The Influence of Household Formation on Homeownership Rates across Time and Race

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Abstract

Homeownership rates equal the number of households that own homes divided by the number of households in the population. Differences in the propensity to form a household, therefore, may contribute to changes in homeownership rates over time in addition to longstanding racial gaps in homeownership. We examine these issues on an age-specific basis using data from the 1970 to 2000 public use micro samples (PUMS) of the decennial census.

Results indicate that lower headship rates tend to reduce homeownership rates. This pattern is most notable for individuals in their early and mid-20s. For these individuals, declining headship rates between 1970 and 2000 reduced homeownership rates by 3 to 5 percentage points. Moreover, year-2000 African American headship rates *narrow* white-black gaps in homeownership by roughly three percentage points, while year-2000 Hispanic headship rates *widen* white-Hispanic gaps in homeownership by two to three percentage points. Thus, controlling for differences in headship behavior, white-black homeownership gaps are somewhat more severe than previously recognized, but the reverse is true for white-Hispanic gaps.

1. Introduction

In recent years, much of U.S. Federal housing policy has been dominated by two complementary goals: to push aggregate homeownership rates higher, and to narrow persistent and large gaps in white versus minority rates of homeownership. In November of 1994, President Clinton stressed these goals in a letter to HUD Secretary Henry Cisneros.[1] President Bush also has focused on these issues, including a statement released on June 18, 2002, and related policy initiatives.[2] Both Presidents Clinton and Bush have clearly pushed for higher aggregate homeownership rates and a narrowing of the racial gap in homeownership.[3] Against this backdrop, by some estimates, aggregate homeownership rates rose 3.5 percentage points in the 1990s to roughly 67.5 percent by the end of the decade, a historically high level.[4] Nevertheless, huge racial gaps in homeownership persist. In the year 2000, the white-black and white-Hispanic gaps in homeownership rates both were in excess of 25 percentage points.

This paper examines a largely overlooked feature of homeownership rates that in principle could help to explain changes in aggregate homeownership rates as well as racial gaps in homeownership. Homeownership rates are, by definition, equal to the number of households residing in owner-occupied housing divided by the total number of households, or equivalently, the number of household heads. In this context, a household head refers to whether an individual is identified in the Census as the head of his or her household. Thus, for example, the spouse of a household head would be considered a member of the household, but not a Head.

Bearing these definitions in mind, differences in homeownership rates among populations (e.g. white versus African American) can arise from differences in the *numerator* – the propensity to own conditional on having formed a household – differences in the *denominator* – the propensity to form a household – or both. Although conceptually clear, the possibility that differences in household formation rates may have contributed to changes in homeownership rates and to longstanding racial gaps has been almost entirely ignored in the literature.[5]

Although the literature has largely overlooked the role of household formation when examining housing tenure, there are some important exceptions. Two papers study the joint choice of household type and tenure choice (Borsch-Supan (1986), Haurin, Hendershott and Kim (1994)). An important feature of these studies is to control for possible sample selection in the estimation of tenure choice; that is, they simultaneously account for the choice of household structure and tenure choice. However, neither study addresses the question we pose here: what is the effect of differences in household formation on aggregate homeownership rates and racial gaps in homeownership?

Hendershott (1987) also studies the impact of household formation and the aging of the population on homeownership rates in the 1960-1985 period. He concludes that increases in headship associated with aging of the population substantially boosted homeownership rates over the 1960 to 1985 period.[6] A limitation of Hendershott's work, however, is that he does not fully separate out the influence of changes in headship arising from aging of the population versus changes in age-specific headship rates.

Drawing on these and other studies, our analysis will be broadly structured as follows. With each passing year, each adult (age 21 to 64) ages and faces a recurring choice with respect to his or her living arrangement and housing tenure. The individual can choose to be a household head or not. If the individual chooses to be a household head, then the individual further chooses whether to own or rent the home. Specified in this manner, the number of owner-occupied units is exactly equal to the number of Heads choosing to own.[7] In practice, we implement this approach by estimating our models separately for each individual age group from age 21 on up to 64, for each decade in our sample: 1970, 1980, 1990, and 2000. This is important because headship behavior differs sharply over the life-cycle.[8]

Our model of the relationship between household formation and homeownership is estimated using the public use micro sample (PUMS) data for each decade of the decennial Census from 1970 through 2000. These data were downloaded from the IPUMs website (Integrated Public Use Micro Sample) at www.ipums.org. The huge size of these data sets enables us to examine the influence of headship behavior on homeownership rates on an age-specific basis. Using decomposition methods, we evaluate the degree to which differences over time in the propensity for household formation account for

differences in homeownership rates across decades. A similar exercise decomposes racial differences in homeownership rates.

Summary measures indicate that age-specific homeownership rates changed little from 1990 to 2000. This is consistent with evidence reported by Eggers (2004, Tables 1 and 2) when he restricts his analysis to the relationship between household age and the propensity for homeownership using the 1990 and 2000 Censes.[9] These findings also are in contrast to the much advertised increase in aggregate homeownership rates over this period. Looking over a longer time frame, from 1970 to 2000, age-specific homeownership rates fell by 5 percentage points for individuals from their mid-20s to mid-30s. That difference diminished for older groups, reaching zero for individuals in their mid-40s, and then rose further to 10 percentage points for individuals in their 60s. We find that changes in headship behavior over time contributed little to these observed patterns. The primary exception is for individuals in their early and mid-20s. Among these individuals, lower headship rates in 2000 relative to 1970 depressed homeownership rates by 3 to 5 percentage points. This accounts for much of the observed decline in homeownership for this group over the 1970 to 2000 period. This also indicates that many of the households that would have formed in the year 2000 had headship rates been higher would have been owner-occupants.

Additional findings indicate that for the year 2000, black and Hispanic homeownership rates are sensitive to differences in headship behavior relative to white individuals, although primarily only for individuals in their 20s, 30s, and 40s. Among African Americans, white-black differences in headship behavior serve to narrow the observed white-black gap in homeownership rates by roughly three percentage points. Among Hispanics, white-Hispanic differences in headship behavior served to widen the observed white-Hispanic gap in homeownership rates by two to three percentage points. In both cases, lower headship rates are associated with lower homeownership rates: African Americans have higher headship rates than whites, and whites have higher headship rates than Hispanics. Once again, this finding suggests that many of the households that would have formed had headship rates been higher would have been owner-occupants. Moreover, controlling for headship behavior, white-black

homeownership gaps are somewhat more severe than previously recognized, while the reverse is true for white-Hispanic gaps in homeownership. In contrast, controlling for headship behavior has little effect on white versus Asian homeownership rates.

To clarify these and additional results we proceed as follows. Section 2 develops the empirical model used to estimate the influence of headship on homeownership. This section also clarifies the manner in which the traditional approach to studying homeownership can be represented as a special and restrictive case of our more general approach. Section 3 describes the variables and data used in the analysis. Section 4 plots the age-specific homeownership and headship rates for each decade. This section also presents simulations of homeownership rates that would have prevailed if headship behavior had remained as in other decades (coefficients on the model covariates are provided in the Appendix). Section 5 repeats this analysis focusing on racial gaps in the year 2000. Section 6 concludes and also discusses policy implications.

2. Empirical Model

We begin with a brief review of how Census defines both households and household heads. By definition, each household has a single Head as identified by the Census, and each Head belongs to a household.[10] A household includes all individuals living in a given housing unit, and may consist of a single individual, a family, or a group of unrelated individuals. The number of households is therefore equal to the total number of occupied housing units except for group living units (e.g. prisons, dormitories, nursing homes, etc.), which are excluded from the count of housing units.[11]

Having defined households and Heads in this manner, our primary goal is to isolate the impact of headship behavior on homeownership rates. To be precise, we estimate the degree that homeownership rates would differ if individuals formed households and became Heads in a manner different from what has actually occurred. To do this, we must identify the propensity of each individual in the population to become a household head under various scenarios (e.g. 1980 versus year 2000 conditions). In addition, we must also identify the propensity of each individual in the population to favor homeownership,

regardless of his or her actual headship status. This is because upon simulating headship, each individual in the population is assigned a probability of being a Head and as such, all individuals contribute to the predicted homeownership rate in a manner that will be clarified shortly. We proceed by comparing the traditional approach to estimating homeownership to a model that takes into account headship decisions.

2.1 The Traditional Approach: Homeownership With Exogenous Headship Decisions

The traditional approach to studying homeownership rates treats household formation and an individual's headship status as exogenously given. Homeownership is then estimated over all households – or equivalently – over all household heads. Accordingly, we begin by denoting $P_{Own|Head}$ as the likelihood that a given individual is an owner-occupier conditional on being a household head. Averaging this conditional probability over all household heads in the population, $i = 1,\ldots,H$, gives the aggregate homeownership rate:

$$Homeownership\ Rate \equiv \frac{1}{H}\sum_{i=1}^{H} P_{Own|Head_i} \ . \tag{2.1}$$

This is the measure of homeownership that existing studies in the literature use when estimating homeownership.

From Bayes Law, we can re-write the conditional probability of homeownership as,

$$P_{Own|Head} = \frac{P_{Own,Head}}{P_{Head}} \ . \tag{2.2}$$

In (2.2), $P_{Own|Head}$ is defined as above, $P_{Own,Head}$ is the joint probability of being both a household head and an owner-occupier, and P_{Head} is the unconditional probability of being a household head. Substituting into (2.1) yields

$$Homeownership\ Rate \equiv \frac{1}{H}\sum_{i=1}^{H} \frac{P_{Own,Head_i}}{P_{Head_i}} \ . \tag{2.3}$$

The aggregate homeownership rate can also be expressed as the average over all household heads of the joint probability of headship and owning divided by the unconditional probability of headship.

Writing the homeownership rate as in (2.3) makes clear that the ownership and headship decisions both contribute to the overall homeownership rate. This feature is generally overlooked in existing studies of homeownership rates. That is because in treating headship status as exogenously given, traditional studies of homeownership implicitly assume that the ownership and headship decisions are independent. Under those conditions, the joint probability of ownership and headship simplifies to the product of the unconditional probabilities,

$$P_{Own,Head} = P_{Own} \cdot P_{Head} \,. \tag{2.4}$$

Substituting into (2.3) the aggregate homeownership rate simplifies to

$$Homeownership\ Rate = \frac{1}{H}\sum_{i=1}^{H} P_{Own_i} \,, \tag{2.5}$$

where (2.5) is the average over all household heads of the unconditional probability of homeownership and does not depend on the headship decision.

A key point to recognize in (2.5) is that when the headship and homeownership decisions are independent, the set of ownership propensities, P_{Own}, for household heads is a random sample of ownership propensities from the broader set of *all* individuals in the population, j = 1,…,*J*, not just the *H* household heads. Accordingly, under the assumption that the headship and homeownership decisions are independent, headship behavior has no effect on homeownership rates. As such, differences in headship behavior over time and across race could not account for changes in aggregate homeownership rates or racial gaps.

2.2 Homeownership Rates With Endogenous Headship Decisions

The traditional approach to studying homeownership is convenient. But there is good reason to believe that ownership and headship decisions are not independent of one another. For example, an

individual with unusually strong tastes for homeownership may choose to live in group quarters or a parents' home rather than forming his or her own household. This would allow the individual to reduce costs and accumulate savings for future home purchase. Alternatively, individuals with unusually weak preferences for homeownership may accelerate their departure from a parents' home or group quarters because rental housing requires little wealth up front. For these and related reasons, household heads may have atypical preferences for homeownership relative to the broader population. As such, estimating homeownership over household heads without taking their select status into account could yield biased estimates of the unconditional propensity for homeownership. In the expressions above, this implies that $P_{Own|Head}$ may differ from P_{Own}.

To address this issue, consider an alternative measure of the aggregate homeownership rate. As noted earlier, the homeownership rate is equal to the ratio of the number of household heads that own divided by the number of heads:

$$Homeownership\ Rate = \frac{\#\,Household\ Heads\ that\ Own}{\#\ Household\ Heads} \tag{2.6}$$

Writing the aggregate homeownership rate in this fashion has a number of implications for estimation and interpretation of homeownership rates. In particular, note that both the numerator and denominator of (2.6) are defined over all individuals in the population. This is because each individual has some probabililty of being a household head, and also a household head that owns.

Suppose now that consistent estimates of the numerator and denominator of (2.6) could be obtained. To be precise, let P_{Head} be the probability that a given individual is a household head, and let $P_{Own,Head}$ be the probability that the individual is both a household head and an owner. Averaging over all individuals j = 1,…,J, gives,

$$Percent\ Head \equiv \overline{P}_{Head} = \frac{1}{J}\sum_{j=1}^{J} P_{Head_j}\ , \tag{2.7}$$

and

$$Percent\ Head\ and\ Own \equiv \overline{P}_{Own,Head} = \frac{1}{J}\sum_{j=1}^{J} P_{Own,Head_i} \ . \tag{2.8}$$

Substituting from (2.7) and (2.8) into (2.6), the homeownership rate can be expressed as

$$Homeownership\ Rate \equiv \frac{\frac{1}{J}\sum_{j=1}^{J} P_{Own,Head_i}}{\frac{1}{J}\sum_{j=1}^{J} P_{Head_j}} \ . \tag{2.9}$$

Expressions (2.5) and (2.9) both represent the aggregate homeownership rate but differ in certain key respects. Most important for our purposes, (2.9) is defined over *all* individuals, not just the household heads. In addition, (2.9) clearly depends on both the propensity for headship and also the joint propensity for both headship and ownership status. For these reasons, (2.9) can be used to simulate the impact of changes in the propensity for headship on aggregate homeownership rates.

2.3 Bivariate probit model with sample selection

In order to use (2.9) to simulate the impact of changes in headship propensities on homeownership rates, it is necessary to estimate P_{Head} and $P_{Own,Head}$ for each person in the population. Moreover, our estimate of $P_{Own,Head}$ must allow for the possibility that the headship and ownership propensities are not independent for reasons discussed above. We proceed by estimating a 3-celled bivariate probit model of homeownership and headship drawing on all individuals in the population, not just the household heads. The headship equation is estimated over all individuals, while the parameters governing an individual's propensity for homeownership are simultaneously estimated over just the household heads controlling for sample selection. Details are as follows.

Define an unobservable index I_{own} that represents the intensity of desire to own a home,

$$I_{own} = xb + e_{own} \ . \tag{2.10}$$

This equation determines an individual's preferred tenure status. Elements of x include all characteristics of the individual's household that influence the individual's tenure preferences.[12]

The index I_{own}, of course, is not observed regardless of actual housing tenure status. Instead, for just the household heads, we observe the discrete housing tenure decision (OWN) corresponding to (2.10),

$$I_{own} > 0 \Rightarrow \text{OWN} = 1 \text{ , } \textit{own home} \tag{2.11}$$

$$I_{own} < 0 \Rightarrow \text{OWN} = 0 \text{ , } \textit{rent home}$$

where OWN equals 1 if the head owns and 0 if the head rents.

Denote a second index that governs whether a given person chooses to be a household head or not, I_{Head},

$$I_{Head} = xc + e_{Head} \text{ .} \tag{2.12}$$

The discrete observable realizations corresponding to (2.12) are given by

$$I_{Head} > 0 \Rightarrow \text{Head} = 1, \textit{ becomes a household head} \tag{2.13}$$

$$I_{Head} < 0 \Rightarrow \text{Head} = 0 \text{ , } \textit{does not become a household head}$$

where Head equals 1 if the individual chooses to be a household head and 0 otherwise.

In viewing expressions (2.10-2.13), it is important to recognize that whereas Head is observed regardless of whether OWN takes on a value of 1 or 0, housing tenure preferences are observed only for individuals that become household heads: Head equal to 1. As is well established in the discrete choice literature (e.g., Maddala 1983), if e_{own} and e_{Head} are uncorrelated, observing OWN only for Head equal to 1 presents few difficulties. Assuming e_{own} follows a unit normal distribution, one could obtain unbiased and consistent estimates of *b*, the housing tenure preferences in (2.10), by running a probit model over just that portion of the sample for which Head equals 1. More generally, however, common omitted variables that influence both the likelihood that Head equals 1 and OWN equals 1 would cause estimates of *b* to suffer from sample selection bias given the endogenous character of the sample selection procedure.

To avoid sample selection bias, it is necessary to control for correlation between the error terms in the two latent indexes, e_{Head} and e_{own}.[13] Accordingly, we assume that e_{Head} and e_{own} follow a bivariate standard normal distribution with mean zero and covariance $\sigma_{Head,Own}$.[14] Then the log likelihood function (*L*) for this model is given by,

$$L = \sum\{(1\text{-Head})\cdot\log[F(-xc)] + \text{Head}\cdot\text{OWN}\cdot\log[G(xb,xc,\sigma_{\text{Head,Own}})] \tag{2.14}$$

$$+ \text{Head}\cdot (1\text{-OWN})\cdot\log[G(-xb,xc,-\sigma_{\text{Head,Own}})]\},$$

where F(·) and G(·) are the standard unit and bivariate normal distributions, respectively, and the log-likelihood function is evaluated separately for all observations in the entire sample, $i = 1, \ldots, J$.[15] Note that whereas each observation in the sample contributes to the identification of c, the parameters governing whether an individual becomes a household head, only those individuals for which the observed value of Head is equal to 1 contribute to identification of b, the parameters governing housing tenure preferences. In addition, sample selection effects are controlled for because the covariance between e_{Head} and e_{own} appears in the last two bracketed terms of (2.14) and is estimated simultaneously along with b and c. Thus, (2.14) provides unbiased and consistent estimates of b.[16]

3. Variable Selection and Data

3.1 Headship Variables

Previous studies in sociology and economics have argued that home-leaving and household formation among youths increase with age, marriage, and the presence of children in an individual's family (Goldscheider and Goldscheider 1993; Goldscheider and DaVanzo 1989; Goldscheider et al. 1993; Haurin et al. 1993, 1997). In explaining these patterns, authors typically appeal to social norms that encourage U.S. youths to leave home in their early 20s, and that married couples and youths with children demand greater privacy.[17]

Among individuals living outside of their parents' homes, marriage, partnering (defined as unmarried couples living together), and divorce, have a further direct impact on the number of households in the population: marriage, for example, merges two households into one. For the broader population (i.e., not just youths), Masnick (2001a, 2001b) also finds that the age distribution of the population has a important impact on headship rates, as do marriage/partnering, divorce, and remarriage. Masnick argues that changes in these factors in recent decades have increased the headship rate. For example, the share of

households comprised of a single individual increased from 13.3 percent in 1960 to 25.8 percent in 2000. Between 1970 and 1980, the ratio of divorces to marriages doubled, thereafter remaining constant, while the rate of remarriage has fallen over time. However, the amount of partnering has doubled since 1960, partly offsetting the decline in the percentage of the population that has never married.

On theoretical grounds, Garasky et al. (2001) argue that blacks and Hispanics face discrimination in the housing market, limiting their choice of dwellings. Relative to white youths, this limitation may delay minority youth home-leaving and increase the likelihood that minority youths live in groups after leaving the parents' home. However, empirical studies report mixed results with regard to the influence of race on household formation. In a study with a large number of controls for economic, social, and demographic factors, Garasky et al. (2001) found that black youths are more likely to live with their parents than are white youths, but black youths are less likely to live in large groups if they live apart from parents.[18] These two effects have offsetting impacts on the black headship rate. In general, studies of household formation do not find substantial difference between whites and Hispanics in household formation tendencies.

The cost of independent living is also thought to be an important determinant of headship (e.g. Haurin et al. (1993, 1997), Ermisch and DiSalvo (1997), and Ermisch (1999)), where this cost is measured by the cost of both renting and home purchase in the local area. Moreover, particularly with regard to youth headship rates, Ermisch (1999) shows that when housing demand is price inelastic, as has been widely established in the empirical literature on housing demand, higher housing costs encourage youths to remain longer with their parents. Garasky et al. (2001) extend this model to examine whether youths tend to group-up or live alone upon leaving their parents' homes. They argue that the greater a youth's income and the lower the housing prices, the higher the proportion of youths who will choose to live alone. These arguments suggest that youths with low earnings ability and youths living in high housing cost locations will be less likely to form their own households, either because they remain longer in their parents' home, or because they live in groups outside of their parents' home.

Drawing on the literature described above, when estimating the headship model we control for all of the following variables for each individual in the sample:

Race and Gender	**Family Structure**	**Census Region**	
Female	Age of individual	New England	East-South
Black	Currently Married	Middle Atlantic	West-South
Asian	Married At Least Once	East-Midwest	Mountain
Hispanic	Children < 18 in household	West-Midwest	Pacific
Other Race		South-Atlantic	
Education	**Disability Status**	**Immigrant Status**	
Less than High School	Disability that limits work	Natural citizen or > 20 years in U.S.	
High School		Years in the U.S. zero to 10 (1 for yes, 0 for no)	
Some College or more		Years in the U.S. 11 to 20 (1 for yes, 0 for no)	

Race, gender, and family structure are included in the covariate list for the reasons outlined above. Census region is included to control for region-wide differences in housing costs and also differences in social norms. Absent from the covariate list is income even though an individual's income clearly affects the ability to establish a household. However, income is also endogenous: a 20 year old with a very high "family" income, for example, likely is still living at home with the parents, while a 20 year old with little family income is more likely to have already left the parents' home and be a household head. For this reason, Haurin et al. (1994) focus on an individual's *potential* income, or human capital, when studying household formation. Potential earnings are captured at least in part by education, disability status, and immigrant status in particular, in addition to the other variables included in the model.

3.2 Homeownership Variables

A huge literature exists on the determinants of homeownership (see Haurin et al (2003) for a recent survey). Drawing on that literature, we include all of the variables noted above in the homeownership model. In addition, we also include family income because, conditional on headship status, we can treat a household head's income as exogenous relative to their housing tenure status. In all of the models, family income is entered in current as opposed to constant dollars.

3.3 Data

Data for the analysis were drawn from the IPUMs website, www.ipums.org, for each decade of the Decennial Census, 1970, 1980, 1990, and 2000. For 1970 and 2000 we used the 1-percent sample. For 1980 and 1990 the 5 percent samples were available and were used. For all summary measures and simulations, when measuring person specific variables such as the headship rate, the "person" weights provided in the IPUMs were used to ensure that the results were representative. When measuring household specific variables, such as the actual homeownership rate, "household" weights were used to ensure that results were representative.[19] In all cases, when estimating the parameters of the bivariate probit model, sampling weights were not used given the assumption that the covariates are exogenous.

A strength of the PUMS data is the huge sample size, especially the 5 percent samples. As an example, for the 1990 sample, there are 190,778 individuals of age 40. This is indicative of the very large samples available for the other age groups and decades. Because these data are so vast, this enables us to estimate the probit model separately for each individual age group from age 21to 64 for each decade from 1970 through 2000. The analysis is restricted to individuals under age 65 for two reasons. First, individuals in the age 21 to 64 group are comprised primarily of individuals who are potentially active in the workforce. Second, disability status is only available for individuals under age 65 in the 1970 survey.

3.4 Model Coefficient Estimates

Roughly twenty-five variables are included in each of the headship and homeownership equations, as outlined in the variable list above. Because these equations are estimated separately for each decade and each age group from age 21 through 64, this generates over 2,000 coefficients. The very large number of estimated coefficients adds a tremendous richness to our analysis, and is made possible by the huge sample sizes in the PUMS data. The large number of coefficients also complicates presentation. Accordingly, the Appendix provides plots of covariate partial derivatives for all of the

sociodemographic variables in the headship and homeownership models for each age group and decade. In each plot, age is reported along the horizontal axis, while a 5-year moving average of the partial derivative based on adjacent age groups is represented along the vertical axis. The 5-year moving average smooths away some of the noise in the estimates and facilitates review. Plots for the impact of the regional dummy variables are not provided to conserve space.

Four important points should be noted in considering the model coefficients. First, virtually all of the sociodemographic factors help to explain both the propensity for homeownership and headship. Second, for each decade and age group, the estimated effects generally are consistent with established priors. Income and education, for example, have strong positive effects on the propensity for homeownership. Third, for many of the covariates, the estimated effects differ systematically across decades in a manner that is suggestive of shifts in economic and social opportunities. In the headship equation, for example, for each age group, additional education has a larger impact in 2000, where education serves to increase headship. This is suggestive that educated individuals tend to marry latter in 2000 than in 1970, consistent with established trends in the broader population.

The fourth pattern is that for many of the headship and homeownership model covariates, there are systematic and sometimes even dramatic differences in effects across age groups. In the homeownership equation, for instance, note that in each decade, the impact of BLACK (relative to white) is modest for individuals in their early 20s, increases in magnitude to a sharp negative value for individuals in their mid-30s, and moderates thereafter. This likely reflects the tendency of African Americans to attain homeownership latter in life relative to comparable white households. Analogous age-related patterns among the homeownership coefficients are evident with respect to other race/ethnicity, education, and gender of the household head. Very likely, many of these patterns arise in part because of unobserved wealth and other factors that vary over the life cycle and are correlated with the model covariates. Nevertheless, these age-related patterns are striking, especially given that the huge literature on homeownership typically does not allow for age-related variation of this sort. An important

implication of plots in Figure A-1, therefore, is that future studies of homeownership behavior should attempt to stratify models by age whenever possible.

Because the influence of the individual covariates is not central to this paper, we refrain from further discussion of the model coefficients here. This allows us to now turn our attention to the impact of headship behavior on homeownership.

4. Aggregate Headship and Homeownership Rates

4.1 Summary Measures

We begin with some summary measures of age-specific homeownership and headship rates for the entire population. Figure 1a plots age-specific homeownership rates for the U.S. for each decade from 1970 to 2000. In each decade, homeownership rates rise sharply with age until about age 30 to 35, reaching roughly 60 percent at age 35 in the year 2000. Rates rise more slowly for individuals from their mid-30s to early 50s, rising to just over 75 percent by age 50 in the year 2000. Homeownership rates edge up even more slowly thereafter, reaching 80 percent among individuals in their early 60s in the year 2000. Figure 1a makes clear that these patterns have been largely present in each decade since 1970.

Figure 1b plots the differences in age-specific homeownership rates for each decade from 1970 to 2000. Patterns here are also striking, and in some instances, less well known. For all age groups, homeownership rates in 1980 were 2 to 5 percentage points higher than in 1970: the 1970s was a time when homeownership rose for individuals throughout the lifecycle. In sharp contrast, homeownership rates in 1990 were roughly 8 percentage points *lower* for most age groups under age 35 relative to comparable age-specific homeownership rates in 1980. That differential diminishes among older individuals and largely disappears for individuals in their mid-50s. The 1980s, therefore, was a time when age-specific homeownership rates fell sharply, especially for individuals under age 45. Finally, Figure 1b also shows that for all age groups, age-specific homeownership rates in 2000 are nearly identical to those in 1990. This is in sharp contrast to the much advertised increase in aggregate homeownership rates for the *entire* U.S. population in the 1990s. Those increases, it would appear, are

largely the result of shifts in the age distribution in the population because age-specific homeownership rates were largely unchanged in the 1990s.

Figures 2a and 2b repeat these plots for headship rates. Recall that, as noted earlier, each individual in the sample is either a household head or not, and each household has just one household head. In Figure 2a, notice that in each decade, headship rates rise sharply to roughly 50 percent by age 30 and then edge gradually up to roughly 60 percent by age 65. Here too, however, there are striking differences in behavior across decades. The 1970s was a time when age-specific headship rates rose from 2 to 4 percentage points for individuals under roughly age 35. That increase was more muted among older individuals, diminishing to roughly zero for individuals in their late 50s and beyond. The 1980s, in contrast, was a time when headship rates fell back by 2 percentage points among individuals in their 20s, but among individuals in their 40s headship rates rose a further 2 percentage points. In the 1990s, headship rates generally declined for most age groups. The largest declines were about 2 percentage points for individuals from their early 20s to mid-40s. That differential narrowed continuously with age to about zero for individuals in their late 50s.

4.2 Dependence of Headship and Homeownership Decisions

A general and important point evident in Figure 2b is that headship patterns changed markedly from 1970 to 2000, falling by up to 4 percentage points for individuals in their mid-20s, and rising by up to 4 percentage points among individuals in their late 30s to late 40s. The question then is whether these changes could have contributed to changes in aggregate U.S. homeownership rates? As discussed in Section 3, a necessary condition for changes in headship behavior to have affected aggregate U.S. homeownership rates is that the headship and homeownership decisions cannot be independent. Figures 3a and 3b consider this question.

In Figure 3a, we plot the estimated model correlation coefficient, $\sigma_{Head,Own}$, from expression (2.14) for each age group and decade. To facilitate review of the results we smooth some of the noise across age

groups by plotting 5-year age group moving averages. Figure 3b plots differences in these values across decades. Observe in Figure 3a that for most decades, $\sigma_{Head,Own}$ begins at roughly positive 0.2 to 0.4 for individuals in their early 20s and then declines monotonically to roughly negative 0.6 for individuals age 50, after which there is little further change among older individuals.[20] The general pattern then across all decades is that $\sigma_{Head,Own}$ is positive for younger individuals, declines monotonically with age, and becomes increasingly negative for individuals beyond their early 40s.

How should the patterns in Figure 3a be interpreted? First and most important, it is clear that for most age groups and in all of the decades, results clearly indicate that the headship and homeownership decisions are not independent. This has direct implications for the possible impact of headship behavior on homeownership and estimation of homeownership rates in general, as described in Section 2.

It is also important to recall that $\sigma_{Head,Own}$ measures the correlation in the error terms from the headship and ownership equations having already conditioned out the influence of the covariates in the model (see Section 3 for a list of the covariates). Accordingly, a positive value for $\sigma_{Head,Own}$ means that unobserved factors that cause us to be surprised at the intensity of an individual's desire to be a household head, also cause us to be surprised at the intensity of the individual's desire to be a homeowner. An example here might be unobserved wealth which likely contributes both to headship and homeownership. In contrast, when $\sigma_{Head,Own}$ is negative, unobserved factors that cause us to be surprised at the intensity of an individual's desire to be a Head, also cause us to be surprised at the intensity of the individual's desire to be a renter. One example here might be unobserved deviant behavior (e.g. chronic gambling, alcoholism, criminal activity, etc.) that makes it difficult for the individual to live with others while also limiting the individual's ability to meet the responsibilities necessary for homeownership.

4.3 Simulated Homeownership Rates and Model Forecast Errors

Having estimated (2.14) for each age group and decade, it is now possible to simulate the impact of headship behavior on homeownership rates. Denote a given age-decade sample $S_{a,t}$, where a =

21,…,64, for the age groups, and t = 1970, …, 2000, for the different years. For a given sample, $S_{a,t}$, we can use the estimated values for b, c, and $\sigma_{\text{Head,Own}}$ to form $\overline{P}_{Head}$ and $\overline{P}_{Own,Head}$ from (2.7) and (2.8). Substituting into (2.9) gives the simulated aggregate homeownership rate. The nature of the simulation, of course, depends on the manner in which the sample used in the simulation is matched to the age and decade from which the parameters were estimated. In all of the simulations to follow, we use within sample estimates of b and $\sigma_{\text{Head,Own}}$. Then, by varying the sample from which the headship coefficients were obtained, it is possible to isolate the impact of differences in headship behavior on homeownership rates holding everything else constant. For example, suppose we take the headship coefficients estimated with the 1990 data. Combining those coefficients with data, homeownership coefficients, and $\sigma_{\text{Head,Own}}$, from each individual decade, would enable us to estimate the values for $\overline{P}_{Head}$ and $\overline{P}_{Own,Head}$ that would have prevailed in each decade had individuals formed households as in 1990.

To formalize the procedure above, and to simplify the exposition to follow, we denote a given simulated homeownership rate (*SHR*) as,

$$SHR_{a,t}(k) \equiv \frac{\overline{P}_{Own,Head}(\hat{b}_{a,t}, \hat{c}_k, \hat{\sigma}_{Head,Own_{a,t}} \,|\, S_{a,t})}{\overline{P}_{Head}(\hat{b}_{a,t}, \hat{c}_k, \hat{\sigma}_{Head,Own_{a,t}} \,|\, S_{a,t})} \qquad .(4.1)$$

In (4.1), observe that $\hat{b}_{a,t}$, $\hat{\sigma}_{Head,Own_{a,t}}$, and $S_{a,t}$ are all based on the same age group and decade, a and t. However, the parameters from the headship equation, $\hat{c}_k$, are estimated using sample k, where k will typically differ from the simulation sample. For the special case where k is based on the same age and decade as for the simulation sample, age group a and decade t, it is possible to compare $\text{SHR}_{a,t}(a,t)$ to the actual homeownership rates for a/t in order to check the accuracy of the model. This is done in Figure 4 where the difference between actual and simulated model predictions is plotted for each age group and decade.

In Figure 4, it is immediately apparent that the model in expression (4.1) is biased in a systemic manner. For each decade, the model predictions from (4.1) overestimate the actual homeownership rates

for all age groups, but the forecast error diminishes monotonically with the age of the population. The model over-prediction is roughly 15 percentage points for individuals in their early 20s, declines to less than 5 percentage points for individuals in their early to mid-30s, and declines further to 1 to 2 percentage points for individuals in their 60s. The principal exception to this pattern is for 1990 for which the initial model forecast error is even larger among young individuals.

Extensive testing and attempts to re-specify the model failed to substantially influence the error patterns present in Figure 4. Possibly, the systematic age-related bias reflects the influence of an unobserved age-related variable such as wealth, but our data do not allow us to directly determine or control for such possibilities. On the other hand, it seems quite likely that the model forecast error arises not from the headship coefficients but from the estimated homeownership parameters. Recall that in (2.14) the parameters of the homeownership equation are estimated over just the household heads controlling for sample selection – in principle. Those estimates are then used to evaluate the joint probability of headship and ownership for each individual in the sample when forming *SHR*. In contrast, the headship parameters are estimated over all individuals in the sample – not just the household heads. For this reason, the headship parameters are much less likely to be subject to error, and the degree of bias associated with any given *SHR* is likely driven primarily by the age-specific homeownership coefficients. Assuming this is indeed the case, differences in age-specific simulations based on different headship parameters likely difference away the bias in Figure 4. As will become apparent, this enables us to identify the manner in which changes in headship behavior over time have influenced homeownership rates. With this in mind, we now proceed to the simulations.

4.4 Simulations of Changes in Headship Behavior on Year 2000 Homeownership Rates

Figures 5a and 5b present the simulated age-specific homeownership rates for the year 2000 based on the year 2000 sample and headship coefficients from different decades. These simulations enable us to evaluate the extent to which year-2000 homeownership rates would have differed had individuals in the year 2000 formed households in a manner similar to that of the previous decades. In

this manner, these simulations isolate the influence of changes in headship behavior from 1970 to 2000 on year-2000 homeownership rates, all else equal.

In Figure 5a we plot the simulated age-specific homeownership rates four times, once for the headship coefficients from each of the four decades, 1970 through 2000. Estimates are sufficiently similar that the plotted values appear to lie almost on top of each other for the different decades. Figure 5b plots the differences in these values across decades. It is clear from this figure that although the differences across decades are small, they do exist. In addition, in both figures, to smooth out age-specific noise, estimates for 5-year moving averages of age groups are reported.

Among individuals in their early 20s, changes in headship behavior between 1990 and 2000 reduced year 2000 homeownership rates by roughly 1 percentage point. That effect was reversed for individuals from their late-20s to mid-40s: among these individuals, changes in headship behavior in the 1990s increased homeownership by roughly 1 percentage point. For individuals beyond their mid-40s, changes in headship behavior in the 1990s had little impact on homeownership. Moreover, because of offsetting effects of changes in headship behavior in the 1970s and 1980s, these patterns just noted are largely indicative of the accumulated impact of changes in headship behavior from 1970 to 2000. The primary exception is for individuals in their early 20s for whom changes in headship behavior from 1970 to 2000 served to depress homeownership rates by up to 5 percentage points.

In considering these results, it is useful to recall from Figure 2b that headship rates fell sharply among individuals in their 20s from 1970 to year 2000, but rose sharply among individuals in their 30s and 40s. This implies a positive correlation between changes in headship patterns over the last 30 years and the simulated impact of headship on homeownership: reduced headship rates among individuals in their 20s are associated with lower homeownership, while increased headship rates among individuals in their 30s and 40s are associated with higher rates of homeownership.

On the surface it is perhaps puzzling that a decline in the headship rate would be associated with a decline in the homeownership rate. In (2.6), for example, a decline in the headship rate holding constant the number of owner-occupied households must necessarily increase the homeownership rate. The key,

however, is that not everything else is held constant. Instead, it matters how additional families are created (or eliminated) because this change potentially also affects the number of Heads that own homes, the numerator in the homeownership equation. For example, if new households are formed because married renters split into multiple households, then the number of heads that own is unaffected while the denominator in (2.6) increases causing the homeownership rate to fall. On the other hand, if new households are formed because single owner-occupiers marry and merge households, then the numerator in (2.6) is reduced by the same arithmetic amount as the denominator, but because the number of owner-occupiers (the numerator) is smaller than the number of households (the denominator), the percentage effect on the numerator in (2.6) exceeds the effect on the denominator. Under this scenario, the homeownership rate would rise. The degree to which a decline in headship will decrease or increase homeownership rates is, therefore, determined in large measure by the degree to which changes in headship and homeownership are dependent upon one another. In our model, this is governed by all of the estimated parameters, including *b* and *c*, and especially the model correlation coefficient, $\sigma_{Head,Own}$.[21]

5. Racial Gaps in Homeownership Rates

This section examines the influence of headship rates on year 2000 racial gaps in homeownership. Because of small sample sizes for some race-specific age groups, throughout this section all of the analysis is based on individuals grouped in five-year age increments as compared to year-to-year age increments in the earlier discussion.

5.1 Summary Measures

As is well known, white homeownership rates far exceed those of non-white households. Less well known, the plots in Figures 6a and 6b also make clear that racial gaps in homeownership vary widely with age. Among individuals in their early 20s, racial gaps are modest in size, presumably because few people of any race seek homeownership in their early 20s. Among white families, the homeownership rate increases sharply with age, reaching 80 percent for Heads in their late 40s.[22] Among minorities,

homeownership also increases sharply with age, but more slowly than for white households, and never to the same degree even later in the life cycle. Comparing white to black Heads, disparities in homeownership rates peak at roughly 30 percentage points for individuals in their late 30s and then narrow to just over 20 percentage points among individuals in their 60s. Comparing white to Hispanic Heads, homeownership gaps peak at 20 percentage points for individuals in their early 30s and then gradually edge down to roughly 16 percentage points among individuals in their 60s.[23] Comparing white to Asian Heads, homeownership gaps peak at roughly 23 percentage points among individuals in their late 20s, and then decline to roughly 12 percentage points among individuals in their 60s.

Figures 7a and 7b provide analogous plots for headship rates by race. The patterns here are quite different. For all age groups, black headship rates exceed those of white individuals. The white-black difference in headship rates is small among individuals in their early 20s, averaging just 2 percentage points, but increases monotonically with age to just over 10 percentage points among individuals in their 60s. Comparing white to Hispanic individuals, white headship rates are 5 percentage points higher among young individuals (in their early 20s), but become more similar thereafter and are nearly identical for individuals beyond their mid-30s. Comparing white to Asian individuals, headship rates also are initially 5 percentage points higher for whites and become nearly identical for individuals in their 40s. However, differences in headship rates increase thereafter, peaking at roughly 10 percentage points for individuals in their early 60s.

5.2 Simulations of Racial Differences in Headship Behavior on Homeownership

In order to evaluate the degree to which racial differences in headship behavior contribute to the age-specific racial differences in homeownership outlined above, we apply the same model as from the previous section. In this case however, the bivariate probit model is estimated separately for each racial group. In addition, we estimate the model only for the year 2000. Headship coefficients from each of the race-specific models are then used to simulate the influence of racial differences in headship behavior on racial gaps in homeownership rates. Results from these simulations are provided in Figures 8, 9, 10, and

11 for white, black, Hispanic, and Asian individuals, respectively. In each of the figures, we plot simulations of the homeownership rates that would have prevailed for the racial group in question if their headship behavior had been as for an alternative group.

Figure 8a plots white homeownership rates that would have prevailed if white individuals had displayed the headship behavior of different races. Figure 8b plots the differences in white homeownership rates corresponding to the headship behavior of different races. In Figure 8b, observe that if white individuals had formed households in a manner similar to that of black individuals, age-specific white homeownership rates would have differed by no more than one percentage point among individuals in their 20s and 30s, but hardly at all for individuals beyond their 30s. The influence of Hispanic and Asian headship behavior on white homeownership rates for individuals in their 20s and (especially for Hispanic headship behavior) 30s is somewhat larger, reaching up to 2 percentage points for some age groups. Here too though, for individuals beyond their mid-40s there is little influence of racial differences in headship rates.

Figures 9a and 9b present analogous simulations for the black population. Before proceeding, it is important to recognize that the limited impact of white-black headship differences on *white* homeownership rates need not carry over to *black* homeownership rates. The reason is that the headship coefficients are but one of the differences that contribute to the simulated effects. For example, as discussed earlier, if $\sigma_{Head,Own}$ equals zero, then differences in headship behavior have no impact on homeownership rates. Similarly, if all of the covariates in the homeownership equation equal zero, then, once more, differences in headship will have no impact on predicted homeownership rates. More generally, the influence of any given set of headship coefficients on homeownership rates is sensitive to $\sigma_{Head,Own}$, as well as the homeownership coefficients and sample, as is clear from the model in Section 2 and also the simulation equation (4.1).

Bearing the above discussion in mind, results for blacks' homeownership rates in Figures 9a and 9b are strikingly different from those for whites in the prior figures. Among individuals in their early 20s,

black homeownership rates would have been 5 percentage points lower if blacks had formed households in a manner similar to that of white individuals. Those effects diminish roughly monotonically with age, narrowing to less than one percentage point for individuals in their 60s. Hispanic headship behavior also would have lowered black homeownership rates for individuals in their early 20s by 5 percentage points. That effect diminishes to zero for individuals in their mid-40s and rises to positive 2 percentage points for individuals in their early 60s. A similar pattern occurs when Asian headship rates are applied to black individuals.

Figures 10a and 10b repeat the analysis above for Hispanic households. In this case, observe that Hispanic homeownership rates would be 3 percentage points higher among individuals in their early 20s if Hispanics had formed households in a manner similar to that of white individuals. That effect declines to zero for individuals in their mid-50s, and negative one percentage point among individuals in their 60s. A nearly identical pattern would occur if Hispanics formed households in a manner similar to African Americans. In contrast, Hispanic homeownership rates would differ little if Hispanic individuals formed households in a manner similar to Asians.

Finally, Figures 11a and 11b plot the simulated homeownership rates for the Asian population, applying the headship parameters from different racial groups as above. If Asians formed households in a manner similar to white individuals, homeownership rates would be largely unchanged except for an anomalous sharp decline for individuals in their mid-20s. A similar pattern occurs when applying the headship behavior of black individuals, although for Asians beyond their mid-40s black headship behavior would raise homeownership rates by roughly 2 percentage points. Applying Hispanic headship behavior would increase Asian homeownership rates by roughly 2 percentage points for all age groups up to the mid-50s, after which there is little effect.

6. Conclusions

Homeownership rates are by definition equal to the number of households that own homes divided by the number of households in the population. For that reason, changes over time in

homeownership rates and racial gaps in homeownership could potentially be explained by differences across groups in headship behavior. Although intuitive, this idea has largely escaped attention in the literature and related policy discussions. This paper fills that "gap" by evaluating the influence of differences in headship behavior on changes in aggregate homeownership rates from 1970 to 2000, and also differences in year 2000 disparities in homeownership rates across race. We explore these issues by drawing on the public use micro sample (PUMS) data files in the decennial census for each decade from 1970 to 2000. The large samples in the PUMS enable us to estimate models on an age-specific basis, providing great detail for the analysis.

Results indicate that despite much advertised increases in aggregate homeownership rates in the 1990s, age-specific homeownership rates were little changed from 1990 to 2000. This implies that much of the observed change in aggregate homeownership rates in the last decade can be attributed to shifts in the age distribution of the population; more precisely, to an aging of the population because homeownership rates increase sharply with age.

Findings also indicate that between 1990 and 2000, among individuals in their mid-20s to mid-40s, headship rates increased by roughly 1 percentage point, causing homeownership rates to rise by roughly 1 percentage point as well. This occurred because with higher headship rates some prospective households formed that might not otherwise have been created, and a disproportionate share of these newly formed households became owner-occupants. For individuals in their 50s and 60s, however, changes in headship behavior in the 1990s had little influence on homeownership rates. These patterns are largely indicative of the cumulative effect of changes in headship behavior from 1970 to 2000 owing to offsetting effects in different years. The principal exception is that lower headship rates between 1970 and 2000 served to lower homeownership rates by several percentage points among individuals in their early to mid-20s. This occurred because with lower headship rates some prospective households did not form, and many of these prospective households would have been owner-occupants.

We also find that white homeownership rates would be little different if white individuals formed households in a manner similar to that of various minority groups. However, black homeownership rates

would be several percentage points higher if African Americans formed households as do white families, especially among individuals in their 20s and 30s. The opposite pattern prevails for the Hispanic population: among Hispanics in their 20s and 30s, homeownership rates would have been several percentage points lower if Hispanics formed households as do white families. Among the Asian population, homeownership rates would be little different if Asians formed households as do white individuals.

Overall, these results suggest that changes in headship behavior had only a modest effect on changes in aggregate homeownership rates from 1990 to 2000, and also from 1970 to 2000. The primary exception is for individuals in their early 20s for whom changes in headship behavior from 1970 to 2000 reduced homeownership rates by five percentage points. In contrast, differences in year 2000 headship rates between white and non-white individuals in their 20s, 30s, and 40s served to *narrow* the white-black homeownership gap by several percentage points, but *widen* the white-Hispanic gap. In that regard, holding constant headship behavior, white-black gaps in homeownership rates are even more severe than previously recognized, while white-Hispanic gaps are somewhat less dramatic.

Two important policy implications follow from our work. First, given evidence that changes in headship rates have potential to change homeownership rates, HUD and related institutions should continue to monitor changes in headship rates and their impact on homeownership.

Second, although aggregate homeownership rates rose in the 1990s, age-specific rates did not. This is consistent with evidence reported by Eggers (2004, Tables 1 and 2) and Gabriel and Rosenthal (2005). As an approximation, therefore, it appears that aging of the population accounts for much of the increase in homeownership from 1990 to 2000. Because this aging process is expected to continue and the propensity for homeownership increases with age, aggregate homeownership rates will also likely continue to rise even in the absence of further policy interventions in the market.

References

Boyes, W., D. Hoffman, and S. Low. 1989. An Econometric Analysis of the Bank Credit Scoring Problem. *Journal of Econometrics* 40(1): 3-14.

Borsch-Supan, A. 1986. "Household Formation, Housing Prices, and Public Policy Impacts," *Journal of Public Economics* 30: 145-164.

Ermisch J. 1999. "Prices, Parents, and Young People's Household Formation," *Journal of Urban Economics* 45: 47-71.

Ermisch J. and P. Di Salvo. 1997. "The Economic Determinants of Young People's Household Formation," *Economica* 64: 627-644.

Gabriel, Stuart and Stuart S. Rosenthal. 2005. "Homeownership in the 1980s and 1990s: Aggregate Trends and Racial Gaps," *Journal of Urban Economics*, 57, 101-127.

Garasky, Steven, R. Jean Haurin, and Donald R. Haurin. 2001. "Group Living Decisions as Youths Transition to Adulthood," *Journal of Population Economics* 14: 329-349.

Goldscheider F. K. and C. Goldscheider. 1993. *Leaving Home Before Marriage*. University of Wisconsin Press, Madison WI

Goldscheider, F. K. and J. DaVanzo. 1989. "Pathways To Independent Living In Early Adulthood: Marriage, Semiautonomy, And Premarital Residential Independence," *Demography* 26: 597-614.

Goldscheider, F., A. Thornton and L. Young-DeMarco. 1993. "A Portrait Of The Nest-Leaving Process In Early Adulthood." *Demography* 30: 683-699.

Eggers, Frederick J., 2003. "Homeownership Gains During the 1990s: Composition Effects and Race Effects," U.S. Department of Housing and Urban Development report, Contract # C-OPC-21895.

Haurin, Donald, Stuart Rosenthal, Christopher Herbert, and Mark Duda. 2003. "A Review of the Literature on Homeownership Gaps Among Low-Income and Minority Borrowers and Neighborhoods," prepared for the Department of Housing and Urban Development (HUD).

Haurin R. J., D. R. Haurin, P. H. Hendershott, S. C. Bourassa. 1997. "Home or Alone: The Costs of Independent Living for Youth," *Social Science Research* 26: 135-152.

Haurin, D. R., P. H. Hendershott and D. Kim. 1993. "The Impact Of Real Rents And Wages On Household Formation," *Review of Economics and Statistics* 75: 284-293.

Haurin, D. R., P. H. Hendershott and D. Kim. 1994. "Housing Decisions Of American Youth," *Journal of Urban Economics* 35: 28-45.

Hendershott, Patric H. 1987. "Household Formation and Homeownership: Impacts of Demographic, Sociological, and Economic Factors," *Housing Finance Review* 7: 201-224.

Maddala, G. S., Limited-Dependent and Qualitative Variables in Econometrics, Cambridge University Press, New York (1983).

Masnick, G. S. and Z. X. Di. 2001. "Cohort Insights into the Influence of Education, Race and Family Structure on Homeownership Trends by Age: 1985 to 1995." Harvard Joint Center for Housing Studies Research Note N01-1.

Masnick, G. S. and Z. X. Di. 2002. "Projections of US Households by Race/Hispanic Origin, Age, Family Type, and Tenure to 2020: A Sensitivity Analysis." Urban Institute and U.S. Department of Housing and Urban Development Issue Paper: Demographic Trends Important for Housing. May.

Masnick, George S. 2001a. "The New Demographics of Housing," Joint Center for Housing Studies Working Paper W01-11. Harvard University.

Masnick, George S. 2001b. "Home Ownership Trends and Racial Inequality in the United States in the 20th Century," Joint Center for Housing Studies Working Paper W01-4. Harvard University.

Rosen, Harvey. 1979. "Housing Decisions and the U.S. Income Tax: An Econometric Analysis," *Journal of Public Economics*, 88, 1-24.

Rosen, Harvey. 1985. "Housing Subsidies: Effects on Housing Decisions, Efficiency, and Equity," in Handbook of Public Economics, A. Auerbach and M. Feldstein eds. Elsevier Science Publishers, North Holland, 375-420.

Ruggles, Steven and Matthew Sobek, 1997. *Integrated Public Use Microdata Series: Version 2.0.* Minneapolis: Historical Census Projects, University of Minnesota.

Figure 1a
Age-Specific Homeownership Rates By Decade

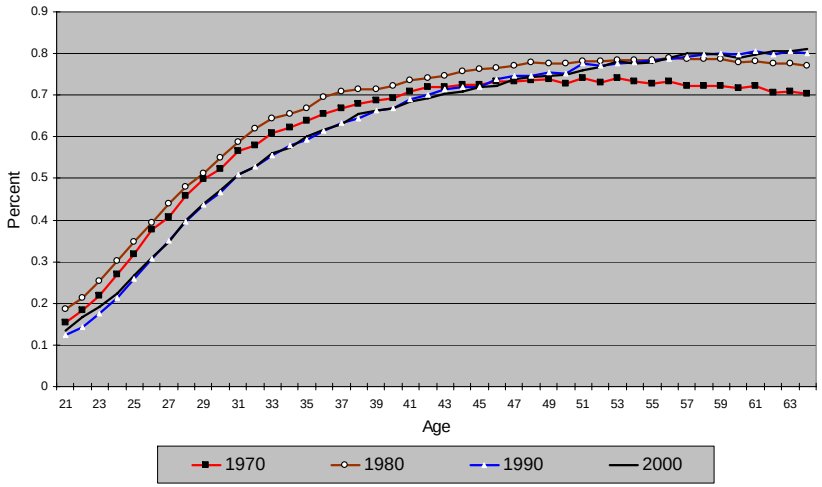


Figure 1b
Differences In Age-Specific Homeownership Rates By Decade

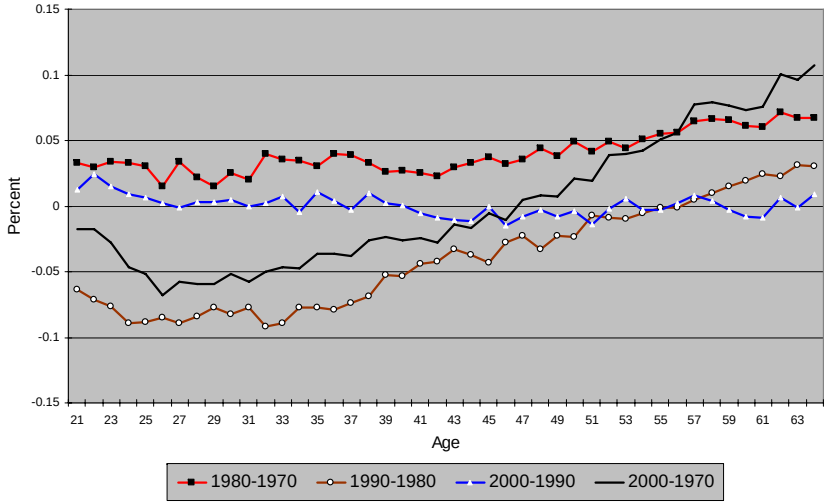


Figure 2a
Age-Specific Headship Rates By Decade

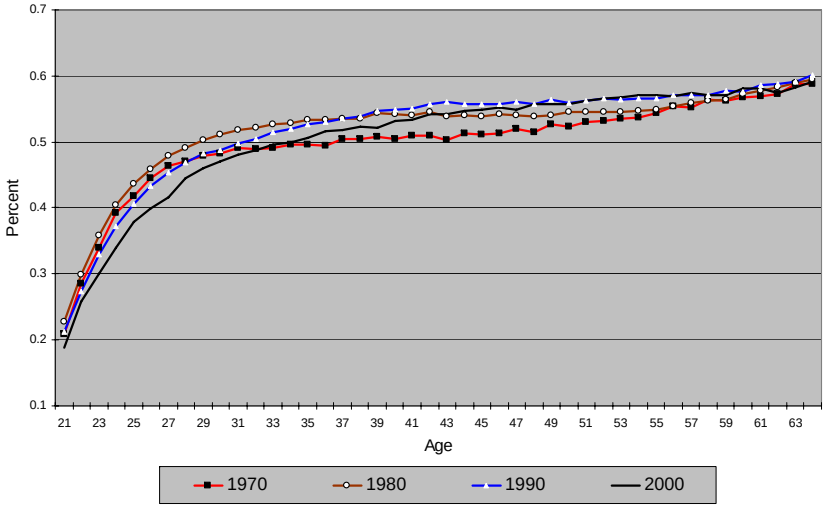
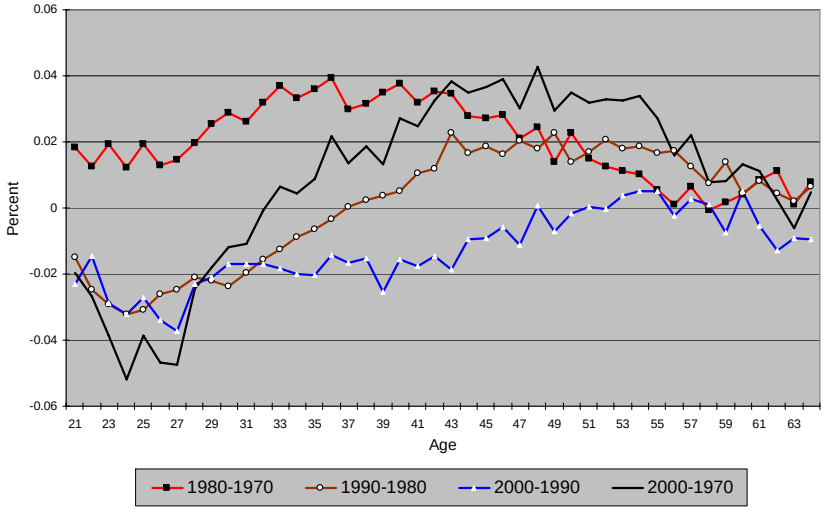


Figure 2b
Differences In Age-Specific Headship Rates By Decade



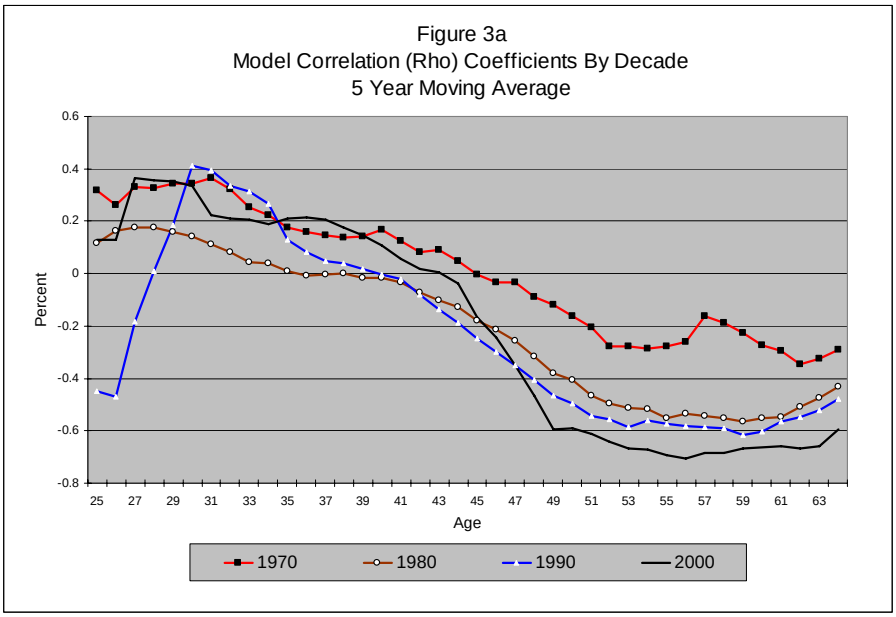


Figure 3a
Model Correlation (Rho) Coefficients By Decade
5 Year Moving Average
Percent
Age
1970
1980
1990
2000

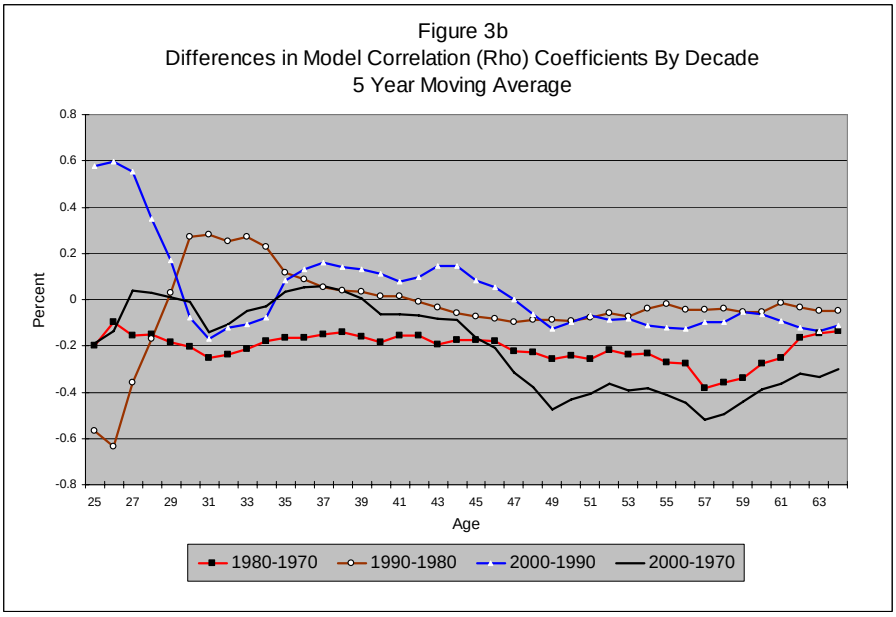
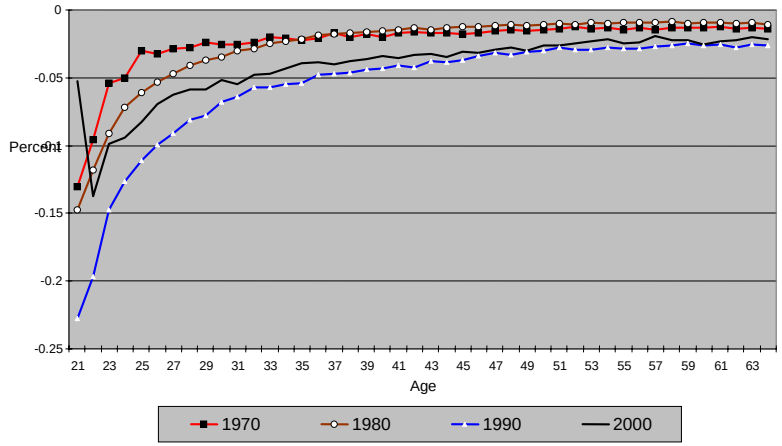


Figure 3b
Differences in Model Correlation (Rho) Coefficients By Decade
5 Year Moving Average
Percent
Age
1980-1970
1990-1980
2000-1990
2000-1970

Figure 4
Within-Sample Model Forecast Errors By Decade
Actual Minus Predicted Age-Specific Homeownership Rates*



[a]Predicted homeownership rates equal the predicted percentage of individuals that are heads and own, divided by the predicted percentage of individuals that are heads.

Figure 5a
Predicted Homeownership Rates With Year 2000 Data
Using Headship Coefficients From Different Decades
5 Year Moving Average

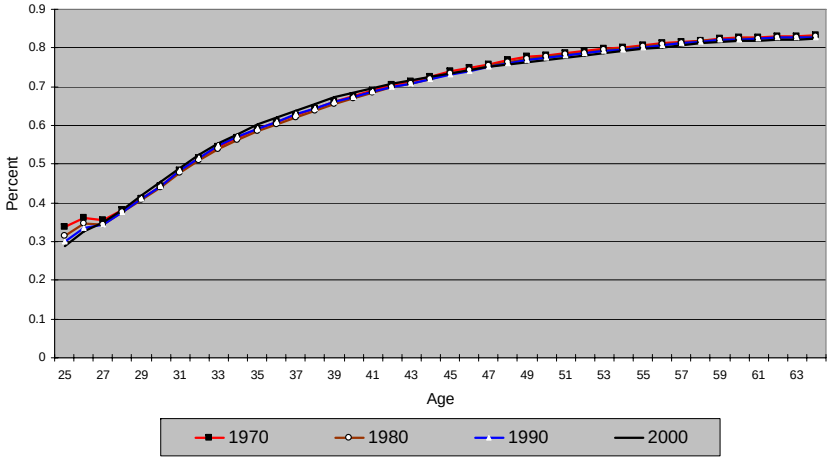
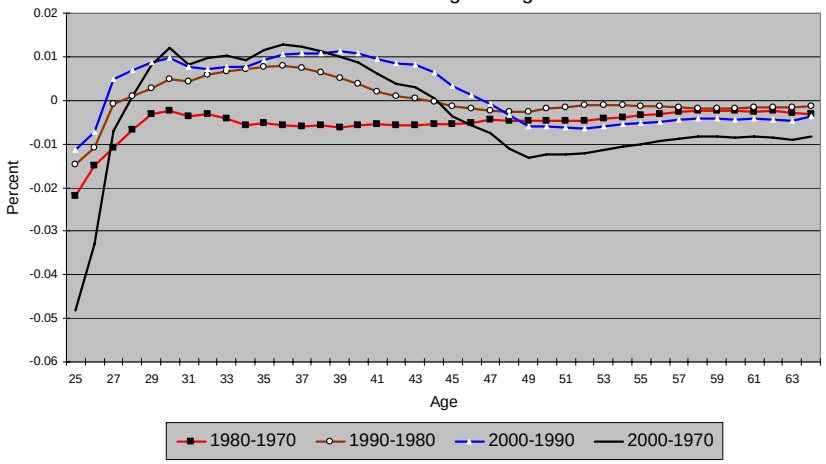


Figure 5b
Differences in Predicted Homeownership Rates With
Year 2000 Data Using Headship Coefficients From Different Decades
5 Year Moving Average



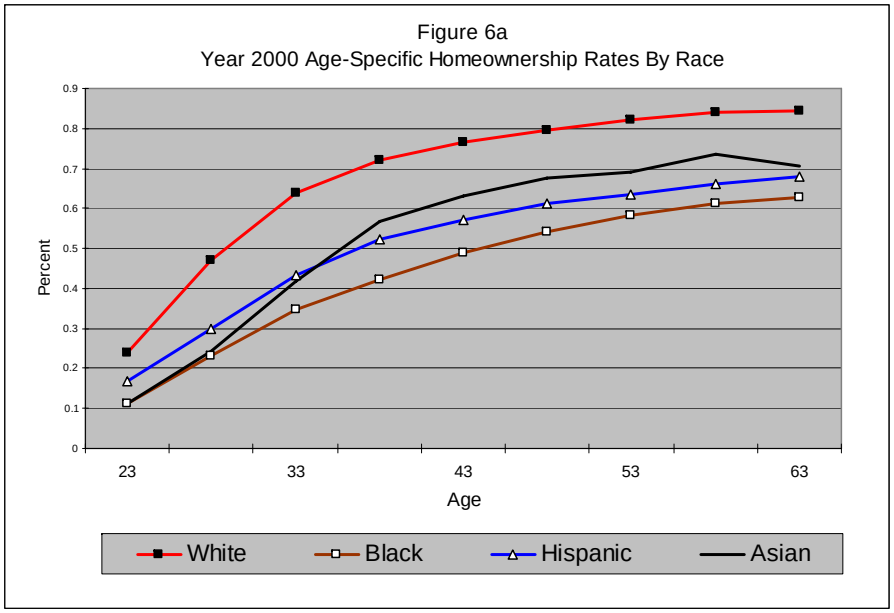


Figure 6a
Year 2000 Age-Specific Homeownership Rates By Race
Percent
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
23
33
43
53
63
Age
White
Black
Hispanic
Asian

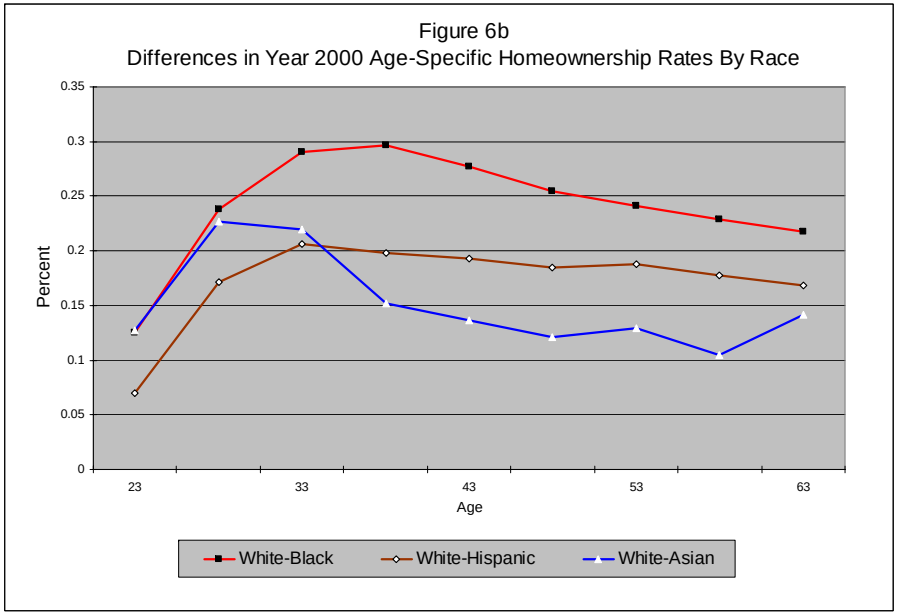


Figure 6b
Differences in Year 2000 Age-Specific Homeownership Rates By Race
Percent
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
23
33
43
53
63
Age
White-Black
White-Hispanic
White-Asian

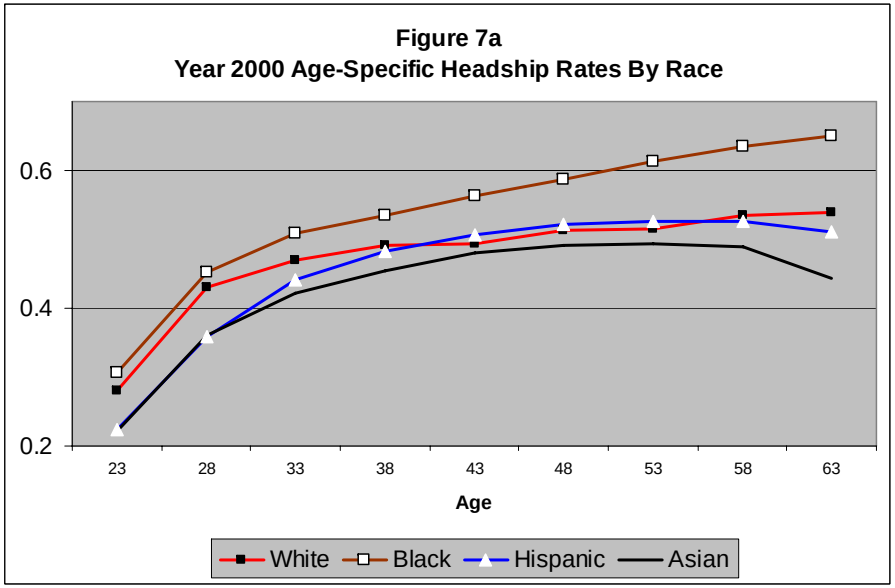


Figure 7a
Year 2000 Age-Specific Headship Rates By Race
0.6
0.4
0.2
23
28
33
38
43
48
53
58
63
Age
White
Black
Hispanic
Asian

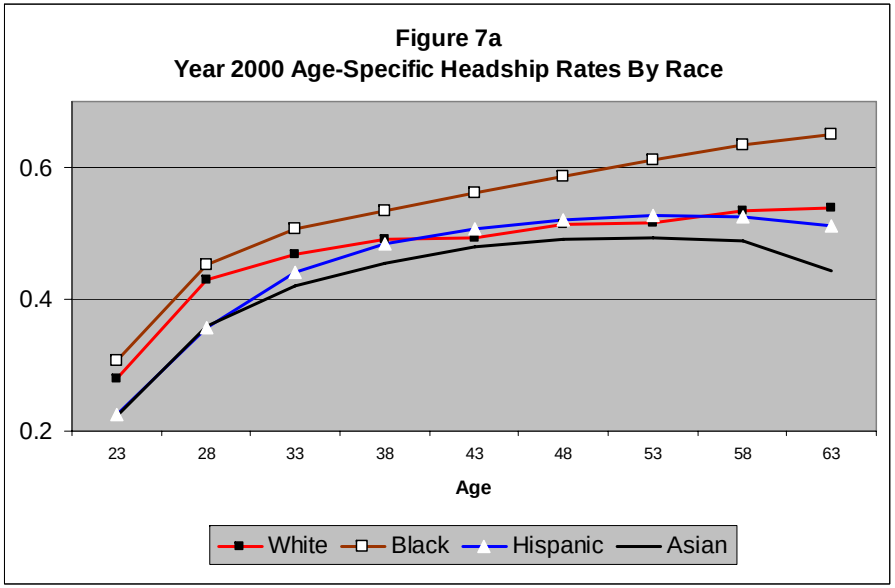


Figure 7a
Year 2000 Age-Specific Headship Rates By Race
0.6
0.4
0.2
23
28
33
38
43
48
53
58
63
Age
White
Black
Hispanic
Asian

Figure 8a
Predicted Homeownership Rates With WHITE Year 2000 Data
and Year 2000 Headship Coefficients From Different Races

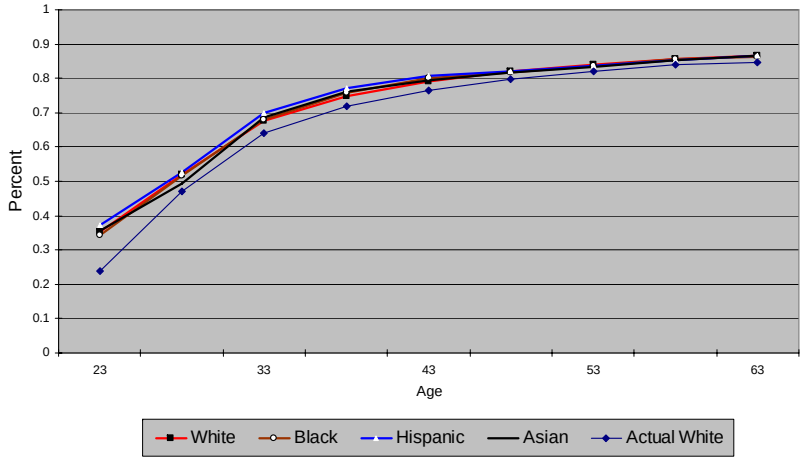


Figure 8b
Differences in Predicted Homeownership Rates With
WHITE Year 2000 Data
and Year 2000 Headship Coefficients From Different Races

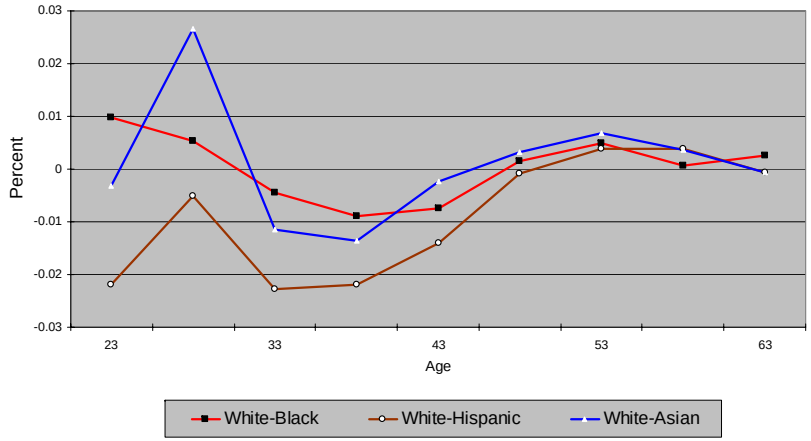


Figure 9a
Predicted Homeownership Rates With BLACK Year 2000 Data
and Year 2000 Headship Coefficients From Different Races

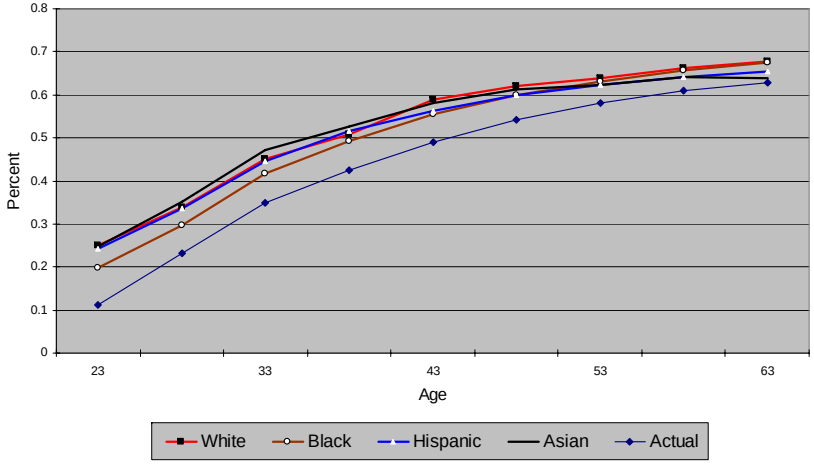


Figure 9b
Differences in Predicted Homeownership Rates With
BLACK Year 2000 Data
and Year 2000 Headship Coefficients From Different Races

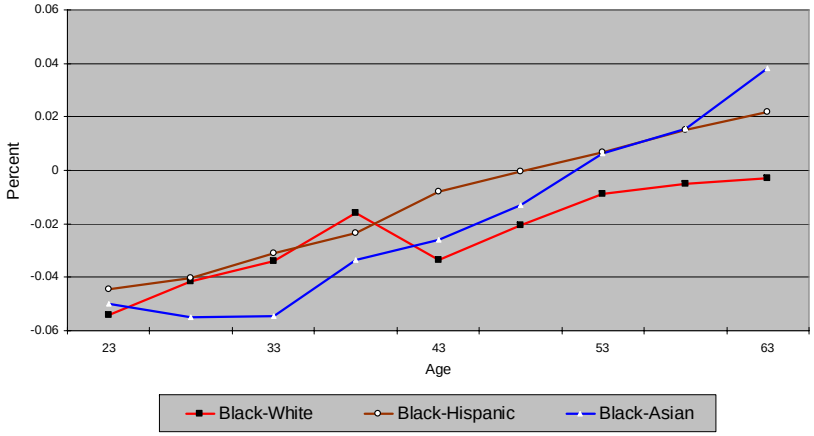


Figure 10a
Predicted Homeownership Rates With HISPANIC Year 2000 Data
and Year 2000 Headship Coefficients From Different Races

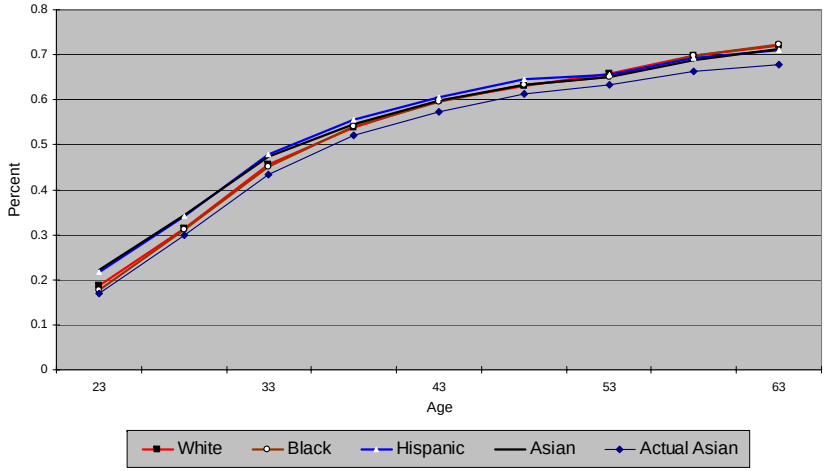


Figure 10b
Differences in Predicted Homeownership Rates With
HISPANIC Year 2000 Data
and Year 2000 Headship Coefficients From Different Races

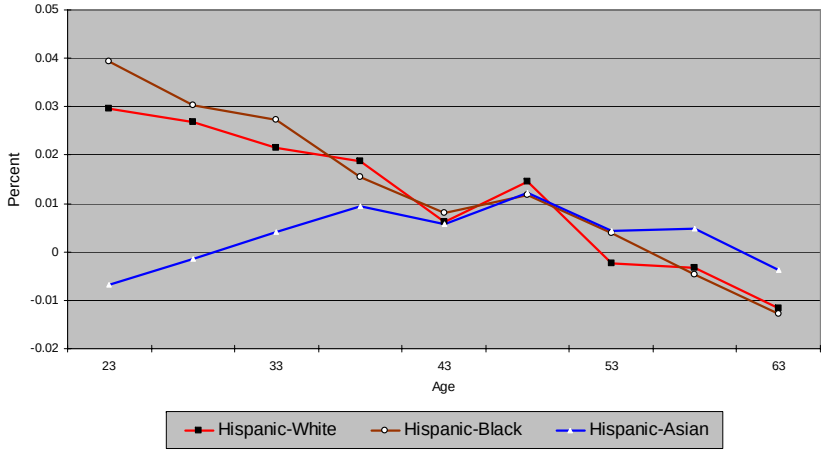


Figure 11a
Predicted Homeownership Rates With ASIAN Year 2000 Data
and Year 2000 Headship Coefficients From Different Races

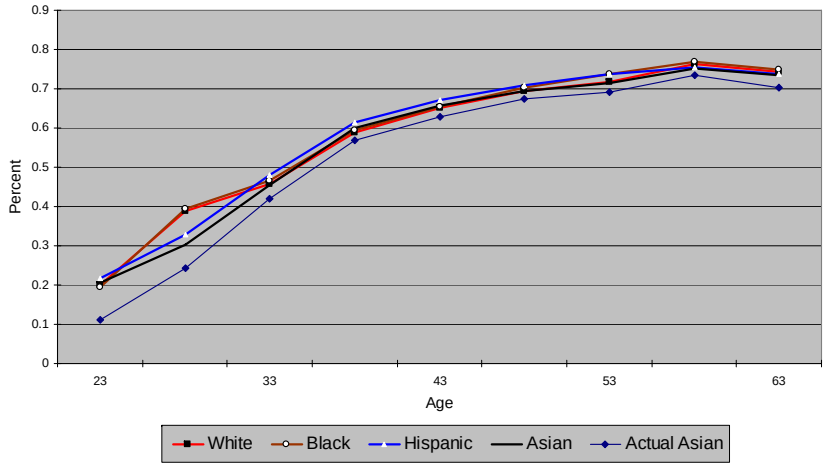
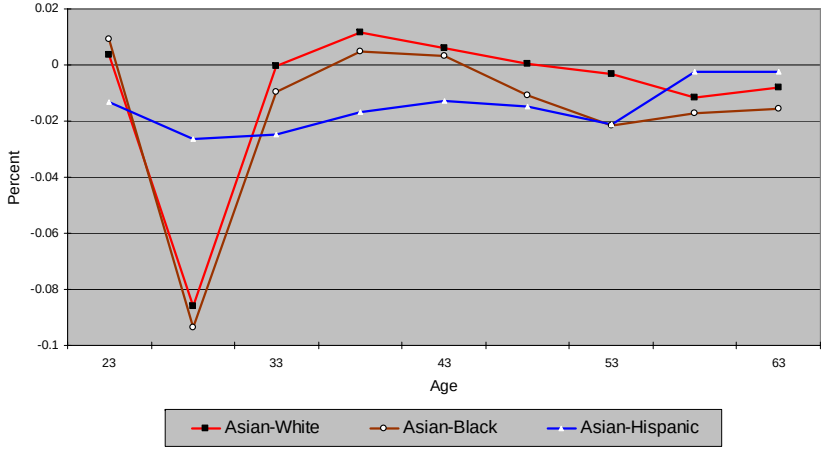
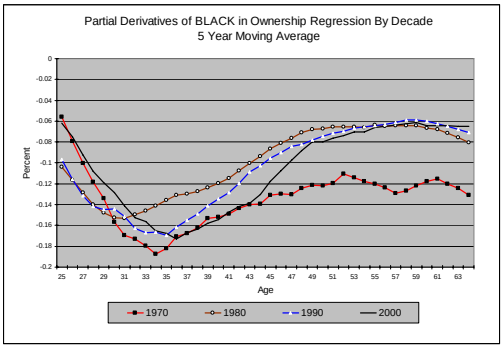


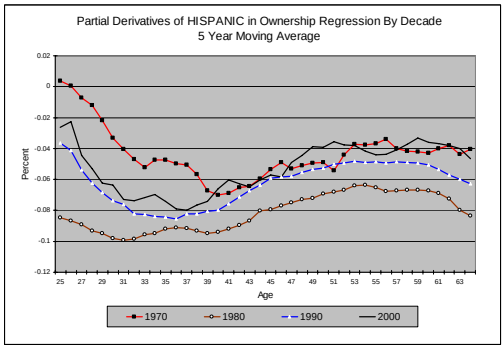
Figure 11b
Differences in Predicted Homeownership Rates With
ASIAN Year 2000 Data
and Year 2000 Headship Coefficients From Different Races

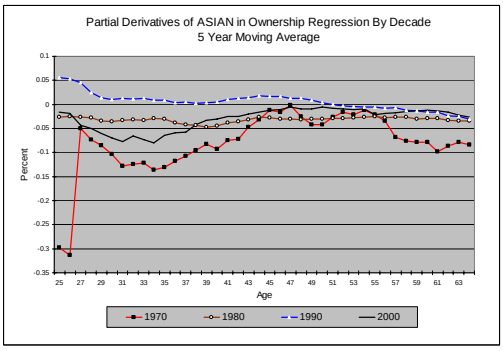


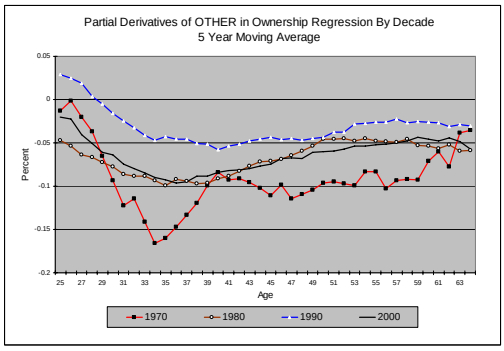
Appendix: Bivariate Probit Model Covariate Effects

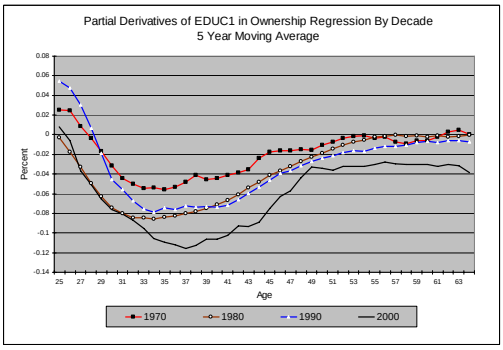
Figure A-1: Partial Derivatives of Estimated Covariate Effects on Homeownership by Decade
(5-Year Moving Average Across Age Groups) [a]

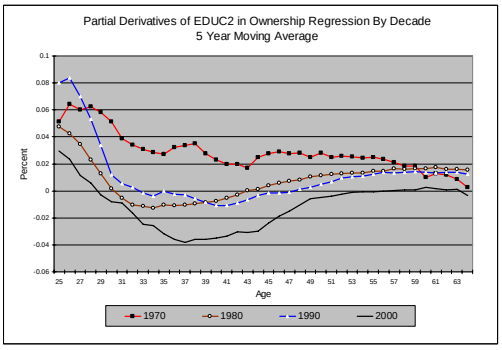


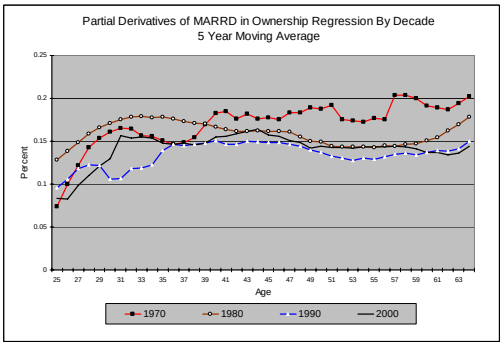












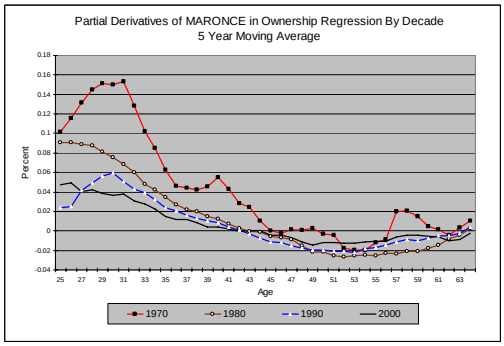
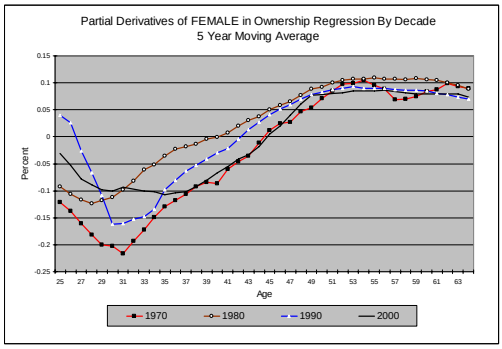
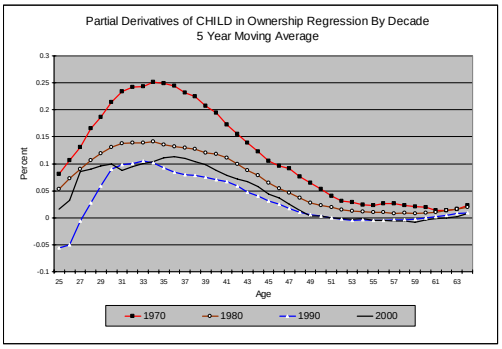
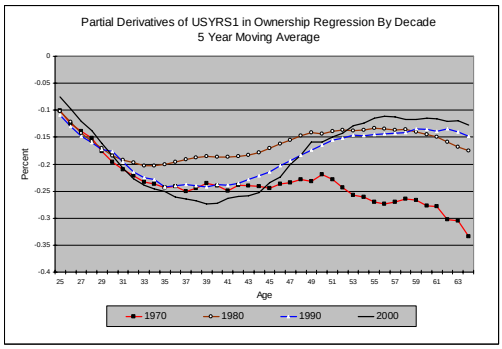
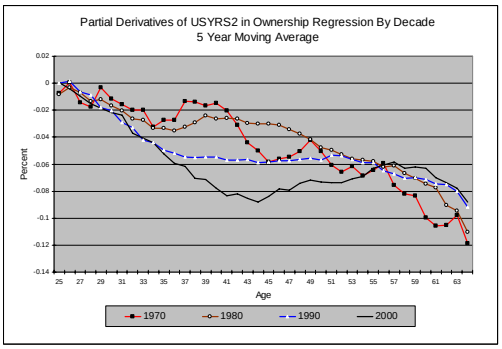


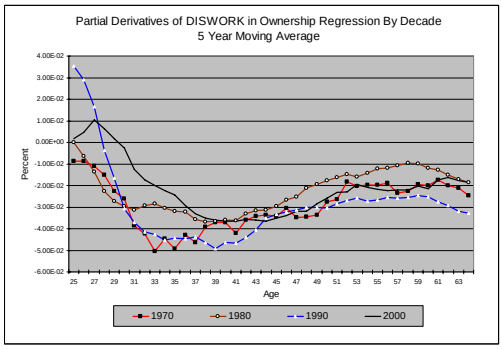
Figure A-1 cont.: Partial Derivatives of Estimated Covariate Effects on Homeownership by Decade (5-Year Moving Average Across Age Groups)[a]

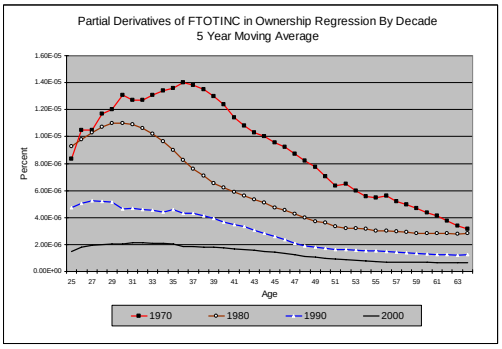






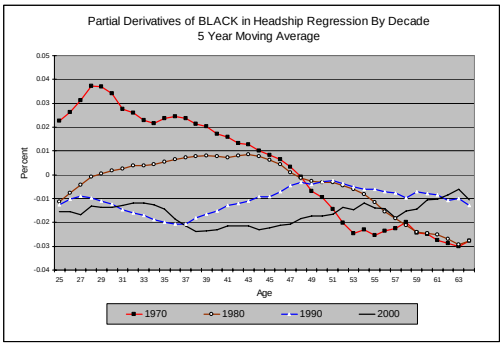


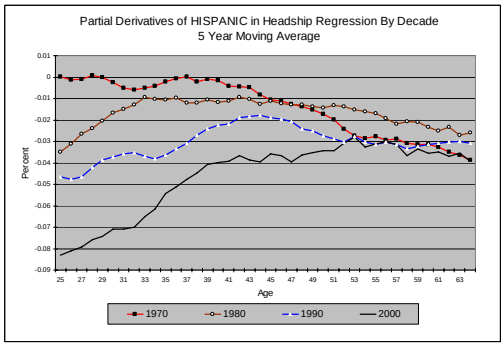


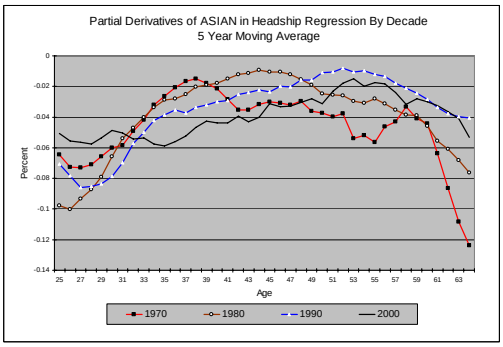


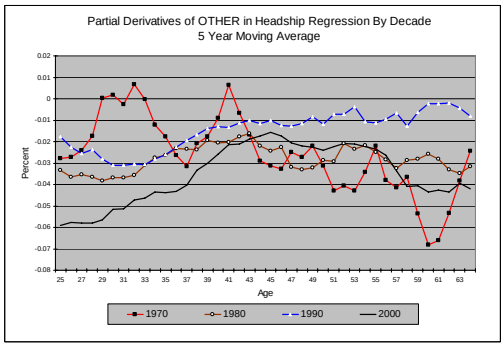
[a]Covariates are defined as follows: Black, Hispanic, Asian, and Other (1 if household head is of the specified race/ethnicity with White as the omitted category); Educ1 and Educ2 (1 if household head less than high school and high school degree, respectively, with some college or more as the omitted category); Marrd and Maronce (1 if currently married and previously but not currently married, respectively with never married as the omitted category); Female (1 if household head is female); Child (1 if children under 18 present in the household); USyrs1 and USyrs2 (1 if household head in the United States 0 to 10 years and 11 to 20 years, respectively, with 20 or more years or natural born citizen as the omitted category); DisWork (1 if household head has a disability that limits or prevents participation in the workforce); FtotInc (total family annual income in current (not constant) dollars).

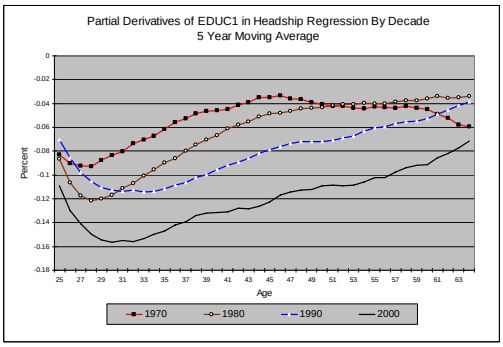
Figure A-2: Partial Derivatives of Estimated Covariate Effects on Headship by Decade
(5-Year Moving Average Across Age Groups) [a]

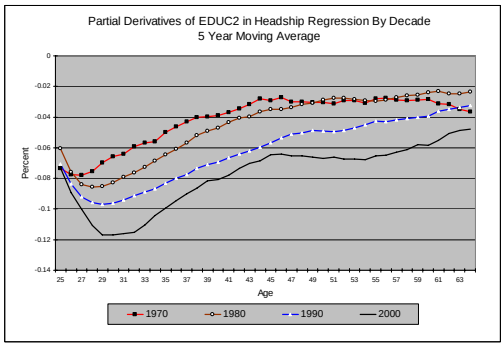


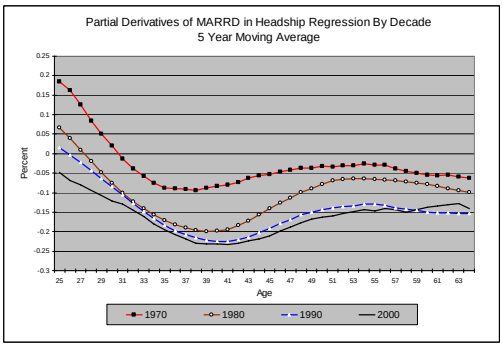












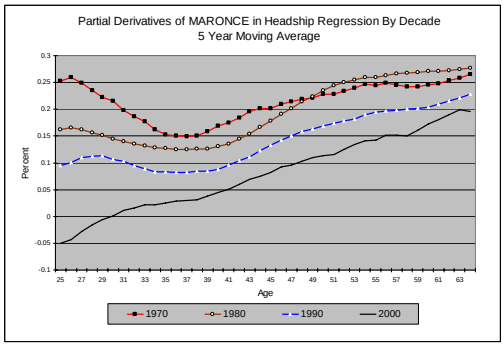
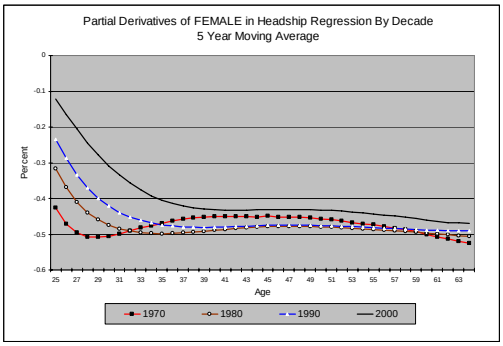
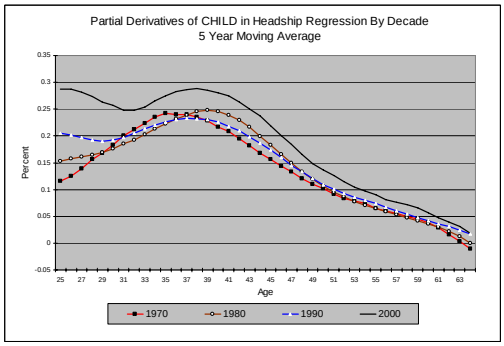
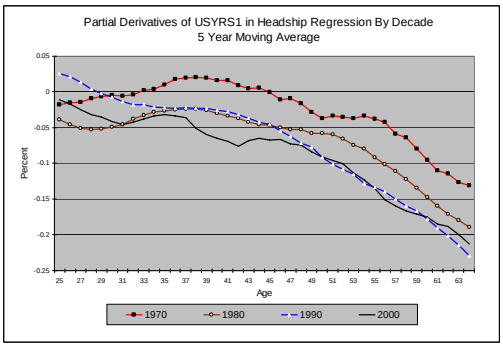
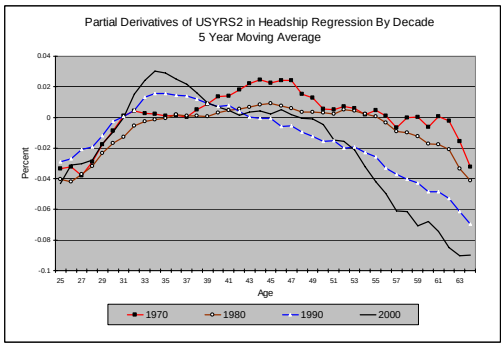


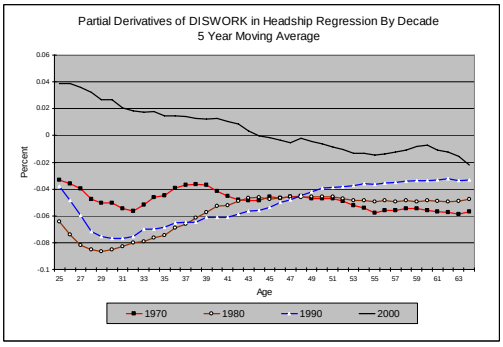
Figure A-2 cont.: Partial Derivatives of Estimated Covariate Effects on Headship by Decade
(5-Year Moving Average Across Age Groups) [a]











[a]Covariates are defined as follows: Black, Hispanic, Asian, and Other (1 if household head is of the specified race/ethnicity with White as the omitted category); Educ1 and Educ2 (1 if household head less than high school and high school degree, respectively, with some college or more as the omitted category); Marrd and Maronce (1 if currently married and previously but not currently married, respectively with never married as the omitted category); Female (1 if household head is female); Child (1 if children under 18 present in the household); USyrs1 and USyrs2 (1 if household head in the United States 0 to 10 years and 11 to 20 years, respectively, with 20 or more years or natural born citizen as the omitted category); DisWork (1 if household head has a disability that limits or prevents participation in the workforce).

Endnotes

[1] "Today, I am requesting that you lead an effort to dramatically increase homeownership in our nation over the next six years. … Your program should include strategies to ensure that families currently underrepresented among homeowners - particularly minority families, young families, and low-income families - can partake of the American Dream."

Letter from President Clinton to HUD Secretary Henry Cisneros, November 3, 1994.

[2] "The goal is that everybody who wants to own a home has got a shot at doing so. The problem is we have what we call a homeownership gap in America. Three-quarters of Anglos own their homes, and yet less than 50 percent of African Americans and Hispanics own homes. That ownership gap signals that something might be wrong in the land of plenty. And we need to do something about it."

President George Bush, June 18, 2002

[3] In their efforts to boost homeownership rates, Presidents Clinton and Bush have both continued a tradition of Federal support for homeownership. For many years, for example, Federal tax policy has heavily subsidized homeownership through deductions for mortgage interest and property tax payments, and the failure to tax imputed rent (e.g. Rosen (1979, 1985)). Homeownership has also been boosted by the creation of government-sponsored institutions in both primary and secondary mortgage markets, including for example, Freddie Mac and Fannie Mae.

[4] See, for example, Table 27, HUD "Current Housing Reports", and the estimates reported there for homeownership rates in 1990 and 2000.

[5] As a result, previously documented changes in homeownership rates over time, and also comparisons of homeownership rates among racial and ethnic groups, should be interpreted with care. For example, homeownership rates will change if the number of owners remains constant but the number of households shrinks. Differences in homeownership rates among racial groups, therefore, could be explained in part by differences in household formation. Household formation, in turn, is sensitive to marriage and divorce rates, the tendency to live with parents or other relatives, and by the share of the population living in group quarters.

[6] Hendershott (1987) estimates that if the age distribution of the population and the propensity of a given type of family to seek homeownership had remained unchanged from 1960 to 1985, the ownership rate would have fallen from 0.623 to 0.570. Instead, the observed ownership rate rose from 0.623 to 0.638 over this period, a difference of 6.8 percentage points. That difference reflects the substantial increase in average age of the population and changes in the homeownership tendencies of specific household types (e.g., married couples).

[7] A more general specification would allow for a further and earlier decision, whether the individual belongs to a Census defined household or not. As note above, Census does not count individuals living in institutions such as prisons, college dormitories, and nursing homes, as belonging to a household. In earlier versions of this work we attempted to formally model the decision to belong to a household using a nested multinomial logit specification, where individuals first choose whether to belong to a household, then choose whether to be a household head, and only then, choose whether to own or rent a home. However, the model proved cumbersome and was set aside for that reason in favor of the more straight forward bivariate probit model of headship and homeownership status.

[8] Estimating our models separately for different age groups allows for age-specific difference in behavior that affect all parameters of both the headship and homeownership models to follow. This is consistent with Masnick (2001a, 2001b), and Masnick and Di (2001, 2002) who emphasizes the importance of accounting for age-specific cohorts when analyzing differences in homeownership rates across groups.

[9] It should also be noted that when Eggers controls further for household income, marital status, presence of children, central city versus suburban location, and race, the independent effect of aging of the population is more muted. Race, of course, is independent of income at the individual level, although in the aggregate

population there is a spurious correlation between race and age: Hispanics, for example, tend to be young relative to other ethnic and racial groups. Income and the other factors mentioned above, however, change with the age of the individual. As a first approximation, therefore, it appears that aging of the population accounts for an important fraction of the increase in homeownership from 1990 to 2000. This is also consistent with recent findings from Gabriel and Rosenthal (2005) that changes in sociodemographic attributes account for most of the increase in homeownership over the 1990s.

[10] In 1970, Census coded the husband as the household head in all married couples. After 1970, married-family household heads were self-reported and could be the husband or the wife. See http://usa.ipums.org/usa-action/variableDescription.do?mnemonic=RELATE for details. .

[11] Group living units include institutionalized individuals in group quarters (nursing homes, prisons, mental hospitals) and non-institutionalized individuals in group quarters (students in a dormitory, military quarters, religious quarters).

[12] Macroeconomic conditions common to all households are captured in the model's constant term.

[13] If (2.10) could be estimated directly, a common approach would be to use well-known Heckman two-step procedures by augmenting (2.10) with a Mills ratio term based on first-stage probit estimates of (2.13). Subject to identification conditions and functional form, in principle including the Mills ratio enables one to obtain consistent estimates of *b*.

[14] The variances of e_{Head} and e_{Own} are normalized to 1 because the parameters of the bivariate probit model can be estimated only up to a scale factor. See Maddala (1983) for further discussion.

[15] Boyes, Hoffman, and Low (1989) estimate a similar three-celled bivariate probit model for the credit card market.

[16] An issue of identification does remain. Selection models such as the one above provide more reliable results when there are variables included in the selection equation (equation (2.12) in this case) that do not belong in the equation of interest (equation (2.9)). In the work to follow, theory offers little justification for omitting variables from the housing tenure equation that appear in the headship equation – it is difficult to think of factors that contribute to headship but which have no influence on housing tenure preferences. Accordingly, we rely on the non-linearity of the bivariate probit specification to identify the model. For a more detailed discussion of bivariate probit models with censoring see Maddala (1983).

[17] There are divergent opinions about the impact of additional education, in part because of the definitional problem of whether a college student has left home. Certainly attaining a college education leads to home-leaving, but often youths in college are not economically independent and frequently they live in dormitories. In addition, as noted earlier, dorms are not counted in the number of dwelling units; thus, youths leaving home for college dorms do not influence the homeownership rate.

[18] These findings are consistent with those of Garasky et al. 2001, who find that youths leaving home at young ages tend to live in large groups, thereby reducing headship rates.

[19] As discussed at the IPUMs website (www.ipums.org), the IPUMs samples for select years, although massive, are not fully representative. Sampling weights are provided for that reason.

[20] The principal exception to this pattern is for 1990 for which $\sigma_{Head,Own}$ actually begins at negative 0.4, but then quickly moves up to positive 0.4 after which the pattern is as described above. Also, for 1970 the decline in $\sigma_{Head,Own}$ bottoms out and plateaus at a higher level, roughly - 0.35.

[21] More formally, taking logs of (2.9) we get,

$$\text{Log(Ownership rate)} = \log(P_{Own,Head}) - \log(P_{Head}).$$

Differentiating with respect to $\log(P_{Head})$ this yields,

∂Log(Ownership rate)/∂log(P_{Head})

$$= \partial\log(P_{Own,Head})/\partial\log(P_{Head}) - 1 = \theta - 1,$$

where θ equals $\partial\log(P_{Own,Head})/\partial\log(P_{Head})$ to simplify notation. Thus, ∂Log(Own)/∂log(P_{Head}) is positive if θ is less than 1 and negative if θ exceeds 1. Whether this condition will hold or not depends on all of the parameters of the model, *b, c,* and $\sigma_{Head,Own}$.

[22] These patterns are echoed in the partial derivative plots associated with race related effects on homeownership in Figure A-1 in the Appendix.

[23] Note that although aggregate white-Hispanic homeownership gaps stand at roughly 28 percentage points, the age-specific white-Hispanic gaps never exceed 20 percentage points. The difference reflects the much younger age of the Hispanic population relative to white individuals. That difference in age distribution puts more weight on younger individuals in the Hispanic community – for whom homeownership rates are low – as compared to that of the white population.