of all jurisdictions in the state in 2000, or 13.2 mills.

Using the simulated property taxes of each household for each jurisdiction in each year, we found the average tax for each jurisdiction-year pair for two groups: those households with heads under 65 years old and households with heads 65 or older. This effectively tells us how generous the exemptions are for older households compared to younger. We then aggregated the average property taxes for the two groups across jurisdictions in the county using city-county housing unit weights. Finally, we take the negative of the ratio of the weighted average bill for households 65 or older to the weighted average bill for households under 65 and use this as our intensity-adjusted measure of treatment.

3.3 Trends in Age-Based Property Tax Exemptions

Table 2 presents the percentage of each jurisdiction with an age-specific property tax exemption in the four decades that we study. It reveals two important patterns. First, although all types of local governments in Georgia offer age-based property tax exemptions, school districts are much more likely to do so than counties or municipalities. For example, in 2010, 54.7% of county school districts and 61.5% of city school districts offered such exemptions compared to 41.5% of counties and 36.9% of cities. Second, regardless of jurisdiction type, age-targeted tax exemptions among Georgia's local governments have increased over time. Indeed, only the rare local government offered them at the start of our analysis period in 1970. The next two decades saw a rapid increase in the share of jurisdictions with some sort of age-based exemption; and, the percentage roughly doubled from 1990 to 2010.

90%-100% to be reasonable, which is consistent with a 1990's study by the AARP that found take-up rates of approximately 90% for homestead exemptions (Baer 1990).

[5] O.C.G.A. 48-5-7 set the assessment ratio at 40% for all Georgia tax jurisdictions. However, several jurisdictions were grandfathered in at ratios other than 40%.

Figure 1 depicts trends in our two treatment variables over time. The solid line shows the proportion of all people (not just those over 65) who live in a jurisdiction with some age-based property tax exemption. The proportion increases from 0.01 in 1970 to 0.59 in 2010. The dashed line shows the population-weighted average of our tax ratio treatment (i.e. the negative of the ratio of the average tax paid by somebody over 65 to somebody under 65). It increases from -0.998 (very close to the lower bound of -1) to -0.68. See Banzhaf, Mickey, and Patrick (2016) for additional discussion of these trends.

3.4 *Household Types and Housing values*

We analyze our outcomes at the county level due to the availability of Census data over time on household types and housing values. We use the 1970, 1980, 1990, and 2000 decennial Censuses as well as the 2008-2012 ACS data for 2010.[6] Table 3 Panel B summarizes the sample counties' population, household types, and housing values across the years in our panel. Our sample counties reflect the general trend towards of growth in the Sunbelt over the period, with the average county in our sample seeing consistent decadal increases in population and households. The average share of the population aged 65+ increases in the early periods, but remains relatively stable over the later periods and peaks in 2010. Older households represent a larger share of owner-occupied housing units than population share throughout our sample, with their share rising until it peaks in 2000 and then falling slightly in 2010.

Perhaps most interesting, though, is the trend in mean housing values by age over the sample period. The mean value of homes occupied by older households is lower than the mean value of homes occupied by homeowners under 65 for most periods in the sample. This difference is consistent with the notion that older households locked into the smaller housing stock of earlier decades, or that they downsize after their children leave home. However, the gap between the mean value reported by older and young households is shrinking over time. By 2010, the average county in our sample has older homeowners occupying housing valued higher than their under 65 counterparts. This pattern suggests changes in the housing stock consumed by older households

[6] The Census changed the universe over which some data were collected as well as the data points collected over the sample period. We used additional data whenever available to increase comparability over time.

relative to younger households over time.

4. Results

4.1 *The Older Homeowner Effect*

Table 4 reports the results of from six separate regressions of the (log) number of households by type. Column (1) reports results for the specification in Equation (1), with Year X Owner and Year X Older effects replacing the basic owner and older effects. Column (2) further adds exemption-year and exemption-county fixed effects. Column (3) adds county-age, county-owner, and year-age-urban status fixed effects to the specification in Column (2). The latter variable controls for changes over time in age patterns by urban/rural counties. Panel A uses the housing unit weighted average of indicator variables denoting any age-based property tax exemption in the county and covered cities. Panel B uses minus the ratio of over 65 to under 65 simulated property taxes as the measure of the age-based property tax exemption treatment.

Table 4 indicates a statistically significant effect in the quadruple difference from the policy, with an effect of about 0.45 log points when using the aggregation of policy indicator variables as the treatment and about 0.63 log points when using the simulated tax ratios. The estimates are robust to specification. Although these coefficients may seem surprisingly large, interpreting these quadruple differences requires caution. These estimates do not imply population changes of this magnitude; they imply that the difference-in-differences effect of the exemptions for older owners differs from older renters by about 50% more than the corresponding difference between younger owners and younger renters. Under slightly weaker identifying assumptions, we could identify these two effects separately. Then the effect on population by tenure (older vs. renter) for younger households can be read from the third row of the table. It shows a *decrease* of 0.11 to 0.53 log points. The relative increase on tenure for older households comes from the first row. Adding the two together would give the total effect on older households, which remains positive. Additionally, the magnitude of the estimates must be interpreted as a change from 0 to 1 in a variable which typically lies at the interior of the unit interval. So, the estimates imply that, for example, a 10% increase in the number of older households qualifying for an exemption, would lead to a 4 to 6 percent increase in the number of older owners, relative to the change in the other groups.

Table 5 indicates mixed results when we allow for county-by-demographic group time

trends. The effect is about a 2 percent change in Panel A of Table 5, and not statistically significant. In Panel B, using the simulated tax ratio, the effect is 69 percentage points, roughly equivalent to the 0.62 log points from Table 4.

4.2 *The Housing Consumption Effect*

Tables 6 and 7 present estimates of the change in counties' (log) mean housing values by age and percentage change in mean housing values by age, respectively. Column (1) reports results for the specification in Equation (1). Column (2) replaces the county and decade fixed effects in Equation (1) with exemption-year and exemption-county interactions. Column (3) adds county-age, year-age and year-urban status interactions to the specification in Column (2). (Note we no longer include year-age-urban, as we no longer have renters in the data, and little variation would remain when interacting age with year and a spatial variable.)

The results suggest that property tax exemption also increases housing consumption by older households, albeit the effect appears weaker than the combined effects on location choice and tenure. Table 6 Panel A Columns (1) and (2) report a 13 log-point increase in the mean house value reported by older households from an age-based property tax exemption for all eligible households in the county. This increase is net of the change in mean housing values for younger households in the treated counties and the change in untreated counties. Panel A Column (3) indicates an less precisely estimated increase of about 5 log points. Using the simulated tax ratio as our measure of treatment (Panel B) produces similar effects, ranging from 10 to 13 log points.

Table 7 reveals a similar pattern for our estimates of the percent *change* in counties' mean housing values by age, with mean housing values increasing by approximately 8 percent using the housing unit weighted indicator of treatment in Panel A Columns 1 and 2 and 41 percent using the simulated treatment measure in Panel B Columns 4 and 5. Columns 3 and 6 indicate a decrease in the percent change when we add additional controls for decade-by-age and decade-by-urban effects, although these estimates are less precisely estimated.

The results in Tables 6 and 7 generally suggest that the reductions in the user cost of housing conferred by age-based property tax exemptions effect older households' decision on the intensive margin as well as the extensive margin. Our results, however, do not tell us whether the increase in housing consumption occurs through purchases of more housing capital than households' otherwise would consume or through foregone liquidation of current homes. The latter may

be welfare enhancing to the extent that the foregone liquidations are prevented moves by older households that value their homes more than the marginal buyer (Shan 2010).

4.3 *The Sorting Model*

Table 8a shows the estimated parameters of the sorting model described in equation (3). It shows all coefficients for the policy are of the expected sign and statistically significant, including the main treatment variable for older households when choosing owner-occupied units. Younger owners also are attracted to the policy, which makes sense if they are forward looking. The parameters are in utils, which are hard to interpret in isolation.

Accordingly, Table 8b simulates a counterfactual scenario in which Cobb County had not introduced their generous policy of 100% tax exemptions on school taxes, and had instead treated older households on par with younger ones. The first two columns use the utility parameters from Model A in Table 8A, the last two use Model B. Although we do not know the supply elasticity, nor have we estimated the price elasticies of demand, we can still bound the population changes. At one end, we can assume perfectly elastic supply, so there are no price changes. At the other end, we can assume perfectly inelastic housing supply and assume the price elasticities are the same for all households; then relative population proportions among types and tenure status would be the same as the perfectly elastic case, but total population would be constant.

We predict large decreases in the population of older owners, from 7,600 to 11,700 households depending on the model, or 31% to 54%. In most models, young renters decline as well (although the effect depends on the assumed elasticity of housing supply), whereas renters increase slightly, with bigger increases under the assumption of more inelastic supply. However, to put these changes in perspective, the results suggest more modest changes as a percent of overall number of households in the county. For example, in the first column, the predicted decline in older owners represents 3.2% of the county's households. Because we are assuming an inelastic supply of housing in this model, these losses are exactly offset by gains, with an increase in young renters equal to 2.2% of the county's households, an increase in young owners of 0.8% and an increase in older renters of 0.2%. Because they are derived from an equilibrium model, these should be interpreted as long run (~10 year) responses.

5. Conclusions

Age-based property tax exemptions are likely to continue to be an important and controversial policy tool in the current environment of increasing property values, shifting property tax burdens towards residential property, declining property tax bases, and increased pressure for decentralized provision of public goods. Such exemptions have the potential to provide welfare-enhancements as well as to exacerbate public good financing crises. The consequences of age-based property tax exemptions depend upon the extent to which they influence households' location decisions, housing tenure decisions, and housing consumption.

We provide the first evidence on (long-term) changes in household composition and housing consumption attributable to local, age-based property tax exemptions. We find significant increases in older homeowners and in the growth rate of older homeowners from age-based property tax exemptions. Our results suggest that the combined effects of age-based property tax exemption induced migration and housing tenure changes are substantial, with a 44 percent increase in the rate of change of older homeowners from adopting an age-based property tax exemptions above the change for younger homeowners, relative to the associated change for older and younger renters. We also provide evidence that age-based property tax exemptions increase housing consumption among older households.

References

Augustine, Nancy Y., Michael E. Bell, David Brunori, and Joan M. Youngman. 2009. "The Property Tax Under Seige," in *Erosion of the Property Tax Base: Trends, Causes, and Consequences,* eds. Nancy Y. Augustine, Michael e. Bell, David Brunori, and Joan M. Youngman. Cambridge, Massachusetts: Lincoln Institute of Land Policy.

Banzhaf, H. Spencer, Ryan Mickey, and Carlianne E. Patrick. 2016. "Age-Based Property Tax Exemptions in Georgia," *State Tax Notes,* Sept. 26, 2016, pp.1055-60.

Baer, D., 1998. Awareness and Popularity of Property Tax Relief Programs. AARP Public Policy Institute.

Conway, Karen Smith, and Jonathan C. Rork. 2006. "State 'Death' Taxes and Elderly Migration: The Chicken or the Egg? *National Tax Journal* 59(1): 97-128.

Conway, Karen Smith, and Jonathan C. Rork. 2012. "No Country for Old Men (or Women): Do State Tax Policies Drive away the Elderly?" *National Tax Journal* 65(2): 313-56.

Janel Davis. 2010. "Tax breaks for seniors: Can counties afford them?" *Atlanta Journal-Constitution*.

Downey, Maureen. 2013. "Make 62-year-olds pay school taxes," *Atlanta Journal-Constitution,* May 21.

Farnham, Martin, and Purvi Sevak. 2006. "State Fiscal Institutions and Empty-Nest Migration: Are Tiebout Voters Hobbled?" *Journal of Public Economics* 90 (3): 407–27

Gallagher, Ryan M., Joseph J. Persaky, and Haydar Kurban. 2017. "The Growth of Local Education Transfers: Explaining How Older Households Have Supported Schools." *Public Finance Review,* forthcoming.

Hanson, Andrew. 2012. "Size of home, homeownership, and the mortgage interest deduction." *Journal of Housing Economics* 21(3): 195-210.

Langley, Adam H. 2015. "Estimating Tax Savings from Homestead Exemptions and Property Tax Credits. Working Paper. Cambridge, MA: Lincoln Institute of Land Policy.

Onder, Ali Sina, and Herwig J. Schlunk. 2010. "State Taxes, Tax Exemptions and Elderly Migration." *Working Paper*

Seslen, Tracey. 2005. "Property Tax Abatement Programs: Does Relief Really Keep Grandma in Her Home." *MIT Dissertation*.

Shan, Hui. 2010. "Property Taxes and Elderly Mobility." *Journal of Urban Economics* 67:194-205.

Table 1: Summary of Identification Strategy for the Homeowner Effect

	Renter	Owner	Difference (Owner-Renter)
Young	γ_4	$\gamma_4 + \gamma_6$	γ_6
Older	$\gamma_4 + \gamma_5$	$\gamma_4 + \gamma_5 + \gamma_6 + \gamma_7$	$\gamma_6+\gamma_7$
Difference (Older-Young)	γ_5	$\gamma_5 + \gamma_7$	$\boldsymbol{\gamma_7}$

The four upper, left cells represent four jurisdiction-year difference-in-differences for the four demographic categories shown (young renters, young owners, older renters, and older owners). The bottom rows for the first two columns and right-most Column for the first rows represent triple differences. The lower-right represents the quadruple difference.

Table 2. Percent of jurisdictions with age-specific property exemptions, by jurisdiction type and year

Jurisdiction Type	1970	1980	1990	2000	2010
Counties	0.0	3.1	19.5	35.9	41.5
County School Districts	0.6	6.3	33.3	46.5	54.7
Cities	3.6	15.7	19.6	31.3	36.9
City School Districts	3.9	19.2	37.0	53.9	61.5

Table 3. County Summary Statistics

	1970	1980	1990	2000	2010
			Panel A		
Weighted Indicator	0.0048	0.0275	0.155	0.241	0.369
	(0.0470)	(0.113)	(0.247)	(0.309)	(0.396)
Simulated Taxes under 65	136.6	422.1	902.2	1488.7	1979.0
	(14.80)	(50.48)	(106.2)	(175.4)	(251.6)
Simulated Taxes over 65	136.4	350.2	803.7	1228.6	1560.4
	(14.60)	(46.18)	(153.1)	(255.8)	(469.2)
Simulated Tax Ratio	-0.999	-0.831	-0.887	-0.821	-0.784
	(0.0149)	(0.0605)	(0.118)	(0.124)	(0.197)
			Panel B		
Total population	27988.6	34359.2	40743.5	51487.1	73903.2
	(63333.0)	(69744.4)	(83663.8)	(108931.2)	(139963.8)
Share of Pop. 65+	0.0967	0.114	0.125	0.120	0.130
	(0.0227)	(0.0281)	(0.0331)	(0.0336)	(0.0303)
Owner occupied units	4529	7650.5	9665.2	10180.6	17591.9
	(9543.2)	(14040.9)	(18268.0)	(20897.2)	(31989.4)
Owner occupied by 65+	608.3	1543.6	2035.9	2582.3	3914.5
	(1120.3)	(2509.9)	(3301.9)	(4136.8)	(5694.6)
Renter occupied units	2435.8	4120.9	5219.2	5500.4	9156.4
	(6511.8)	(11913.4)	(14220.0)	(15356.1)	(20805.7)
Renter occupied by 65+	231.8	640.7	620.6	644.8	887.1
	(519.5)	(1664.9)	(1523.5)	(1525.1)	(1824.8)
Mean value under 65	12,877.3	35,090.8	62,222.9	103,554.2	151,718.3
	(2770.2)	(8360.1)	(20094.7)	(36960.5)	(52742.1)
Mean value 65+	10,740.0	26,178.0	51,780.1	89,296.9	154,005.9
	(2248.7)	(6021.2)	(16963.9)	(34515.8)	(62374.4)

NOTES: The table reports the mean and standard deviation of household composition and housing values as well as our measure of treatment in the sample of 159 Georgia counties over time.

Table 4. Count of household type quadruple-difference

	Panel A: Exemption Indicator			Panel B: Simulated Tax Ratio		
	(1)	(2)	(3)	(1)	(2)	(3)
Treat. X Older X Owner	0.447***	0.447***	0.447***	0.625***	0.625***	0.625***
	(0.0666)	(0.0677)	(0.0718)	(0.118)	(0.122)	(0.129)
Treatment X Older	-0.737***	-0.737***	-0.212***	-1.426***	-1.426***	-0.412***
	(0.103)	(0.104)	(0.0576)	(0.187)	(0.193)	(0.114)
Treatment X Owner	-0.174*	-0.174*	-0.344***	-0.113	-0.113	-0.523***
	(0.0949)	(0.0965)	(0.0656)	(0.200)	(0.206)	(0.139)
Treatment	0.836***	1.109***	0.0523	1.513***	1.258***	0.871***
	(0.101)	(0.138)	(0.354)	(0.211)	(0.167)	(0.129)
Year FE	Y	Y	Y	Y	Y	Y
Year X Owner FE	Y	Y	Y	Y	Y	Y
Year X Older FE	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
Treatment X Year	N	Y	Y	N	Y	Y
Treatment X County	N	Y	Y	N	Y	Y
County X Older	N	N	Y	N	N	Y
County X Owner	N	N	Y	N	N	Y
Year X Older X Urban	N	N	Y	N	N	Y
Observations	3,180	3,180	3,180	3,176	3,176	3,176
R-squared	0.947	0.955	0.981	0.946	0.953	0.979

NOTES: The table presents results from six separate regressions of the (log) number of each household type. Column (1) reports results for Equation (1), with year X owner and year X older effects replacing owner and older effects. Column (2) replaces the county and decade fixed effects in Equation (1) with exemption-year and exemption-county interactions. Column (3) adds county-age, county-owner, and year-age-urban status interactions to the specification in Column (2). Panel A uses the housing unit weighted average of indicator variables denoting any age-based property tax exemption in the county and covered cities. Panel B uses the inverse of the ratio of under 65 to over 65 simulated property taxes as the measure of the age-based property tax exemption treatment.

Robust standard errors clustered at the county level are reported in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 5. Percentage change in household type quadruple-difference

	Panel A: Exemption Indicator			Panel B: Simulated Tax Ratio		
	(1)	(2)	(3)	(1)	(2)	(3)
Treat. X Older X Owner	0.0186	0.0186	0.0186	0.691***	0.691***	0.691***
	(0.0492)	(0.0502)	(0.0541)	(0.135)	(0.140)	(0.152)
Treatment X Older	0.141***	0.141***	0.161**	-0.0974	-0.0974	0.0231
	(0.0490)	(0.0500)	(0.0778)	(0.0956)	(0.0991)	(0.146)
Treatment X Owner	-0.0270	-0.0270	0.134**	-0.334***	-0.334***	-0.00108
	(0.0331)	(0.0337)	(0.0637)	(0.0869)	(0.0900)	(0.167)
Treatment	-0.122**	-1.600***	0.0504	-0.0549	0.491***	0.327***
	(0.0479)	(0.237)	(0.257)	(0.128)	(0.0735)	(0.104)
Year FE	Y	Y	Y	Y	Y	Y
Year X Owner FE	Y	Y	Y	Y	Y	Y
Year X Older FE	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
Treatment X Year	N	Y	Y	N	Y	Y
Treatment X County	N	Y	Y	N	Y	Y
County X Older	N	N	Y	N	N	Y
County X Owner	N	N	Y	N	N	Y
Year X Older X Urban	N	N	Y	N	N	Y
Observations	2,544	2,544	2,544	2,544	2,544	2,544
R-squared	0.719	0.738	0.768	0.717	0.740	0.771

NOTES: The table presents results from six separate regressions of the decadal percentage change in the population of each household type (using the midpoint formula in the denominator) on the policy values at the beginning of the decade. Column (1) reports results for Equation (1). Column (2) replaces the county and decade fixed effects in Equation (1) with exemption-year and exemption-county Interactions. Column (3) adds county-age, county-owner, and year-age-urban status interactions to the specification in Column (2). Panel A uses the housing unit weighted average of indicator variables denoting any age-based property tax exemption in the county and covered cities. Panel B uses the inverse ratio of under 65 to over 65 simulated property taxes as the measure of the age-based property tax exemption treatment.
Robust standard errors clustered at the county level are reported in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Mean housing value triple-difference

	Panel A: Exemption Indicator			Panel B: Simulated Tax Ratio		
	(1)	(2)	(3)	(1)	(2)	(3)
Treatment X Older	0.128***	0.128***	0.0529*	0.106***	0.106**	0.127*
	(0.0220)	(0.0229)	(0.0300)	(0.0405)	(0.0431)	(0.0665)
Treatment	0.0639*	0.00644	-0.781**	0.202**	0.514***	0.504***
	(0.0384)	(0.125)	(0.376)	(0.0897)	(0.0864)	(0.111)
Older	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Treatment X Year	N	Y	Y	N	Y	Y
Treatment X County	N	Y	Y	N	Y	Y
County X Older	N	N	Y	N	N	Y
Year X Urban	N	N	Y	N	N	Y
Year X Older	N	N	Y	N	N	Y
Observations	1,524	1,524	1,524	1,522	1,522	1,522
R-squared	0.975	0.982	0.986	0.975	0.979	0.984

NOTES: The table presents results from six separate regressions of the (log) mean housing value by age. Column (1) reports results for Equation (2). Column (2) replaces the county and decade fixed effects in Equation (2) with exemption-year and exemption-county interactions. Column (3) adds county-age, year-urban status, and year-age interactions to the specification in Column (2). Panel A uses the housing unit weighted average of indicator variables denoting any age-based property tax exemption in the county and covered cities. Panel B uses the inverse ratio of under 65 to over 65 simulated property taxes as the measure of the age-based property tax exemption treatment.

Robust standard errors clustered at the county level are reported in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 7. Percent change in mean housing value triple-difference

	Panel A: Exemption Indicator			Panel B: Simulated Tax Ratio		
	(1)	(2)	(3)	(1)	(2)	(3)
Treatment X Older	0.0813***	0.0813***	-0.0698*	0.419***	0.419***	-0.152*
	(0.0197)	(0.0205)	(0.0382)	(0.0679)	(0.0739)	(0.0898)
Treatment	-0.131***	-2.713***	-2.691***	-0.501***	-0.404***	-0.0408
	(0.0280)	(0.347)	(0.401)	(0.0637)	(0.0623)	(0.0899)
Older	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Treatment X Year	N	Y	Y	N	Y	Y
Treatment X County	N	Y	Y	N	Y	Y
County X Older	N	N	Y	N	N	Y
Year X Urban	N	N	Y	N	N	Y
Year X Age	N	N	Y	N	N	Y
Observations	1,206	1,206	1,206	1,206	1,206	1,206
R-squared	0.707	0.743	0.792	0.722	0.772	0.812

NOTES: The table presents results from six separate regressions of the percent change in counties' mean housing value by age. Column (1) reports results for Equation (2). Column (2) replaces the county and decade fixed effects in Equation (2) with exemption-year and exemption-county interactions. Column (3) adds county-age, year-urban status, and year-age interactions to the specification in Column (2). Panel A uses the housing unit weighted average of indicator variables denoting any age-based property tax exemption in the county and covered cities. Panel B uses the inverse ratio of under 65 to over 65 simulated property taxes as the measure of the age-based property tax exemption treatment.
Robust standard errors clustered at the county level are reported in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 8a. Sorting Model (Estimated Utility Parameters)

	Panel A: Exemption Indicator	Panel B: Simulated Tax Ratio
Treat. X Older X Owner	0.36894***	0.39650***
	(0.00536)	(0.01009)
Treatment X Older	-0.70251***	1.09914***
	(0.00501)	(0.00939)
Treatment X Owner	0.05506***	0.47968***
	(0.00224)	(0.00389)
Treatment	0.40400***	0.43116***
	(0.00225)	(0.00396)

Table 8b. Simulated Population Changes for Cobb County, from Sorting Model

	Model A: Perfectly Inelastic Supply	Model A: Perfectly Elastic Supply	Model B: Perfectly Inelastic Supply	Model B: Perfectly Elastic Supply
Change Older Owners	-7,648	-8,896	-7,999	-11,682
(Pct Change)	-31.6%	-37.7%	-34.0%	-53.9%
(As Pct of Co Pop)	-3.2%	-3.8%	-3.5%	-5.0%
Change Young Owners	+1,843	-6,263	-12,554	-37,712
(Pct Change)	+1.4%	-4.9%	-9.0%	-29.7%
(As Pct of Co Pop)	+0.8%	-2.7%	-5.4%	-16.3%
Change Older Renters	+526	+95	+1,500	+111
(Pct Change)	+7.8%	+1.4%	+22.7%	+1.9%
(As Pct of Co Pop)	+0.2%	<0.1%	+0.6%	<0.1%
Change Younger Renters	+5,278	+179	+1,953	+1,058
(Pct Change)	+6.5%	+0.2%	+22.1%	+1.4%
(As Pct of Co Pop)	+2.2%	<0.1%	+8.2%	+0.5%

Figure 1. Population-Weighted Treatment over Time