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HOME OWNERSHIP RATES OF MARRIED COUPLES: AN ECONOMETRIC INVESTIGATION

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ABSTRACT

Ownership patterns for young (under 45) married couples are striking in two respects. First, ownership rates rise dramatically with age: couples 35-44 consistently have ownership rates nearly 50 percentage points higher than couples under 25. Second, half of the sharp ownership gains of young married couples in the 1970s were reversed in the first half of the 1980s. These patterns do not hold either for single or other households or for married couples over 44.

To increase understanding of this variability by age and over time, we analyze the tenure behavior of young married couples using aggregate income/age-class data from the 1973-83 Annual (American) Housing Surveys (AHS). The income of a household affects its tenure choice both directly (the taste for ownership rises with income) and indirectly (the cost of owning declines as income rises owing to the greater value of investment in a nontaxed asset for investors in higher tax brackets). Age affects tenure choice because older households have higher incomes, are less mobile (annual-equivalent transactions costs are lower), have more wealth (portfolio diversification for owner-occupiers is easier), and have more certain income (and are thus more willing to commit to ownership).

Price and income elasticities for tenure choice are computed, the rise in ownership rates between 1973 and 1979 and the subsequent decline are interpreted, and an impact of the Tax Reform Act of 1986 is predicted.

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Home Ownership Rates of Married Couples: An Econometric Analysis

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Home ownership by younger married couples varies enormously with age: the average ownership rate of couples age 35 to 44 has exceeded that of couples under 25 by roughly 50 percentage points over the past quarter century, far more than the differences between ownership rates of these two age classes for single or other households. The ownership rate of married couples under 45 has also varied markedly over time. During the 1970s, the ownership rate increased by 9 to 11 percentage points for married couples under age 35 and by 7 percentage points for couples between ages 35 and 64. Half of these increases were reversed in the 1980s for couples under age 45; neither single, other, nor older married households experienced significant declines.

To increase understanding of this variability by age and over time, we analyze the tenure behavior of young (under 45) married couples using aggregate income/age-class data from the 1973-83 Annual (American) Housing Surveys (AHS). The income of a household affects its tenure choice both directly (the taste for ownership rises with income) and indirectly (the cost of owning declines as income rises owing to the greater value of investment in a nontaxed asset for investors in higher tax brackets). Age affects tenure choice because older households have higher incomes, are less mobile (annual-equivalent transactions costs are lower), have more wealth (investment in housing is more easily diversified), and have more certain income (and are thus more willing to commit to ownership).

The paper is divided into five parts. The first is an examination of the 1973-83 AHS data on married couple ownership rates by age and income. The second and third parts present a model for explaining tenure choice and report

the empiricial estimates. Part IV uses the estimates to interpret the facts on home ownership and to forecast the likely impact of the Tax Reform Act of 1986 on ownership rates. A short summary concludes the paper.

I. The Pattern of Ownership

The ownership rate for married couples increases with both age and income. To illustrate this point, we have plotted the ownership rate (from the AHS) against real income for married households under 25, 25-29, 30-34, 35-44 and 45-64 for 1973 (Figure 1) and 1983 (Figure 2). The real income values are based on midpoints of the nominal income ranges given in the AHS; where the income range is unlimited (the highest class), 125% of the lower end of the range is used. The deflator is the CPI-U X1 (the rental equivalent experimental measure that became the official method of calculating the CPI in 1983), equal to 1.0 in 1986. Thus the lowest income level plotted in 1973 is $1500 (midpoint of the 0 to $3000 range) multiplied by 2.324, or $3486. The 1983 nominal income levels are multiplied by 1.095.

The positive age-ownership relationship is indicated by lower-age ownership-income curves systematically lying below higher-age curves. In fact, only a handful of "crossovers" of these curves occurs in the entire ten years of AHS data. The positive income-ownership relationship is indicated by the general positive slope of the curves. Here, two persistent exceptions seem to exist. First, the ownership rate for the lowest income class (sometimes the lowest two income classes, but still under 10,000 in 1986 dollars) is generally higher than that for the next income class. This tends to be true for married households of all ages, although somewhat less so for the youngest age class. Second, the ownership rate for the youngest married households usually declines from the second highest income class to the highest income class.

The exceptions for the lowest income class are likely due to a mismeasurement of income. Some young, low-income married-couple households are in school and being temporarily supported by their parents or other relatives until the post-graduation increase in income occurs. Moreover, some low-income married households of all ages are temporarily unemployed, either totally or partially. In both cases, current income would substantially understate permanent or expected future income. At the high income end, very young households may have only recently attained this income and thus may not have yet adjusted to it (become owners).

The age-specific ownership rates for married couples for the different income ranges are the data to be explained in our econometric investigation. The above examination suggests that a number of potential annual data observations need to be deleted from consideration. Four types of deletions are made:

1. Low income classes are dropped because permanent income is likely greatly understated. We delete observations for income under 7,500 in 1986 dollars, thereby removing the lowest income class in 1973-75 and 1978 and the lowest two income classes in the other six years.

2. The open-ended highest income class is dropped because the "mean" income, and thus relevant tax rate, of the household is unknown.

3. Additional income classes above 56,000 in 1986 dollars for married couples under 25 are dropped because their incomes may be temporarily high and certainly have been only recently attained. This removes single additional observations in 1978, 1979, 1981 and 1983 and two observations in 1980.

4. Single high-income observations are dropped in 1978 for couples 25-29 and 30-34 and in 1980 for couples 25-29 because too few observations were obtained in the AHS.

The potential and actual observations (income classes) for each of the years 1973-83 are listed in Table 1. As can be seen, there are 60 total usable observations for married couples under 25, 64 for those 25-29, 65 for those 30-34, and 66 observations for married couples 35-44.

Why do the systematic positive relationships between ownership and both age and income exist? One explanation is that the annual rental price of owner-occupied housing is lower for older, higher income households. Older households are less mobile, on average, and thus the transaction costs of buying and selling a home and the up-front points and fees paid on a mortgage are less on an annual-equivalent basis than they are for younger, more mobile households. Further, higher income households are in higher tax brackets and thus pay lower after-tax property taxes and mortgage rates (and opportunity costs on own equity invested in housing). Alternative explanations include older households being wealthier, and thus less likely to be either "equity" or "affordability" constrained (or better able to hold a diversified portfolio with owner-occupied housing in it), and having more certain income streams, and thus being more willing to commit to the ownership of housing than younger households are.

The income/ownership profiles in 1973, 1979 and 1983 are indicated in the upper part of Table 2 for married couples in four different age classes.[1] For 1973 and 1983, these data are linear interpolations between the points plotted in Figures 1 and 2. A similar procedure was used for 1979. As can be seen, ownership rates for any given age/income household rose between 1973 and 1979 and then declined through 1983. These movements are consistent with changes in the annual cost of owner housing relative to the cost of rental housing. The annual costs of owner housing for the married couples considered in the upper part of Table 2 are listed in the lower part (the computation of the costs is discussed in the Appendix). Between 1973 and 1979, these costs fell by 3/4 to 2½ percentage points for households with incomes of 22,500 (1986 dollars) to $60,000. The greater declines at higher incomes reflect greater increases in tenure choice tax rates; at $60,000, these tax rates rose sharply (0.32 to 0.40), while at $22,500, the rates actually fell (0.21 to 0.19).[2] Between 1979

and 1983, owner costs rose by 6½ to 7 percentage points. While real rents also declined between 1973 and 1979 and rose between then and 1983, the movements were much smaller (less than 10 percent). Thus the ratio of costs moved as owner costs did.

While not shown in Table 2, the variation over time in ownership rates of married couples above age 44 has been far less than that of younger married couples. This is not surprising. Because older households are less mobile and have greater wealth than younger households, they should be less sensitive to short run changes in housing costs. For this reason, we restrict our analysis to married couples under 45.

II. The Model

We assume that household i's level of utility is derived from the consumption of a composite good x, the flow of housing services h, and a vector of unobservable preference shifters z that are related to tenure status. Thus,

$$U^i = U(x^i, h^i, z^i). \tag{1}$$

Goods x and h are priced in the market at p_x and p_h. We employ annual rental costs as the measure of the price of obtaining housing services and denote them by p_o for owners and p_r for renters. The z variables capture aspects of ownership that affect utility even though the amount of the housing service flow is held constant.

Maximization of utility subject to the budget constraint yields a household's demand equations, and further substitution into the direct utility function yields the indirect utility function:

$$V_j^{i*} = V^*(p_x, p_j^i, y^i, z_j^i) \tag{2}$$

where j is the state of tenure, j = o,r, and y is the after-tax income of the household if it rented. A household compares V_o^i and V_r^i and decides whether to own or rent.

To develop an estimatable tenure choice equation, we assume that utility can be represented as:

$$V_j^i = V_j^{i*} + e_j^i \quad \text{for } j = o,r. \tag{3}$$

The probability of ownership is then:

$$o^i = \text{Prob}(V_o^i > V_r^i). \tag{4}$$

Substituting (3) into (4) yields:

$$o^i = \text{Prob}[(e_r^i - e_o^i) < (V_o^{i*} - V_r^{i*})]. \tag{5}$$

We assume that both e_o and e_r have Weibull distributions yielding the familiar logit form of estimation:

$$\text{logit } o^i = \ln [o^i/(1-o^i)] = V_o^{i*} - V_r^{i*}. \tag{6}$$

We further assume that V_j^i has a translog functional form (as used by King, 1980, in his study of tenure choice) and that the impact of the tenure status utility shifters is linear. Thus,

$$V_j^{i*} = b_0 + b_1 \ln(p_j^i/y^i) + b_2 \ln(p_x/y^i) + b_3 [\ln(p_j^i/y^i)]^2 + b_4[\ln(p_x/y^i)]^2 + b_5 \ln(p_j^i/y^i) \ln(p_x/y^i) + b_6 z_j^i. \tag{7}$$

Differencing the V_j^{i*} as required by (6) yields:

$$\ln[o_1^i/(1-o_o^i)] = b_1 \ln (p_o^i/p_r) + b_3[(\ln p_o^i)^2 - (\ln p_r)^2] -$$

$$(2b_3 + b_5)\ln y^i \ln(p_o^i/p_r) + b_5 \ln p_x \ln(p_o^i/p_r) + b_6(z_o^i - z_r^i). \quad (8)$$

In this formulation the natural log of the odds of owning a house is a function of the cost of owning compared to that of renting, quadratic terms in these costs, an interaction term composed of the relative cost and income, an interaction term composed of the relative cost and the price of the composite good, and the difference between the z variables. This derivation of the form of the estimating equation imposes a constraint on the regression coefficients (call them a_1 to a_5), specifically, $a_3 = -2a_2 - a_4$.

Each tenure state generates a particular value for z_j, and we hypothesize that the difference $z_o^i - z_r^i$ is a function of real after-tax income and observable demographic characteristics:

$$z_o^i - z_r^i = f(y^i, A^i, N^i, M^i) \quad (9)$$

where A is the age of household head, N is the number of dependents, and M is marital status. An example of a "z" variable is "privacy". The amount of privacy is greater for owners than renters for two reasons. First, rental premises are subject to inspection by the landlord, and alterations of the premises are subject to the landlord's approval. Second, and probably more important, most detached houses are available for ownership, while most attached units are available for rent.

One might anticipate that the value of privacy as an owner compared to a renter differs by age of head, family size, the amount of the household's income, and marital status. To test this hypothesis, we must control for the

the estimating equation (8) and run separate regressions by age group. Then we conduct pooling tests across age categories, thereby determining if the tenure choice process differs significantly by age of head. We do not have data on the number of dependents by age and income, but the number of dependents increases monotonically up to age 44. (In 1980, the averages for married couples were: 0.75 for couples under 25, 1.5 for couples 25-34, and 2.25 for couples 35-44.) Finally, we limit the empirical analysis to married couples.

We use real after-tax income of the household if it rented (the tax saving from housing investment is captured in the owner cost variable) for the measure of y (deflation is by the CPI-U X1 using 1985 as the base year). The variable p_x is measured as the ratio of the nonhousing component of the CPI to the entire CPI. The computation of owner cost variables follows Hendershott and Shilling (1982a), with the tax rate calculation based on Hendershott and Slemrod (1983). In these calculations, the assumed holding period should be positively associated with age. We use 3 years for households under 25, 5 years for households 25-29 and 30-34, and 7 years for households 35-44. The real rental cost is the Lowrey (1981) index, equal to 100 in 1977, deflated by the CPI-U X1, also equal to 100 in 1977. To convert this series to a percentage analogous to the owner cost, we first compute the "equilibrium" rental cost in 1977 (following Hendershott and Shilling), as c. The cost in other years is then computed as the real rental cost times c. Details on the cost calculations are contained in the appendix.

Two and four year lagged responses to <u>increases</u> in owner costs are tested (with two years mattering but four years not). Young married couples are relatively mobile and thus might be expected to respond fairly rapidly to declines in the cost of owning; renters have an incentive to switch quickly, especially if they can lock-in fixed rate mortgage money. However, when the cost of owning rises, owners with below-market fixed rate money can reasonably

delay switching to renting. The variables added to the estimation equation (8) are the difference between the current and lagged values of the natural log of the price ratio, if postive, or zero. Thus we anticipate positive coefficients, and the coefficient on the log of the current price ratio is the long-run response.

III. Estimation

The empirical estimates are reported in this section, and the results are interpreted in the next. Three estimates are discussed: the unpooled age-class equations, pooled estimates with age-varying constant terms, and pooled estimates with age-varying constant terms and linear income responses.[3] The latter are our preferred estimates.

Table 3 contains the unpooled age class estimates of equation (8) with the lagged price ratio term added. All variables are generally significant, except for the price ratio term lagged four years.[4] It is significant for the youngest age group but insignificant (and with the incorrect sign in two of three cases) for the other age classes. The adjusted R^2s reveal that from 88.6% to 98.4% of the variation is explained. Lastly, the coefficient restriction ($a_3 = -2a_2 - a_4$) implied by the theory is not rejected by the data.

Table 4 contains estimates for two equations pooled across the four age classes. In the first equation, separate constant terms are estimated for the four age classes but all other coefficients are constrained to be identical. The t-statistics on the constants, which for the three age classes under 35-44 measure the significance of the difference between the constants for these classes and that for the 35-44 age class, indicate that the differences in constants are quite significant. Income and price elasticities have been calculated at the bottom of the table for median income owners in the age classes in 1973.[5] We choose 1973 because owner costs were then near their mean

values, being lower in the rest of the 1970s and higher in the 1980s, and real after-tax incomes changed little over the 1973-83 decade. The income elasticities decline sharply by age class, from 0.77 to 0.26. The price elasticities are lower and also decline by age class, in absolute value, from 0.18 to 0.04.

In the next equation, the income coefficients and the constants are both allowed to vary by age class. As with the constants, the t-statistics on these coefficients for age classes under 35-44 indicate the significance of the difference between the respective coefficients and that for the 35-44 age class. The coefficients for the two youngest groups are significantly different from that for the oldest group. This equation suggests lower income and higher price elasticities, especially for younger households. Using a Chow-type F test on pooling the data, we find that the age classes cannot be pooled unless we allow for the constant to vary by age group. We can confidently pool the data (as in the second equation in Table 4) if we allow both the constant and the income coefficient to vary with age class. The price elasticities here are about double those from the first equation, while the income elasticities are about the same, except for the youngest age group.

Table 5 provides more detailed information on elasticities implied by the second equation in Table 4. Calculations are presented for the five income levels used in the estimation for 1973. These incomes and their after-tax levels in 1985 dollars are listed at the top of the table. Next are the income and price elasticities followed by the estimated and observed ownership rates for these income ranges by age class. The income elasticities decline by age class, especially at high income levels; the elasticities tend to rise with income for married couples under 30 but decline with income for older married couples. The price elasticities approach minus unity for low income households

and decline as incomes rise, reaching zero at before-tax income of about $60,000. The 1973 data are well explained except for the highest income married couples, where the equation substantially overpredicts ownership.

These income elasticities are similar to the 0.47 obtained by Rosen (1979) in a cross section analysis of families in 1970. However, our price elasticities are far smaller in absolute value than the -1.4 he reported. Our elasticities are also smaller than the -0.5 to -1.0 estimates of Hendershott and Shilling (1982a), who analyzed AHS data but only over the 1973-79 period. Hendershott and Shilling did not distinguish an age-class impact, and they did not allow an income effect. Each of these differences from the present study likely contributes to their larger estimates. On the other hand, our current elasticities are similar to the time series estimates of Rosen and Rosen (1980) and Hendershott and Shilling (1982b).

Much higher price elasticities estimates can be obtained from our data if we allow the cross-section data to dominate. This is achieved by deleting the income shifter, which effectively forces price to capture the positive ownership-income correlation, and by allowing a four-year lagged response to increases in the owner cost, which permits a high long-run price elasticity without requiring a large decline in ownership between 1979 and 1983 (the increase in owner costs since 1979 need not have an impact until after 1983). The estimated elasticities for 1973 medium income owners in the four age classes are -1.7, -1.4, -0.9 and -0.7, five to ten times greater than the -0.35 to -0.1 reported in Table 4. However, the unexplained variance doubles relative to that of equation (2) in Table 4 due to a major worsening of the time series fit: 12 percentage point increases in the ownership rate of median income married couples in our three older age classes are predicted between

1973 and 1983 versus the near constant observed aggregate ownership rates.[6] This suggests caution in using price-elasticity estimates from cross-section studies to make inferences about time series behavior.

IV. Applications

The empirical estimates are applied in two ways. First, we use them to interpret the facts about home ownership discussed above. Second, we analyze the impact of the Tax Reform Act of 1986.

An Interpretation

The empirical estimates from equation (2) in Table 4 can be used to shed some light on the ownership facts emphasized earlier, namely the sharp increase in ownership by age class, the rise in ownership between 1973 and 1979, and the decline in the 1980s. The average ownership rates by age class for 1973, 1979 and 1983 are listed in the upper section of Table 6. As can be seen, these data (from the AHS) indicate a 22 percentage point rise in ownership between under-25 married couples and those 25-29, a 17 point further rise by the early thirties, and another 9 point rise by 35-44. In total, the ownership rate is almost 50 percentage points higher for married couples 35-44 than for those under 25. With the exception of a small relative rise in ownership for those 35-44 in the 1980s, the ownership spreads have been constant over the 1973-83 period.

The lower section of Table 6 contains the after-tax real (1985 dollars) incomes of the median income married couples in the various age classes for 1973, 1979 and 1983. The incomes are higher for older married couples and have generally increased slightly over time. The exceptions are an over 4 percent income decline (between 1979 and 1983) for those under 25 and a 4 percent income rise for those 35-44 in the same period. The latter increase could explain the relative rise in ownership between 1979 and 1983 for those 35-44.

As we noted earlier, the higher ownership rates for older married couples are at least partially explained by their higher incomes. Greater income leads to greater ownership both directly and indirectly through lower owner costs (higher tenure-choice tax rates). Older households are also less mobile and thus the transaction costs of purchasing a house and obtaining a mortgage are less onerous. We have accounted for this by calculating owner costs based on a 3 year holding period for married couples under 25, 5 years for couples 25-34, and 7 years for couples 35-44. An interesting question, then, is how much of the observed rise in ownership by married couples across age groups is explained by these factors and how much by the constant terms in the estimated equation? To answer this question, we simulated ownership rates for the median income households in 1973, obtaining differences comparable to those observed for the age classes (49 percentage point difference between those under 25 and those 35-44 versus the 47 percentage point difference in Table 6). Then the equation was resimulated setting all constant terms equal to that for the 35-44 age class. We conclude that the economic variables explain about 40 percent of the difference in ownership across age groups. The other 60 percent is likely explained by the need to accumulate a downpayment, fewer dependents (and thus lower taste for ownership) of younger married couples, and, possibly, less certain incomes.

Table 7 reports observed changes in ownership rates by age class and simulated changes in ownership rates for the median income married couples in the age classes for 1973-79, 1979-83, and the total 1973-83 period. Note that the simulations are for median income households, not for weighted averages of households across the income spectrum, an experiment that would be expected to reflect observed changes more closely. Two sets of simulations are performed for each period, one with all variables varying and one with only prices varying (income is held constant). Of the eight sub-period simulations, all

move in the same direction as the observed change; 60 percent or more of the observed change is captured in five of the eight cases; and 40 percent is captured in two others. Only the sharp rise in ownership for the under 25 group in 1973-79 is badly missed. For the full 1973-83 period, the simulations accurately portray the notable decline in ownership for the youngest married couples, the relative constancy for couples 25-34, and the rise in ownership of married couples 35-44.

The set of simulations that holds income constant implies that the price variables, not income, explain most of the change in ownership. This is hardly surprising given the relative constancy of real after-tax income. The one exception is the full period rise in ownership for married couples 35-44, which is entirely explained by higher real income.

Our estimated price elasticities are roughly consistent with earlier estimates from time series data. The estimates of Hendershott and Shilling (1982b) suggest about a 6 percentage point increase in the ownership rate in response to the decline in owner costs between the early 1960s and late 1970s. Moreover, they interpret the estimates of Rosen and Rosen (1980) as giving a similar impact. Because half of the 6 point increase should have occurred by 1973, our 2 to 2.7 percent increase in ownership of married couples 25-44 between 1973 and 1979 is of the same order of magnitude as the time series estimates.

The Impact of the Tax Reform Act of 1986

The Tax Reform Act of 1986 is well understood to favor ownership over renting (Hendershott, Follain and Ling, 1987). Owner costs will decline relative to renter costs, and after-tax income for low and moderate income households will rise. Here we translate the changes in these costs and incomes into changes in ownership, using our estimates for the ownership decision.

The Tax Act will increase our real after-tax income variable by 2 to 3 percent for married couples under 30 and by 2½ to 3½ percent for married couples 30-44. The slightly larger percentage for older couples follows from the assumption of two dependents for older households versus one for younger (and the substantial increase in the personal exemption). These increases are roughly independent of income throughout the $15,000 to $60,000 range. Given that average tax rates over these incomes rise from 8 to 25 percent under prel986 tax law, the percentage tax cut declines from roughly 25 to 40 percent at $15,000 (the higher number for married couples with two exemptions) to 7 to 8 percent at $60,000. (Note that these tax cuts are for renters; owners experience slight tax increases because the cut in marginal tax rates reduces the value of their housing deductions.) These average tax cuts exceed those reported in the press, especially at higher incomes. The press data are averages for renters and owners; the averages decrease sharply as income rises because the weight given to owners rises sharply.

In the absence of a decline in interest rates, the Tax Act will tend to raise owner costs, owing to the decline in tenure-choice tax rates, but rental costs will increase even more. With a percentage point decline in interest rates, owner costs will fall for most households, and the increase in rental costs will be less. The ratios of owner costs to rental costs for different income households are largely independent of whether interest rates are constant or decline by a percentage point, and thus so are the ownership rates. In our calculations, we draw upon the analysis of Hendershott, Follain and Ling (1987) which assumes a percentage point decline in interest rates and predicts a 10 percent increase in rents. With these assumptions, the ratio of owner to renter costs declines by 10 to 15 percent.

Table 8 reports the simulated increases in ownership rates for married couples in our four age classes for three different before-tax income levels: 15,000, 25,000, and 40,000 (1988 dollars). Because the price elasticities decline with income, the responses are greater for lower income households. For low income ($15,000) households, the ownership rate rises 2½ to 4 percentage points. By the $40,000 income level, the increase is under a percentage point, and at the $60,000 income level the response is effectively zero.

In 1983, roughly 9 million of the 25 million married couples under 45 had incomes between $10,000 and $25,000. A 2½ percentage point increase in their ownership rate would increase the number of owners by 225,000. A one percentage point increase in the rate for the about 7 million married couples under 45 with incomes between $25,000 and $40,000 would increase owners by 70,000 more. The total 300,000 increase would constitute a 1¼ percentage point rise in the ownership rate of all married couples under age 45. This increase will occur over an extended period of time. Hendershott, Follain and Ling (1987) argue that the rents will rise over a three to eight year period, the longer adjustment occurring in areas with vacancy rates far above equilibrium levels. Adding our two year ownership response suggests that the full ownership effect will take five to ten years.

V. Summary

Ownership patterns for young (under 45) married couples are striking in two respects. First, ownership rates rise dramatically with age: couples 35-44 consistently have ownership rates nearly 50 percentage points higher than couples under 25. Second, half of the sharp ownership gains of young married

couples in the 1970s were reversed in the first half of the 1980s. These patterns do not hold either for single or other households or for married couples over 44.

According to our estimates, roughly two-fifths of the rise in age-specific ownership rates from under 25 to 35-44 is attributable to the increase in income and reduction in mobility associated with age. Both of these changes reduce the annual cost of ownership (a higher tax bracket favors investment in a nontaxed asset and a longer holding period lowers annual equivalent transaction costs). Moreover, the taste for ownership seems to rise with income. The other three-fifths of the rise in age-specific ownership with age is likely attributable to the greater wealth (less difficulty in making a down payment) and larger number of dependents (and resultant greater demand for privacy) of older married couples.

Our estimates explain over half of both the increase in ownership rates of our four age classes between 1973 and 1979 and the decrease between 1979 and 1983. Virtually all of the differences in trend changes in ownership rates over the full 1973-83 period (2½ percentage point decrease for married couples under 25 versus 2 percentage point increase for those 35-44) is explained. Most of the explanation comes from changes in the cost of owning relative to renting, although the trend increase in ownership for those 35-44 is due solely to higher income.

For young married couples, the income elasticity of ownership is in the 0.3 to 0.6 range, and it seems to decline with age. This estimate is roughly consistent with Rosen's. The price elasticity declines sharply with both age and income, exceeding -0.5 (in absolute value) for married couples under age 25 with incomes below $20,000 but being near zero for married couples with incomes over $50,000 or over age 44. These estimates are roughly consistent with the time series estimates of -0.15 (Hendershott and Shilling; Rosen and Rosen) but

are only a tenth to a fifth of Rosen's cross sectional estimate. We illustrate that estimates more comparable to Rosen's can be obtained from our data when the cross-sectional variation is allowed to dominate the estimates, but that such estimates are grossly inconsistent with the time series behavior of ownership rates. This suggests a potential danger in using cross-section estimates to interpret time series variation.

The Tax Reform Act of 1986 will raise after-tax incomes of married couples and lower their cost of owning relative to renting. Thus an increase in ownership should be expected. However, the increase in after-tax income is small (2 to 3 percent), and our estimates of the price elasticities are low. Thus we would forecast only a 300,000 increase in owning married couples or about a 1¼ percentage point increase in the aggregate ownership rate of married couples under 45.

FOOTNOTES

[1] Linear interpolations at incomes below $20,000 can give rise to substantial error because the ownership-income curve is quite nonlinear; thus the lowest income level in the table is $22,500 (median incomes for owners in the four age classes are roughly $22,500, $30,000, $33,000 and $36,000).

[2] Bracket creep acted to raise tenure choice tax rates sharply between 1973 and 1979. However, the increase in the personal exemption from $1000 to $3200 in 1977 offset much, if not all, of the creep for those with incomes between 22,500 and 30,000 (1986 dollars).

[3] Heteroscadasticity is present when aggregated data are used. A procedure suggested by Kmenta (1986) was employed to correct for this problem.

[4] Two other variables were tested: an age-class unemployment rate (possibly a proxy for income uncertainty) and a mortgage payment constraint variable. The unemployment rate had a coefficient near zero; the coefficient on the constraint variable was unexpectedly positive.

[5] The elasticity of ownership with respect to the cost of owner housing $(\partial \ln o^i / \partial \ln p_o^i$ is:

$$\epsilon(o^i, p_o^i) = (1 - o^i)[b_1 + 2b_3 \ln p_o^i - (2b_3 + b_5) \ln y^i + b_5 \ln p_x].$$

The elasticity of the ownership rate with respect to the cost of rental housing is the negative of the elasticity with respect to the cost of owner housing plus $(1-o_i)2b_3 \ln(p_o^i/p_r)$. Lastly, the elasticity of ownership with respect to income is $(1-o^i)[b_6 y^i - (2b_3 + b_5)\ln(p_o^i/p_r)]$.

[6] Moreover, the equation would predict an enormous (about 20 percentage point) ownership decline between 1983 and 1985 when the jump in owner costs between 1979 and 1981 was allowed to have its full impact.

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Table 1: Potential and Actual Data Observations

Year	Potential (income classes)	Actual			
		Under 25	25-29	30-34	35-44
1973	7	5	5	5	5
1974	7	5	5	5	5
1975	9	7	7	7	7
1976	9	6	6	6	6
1977	10	7	7	7	7
1978	10	7	7	7	8
1979	10	6	7	7	7
1980	10	5	6	7	7
1981	10	6	7	7	7
1983	10	6	7	7	7
Total	94	60	64	65	66

Table 2: Ownership Rates and Annual Costs of Owner Housing for Married Households by Age and Real Income (in 1986 Dollars)

	Under 25				25-29				30-34				35-44			
Income:	22500	30000	37500	45000	22500	30000	45000	60000	22500	30000	45000	60000	22500	30000	45000	60000
Ownership Rates (Percent)																
1973	35	40	41	42	53	59	62	65	62	75	80	83	71	76	87	89
1979	41	48	50	53	54	65	75	80	68	78	86	89	75	84	90	93
1983	36	41	46	52	50	57	67	75	64	74	80	83	74	83	88	91
Annual Costs (per $ of housing)																
1973	.0865	.0825	.0793	.0767	.0759	.0725	.0674	.0624	.0759	.0735	.0678	.0627	.0724	.0702	.0648	.0598
1979	.0805	.0717	.0637	.0574	.0686	.0605	.0469	.0370	.0694	.0616	.0472	.0385	.0662	.0586	.0442	.0362
1983	.1537	.1434	.1361	.1285	.1382	.1287	.1150	.1072	.1390	.1297	.1163	.1077	.1319	.1229	.1102	.1028

Table 3: Unpooled Age Class Ownership Estimates
(t-statistics in parentheses)

Variable	Age Class			
	25	25-29	30-34	35-44
price ratio: $\ln (p_o^i/p_r)$	-4.56 (2.2)	-7.16 (3.5)	-8.19 (3.8)	-7.48 (4.2)
current price ratio less lagged two years	.55 (2.2)	.68 (3.3)	.67 (3.0)	.47 (2.6)
current price ratio less lagged four years	.79 (2.2)	.02 (0.0)	-.56 (1.3)	-.40 (1.1)
price ratio times income: $\ln(p_o^i/p_r)\ln y$	.69 (2.2)	1.14 (3.0)	1.42 (3.3)	1.07 (3.0)
price ratio times price index $\ln(p_o^i/p_r)\ln p_x$	-2.01 (1.5)	-2.96 (2.2)	-3.78 (2.5)	-2.25 (1.9)
difference in squared price ratios: $(\ln p_o^i)^2 - (\ln p_r)^2$	.66 (1.2)	.91 (1.8)	1.18 (2.1)	.59 (1.4)
income: y	.31 (4.5)	.46 (7.4)	.59 (8.4)	.70 12.4)
constant	-1.16 (7.0)	-.89 (8.2)	-.46 (3.5)	-.31 (3.3)
$\bar{R}^2$	.946	.886	.961	.984

Table 4: Pooled Ownership Estimates
(t-statistics in parentheses)

	Equation (1): Constant Varies by Age Class	Equation (2): Constant and Income Coefficient Varying by Age Class
price ratio	-6.15 (6.3)	-6.90 (7.4)
current price ratio less lagged 2 years	.56 (5.3)	.52 (5.4)
price ratio times income	.90 (5.0)	.95 (6.2)
price ratio times price index	-2.15 (3.5)	-2.06 (3.9)
difference in squared price ratios	.62 (2.8)	.62 (2.8)
income	.54 (17.2)	
$\bar{R}^2$	.965	.968

	Age Class				Age Class			
	25	25-29	30-34	35-44	25	25-29	30-34	35-44
constant*	-1.63 (32.1)	-1.05 (30.1)	-.41 (10.3)	-.03 (0.6)	-1.34 (9.9)	-.94 (8.0)	-.47 (2.9)	-.19 (2.8)
income*					.40 (4.1)	.50 (3.2)	.57 (1.1)	.61 (20.5)
income elasticity**	.769	.555	.364	.257	.448	.503	.373	.274
price elasticity**	-.180	-.124	-.049	-.039	-.348	-.227	-.106	-.075

*The t-statistics for married couples under 35 refer to the significance of the coefficients from that for the 35-44 age class, not from zero.

**Computed for medium income owners in 1973.

Table 5: Income and Price Elasticities and Ownership Rates, 1973

1973 Income	Income 4000	6000	8500	12500	20000
Median After-tax Income in 1985 $	9119	13680	19379	28496	45593
Income Elasticities					
Under 25	.51	.54	.60	.68	.70
25-29	.39	.44	.48	.55	.46
30-34	.47	.38	.39	.38	.27
35-44	.39	.30	.31	.29	.18
Own Price Elasticities					
Under 25	-.85	-.57	-.36	-.14	.04
25-29	-.84	-.56	-.36	-.13	-.01
30-34	-.61	-.42	-.25	-.09	-.01
35-44	-.55	-.36	-.20	-.08	-.01
Estimated/Observed Ownership Rates					
Under 25	.21/.18	.27/.28	.34/.33	.44/.39	.62/.42
25-29	.34/.24	.42/.37	.50/.50	.61/.59	.79/.62
30-34	.42/.37	.56/.49	.65/.56	.76/.74	.89/.80
35-44	.51/.55	.65/.58	.73/.67	.83/.80	.93/.87

Table 6: Ownership Rates and Median After-Tax Real Incomes (1985$) by Age Class

	Under 25	25-29	30-34	35-44
Average Ownership Rate				
1973	.326	.541	.708	.794
1979	.374	.589	.751	.832
1983	.310	.530	.702	.812
Median After-Tax Real Income				
1973	19908	24876	28000	29416
1979	20495	25597	28131	30150
1983	19610	25674	28571	31359

Table 7: Changes in Observed Average Ownership Rates and in Simulated Ownership Rates for Median Income Married Couples

	Age Class			
	Under 25	25-29	30-34	35-44
1973 to 1979:				
Observed Change	.049	.048	.043	.038
Simulated Change	.009	.034	.026	.024
Due to Price Variation	.003	.027	.025	.020
1979 to 1983:				
Observed Change	-.064	-.059	-.049	-.020
Simulated Change	-.038	-.039	-.022	-.008
Due to Price Variation	-.027	-.046	-.029	-.022
1973 to 1983:				
Observed Change	-.015	-.011	-.006	.018
Simulated Change	-.029	-.005	.004	.017
Due to Price Variation	-.024	-.019	-.004	-.002

Table 8: Long Run Impact of the Tax Reform Act of 1986 on Ownership Rates

Before-Tax Income as Renters, 1988$	Age Class			
	Under 25	25-29	30-34	35-44
15,000	.025	.034	.037	.036
25,000	.011	.012	.013	.011
40,000	.004	.008	.008	.006

FIGURE 1: MARRIED HOUSEHOLDS, 1973

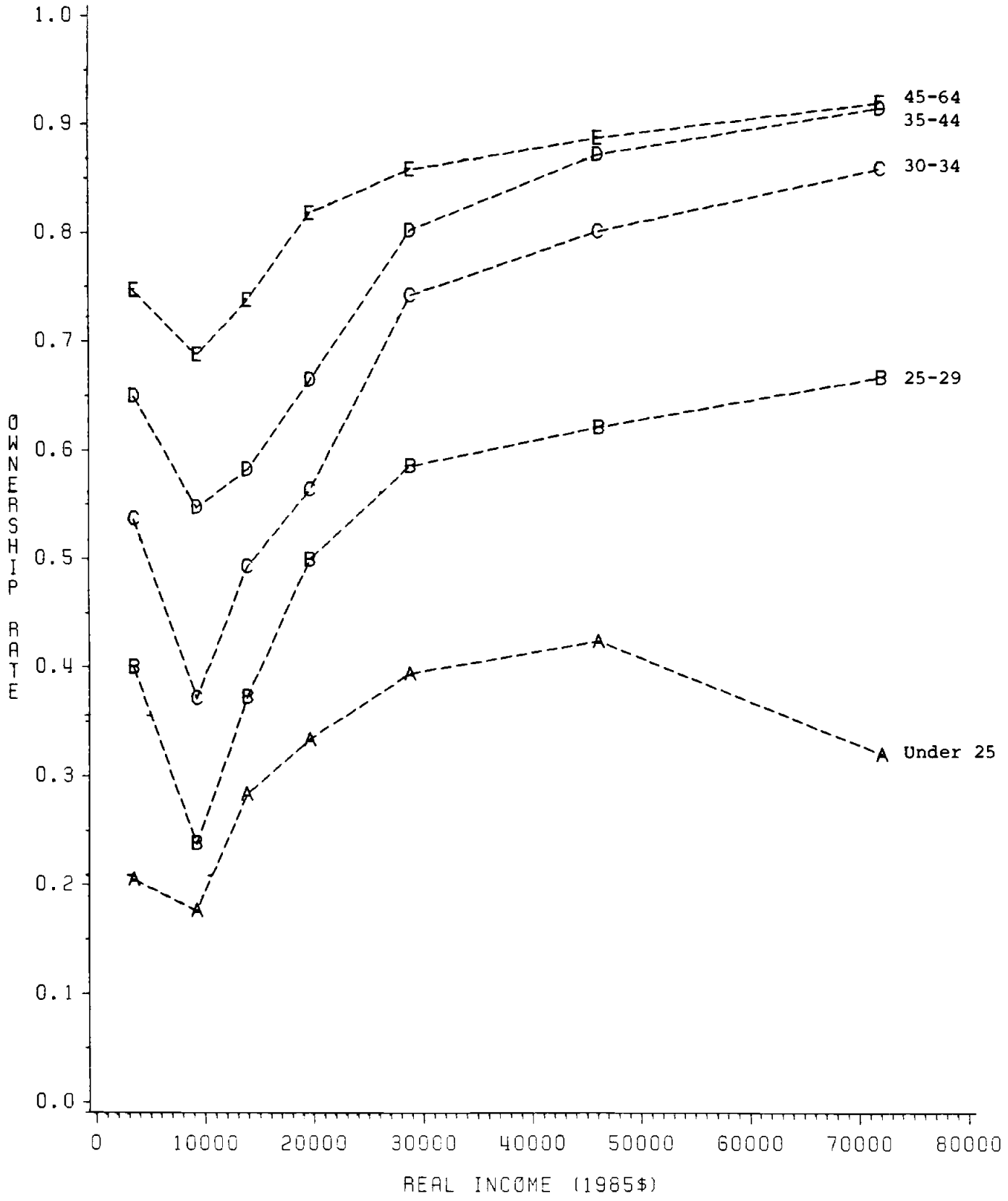
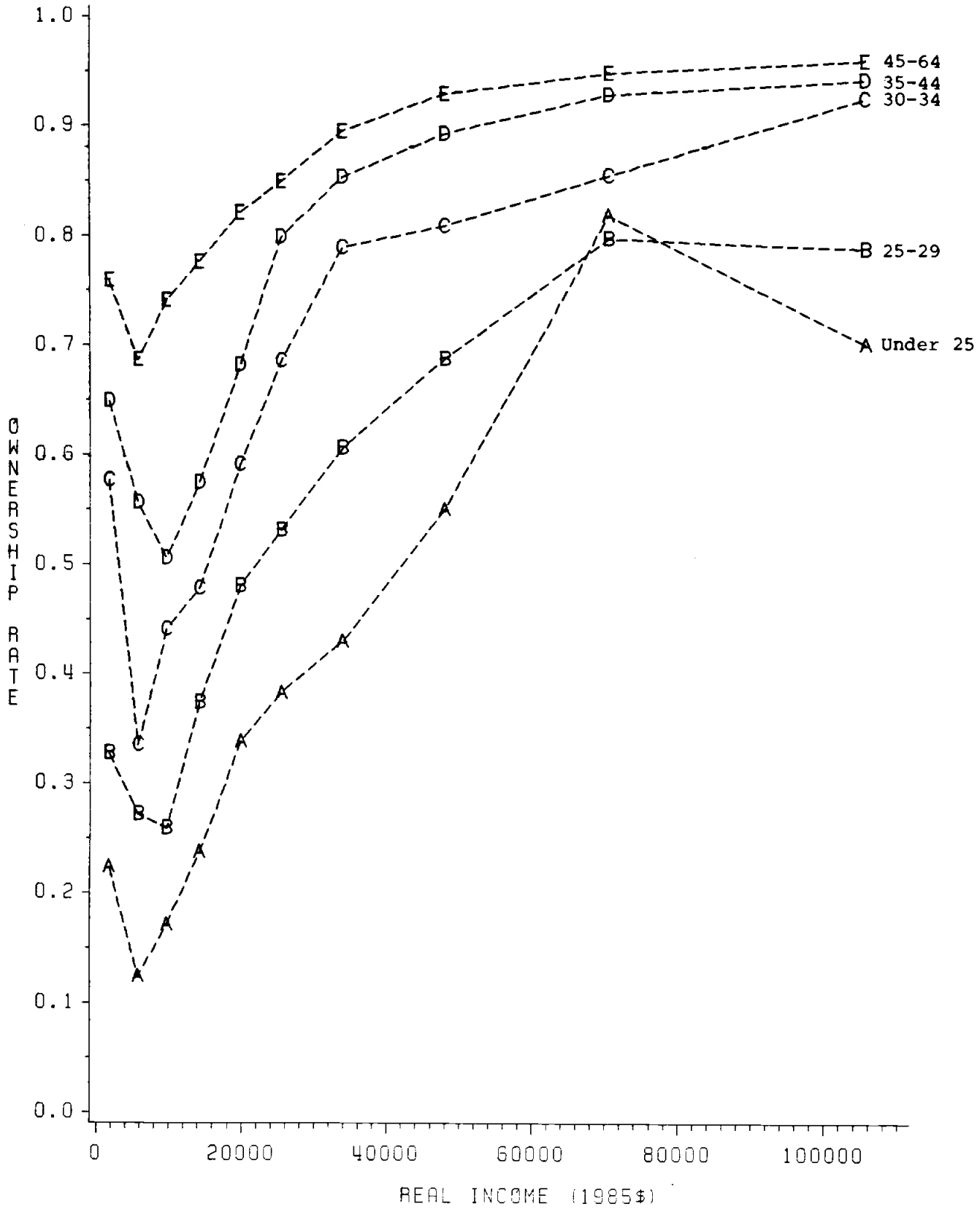


FIGURE 2: MARRIED HOUSEHOLDS, 1983



DATA APPENDIX

The calculations of the annual cost of owner-occupied housing generally follow Hendershott and Shilling (1982a, p. 107). Variables assumed to be constant over time are economic depreciation (0.012), selling costs (0.06), loan origination fee as a percent of loan (0.015), and loan- and structure-to-value ratios (0.80 and 0.83, respectively). We also assume annual maintenance expenditures equal to 2 percent of property value.

The variables that change over time are listed in Table A. Columns 1,2 and 3 contain the annual property tax rates (from Hendershott and Shilling), the contract mortgage interest rate for owner-occupied housing (the Federal Home Loan Bank Board effective interest rate, minus the estimated effect of discount points), up-front financing costs (appraisal fees, title and recording fees, for example) assumed not to vary with loan size. Estimated to be $800 in 1984, prior years are obtained by deflating by the CPI-U X1 index.

Columns 4,5, and 6 are commodity-specific expected inflation rates for the general, house price, and rent indicies, respectively. These adaptive expectations are constructed as 16-quarter distributed lags on the current and past rates of inflation of the relevent indicies (see Hendershott and Shilling). Expected general inflation for each quarter is constructed using the quarterly CPI-UX1 series; quarterly estimates are then averaged to produce the annual figures in column 4. A pure expected house price inflation series is calculated in similar fashion; the quarterly constant quality house price index and the lagged weights are first used to estimate an underlying expected quarterly house price appreciation index and then an annual average is computed. Column 5 is an average of this pure house price appreciation series and the expected rate of general inflation (column 4). The expected rate of growth in the implicit rental income that homeowners receive, column 6, is also a simple average, but in this case of expected general inflation and an

underlying expected rental rate inflation series constructed based up on the Lowry (1981) rental housing index, again using the 16-quarter lagged weights.

Column 7 contains the house price ratio used to convert nominal annual costs of owner-occupied housing into real terms. The ratio equals the constant quality house price index divided by the general (CPI-U X1) price index, with both series equal to 100 in 1972.

The price of owner-occupied housing services relevant to the tenure decision is the annual after-tax cost of obtaining the average (not the marginal) dollar's worth of owner-occupied housing services. The tax rate for this calculation is defined as the average tax rate at which housing related expenditures, including forgone interest on invested equity, are deducted. Because tenure choice tax rates vary widely across households, these tax rates, and thus annual owner costs, are estimated for married couples using the median income of each AHS income class considered in the years 1973-1983 (excluding 1982). Separate tax rate tables are inputed for each year (married couples under 30 are presumed to have one dependent; those over 30, two dependents). Property tax rates and mortgage rates for these calculations are taken from columns 1 and 2. The equity rate is presumed to be the maximum of 0.7 times the contract mortgage rate ("the tax-exempt rate") or the after-tax contract rate plus a 0.03 risk premium. Nonhousing related itemized deductions for each year, including both average and marginal state and local income tax rates, are based on the average deductions of itemizing owners in each income class considered. These averages are taken from each year's Statistics of Income data (IRS Publications 1304). Other assumptions follow Hendershott and Ling (1986). To calculate the two and four year lagged owner prices for each income class, the median income in the current year is deflated back to the lag year using the CPI-U X1 index.

The income variable used in the regression equations is the estimated after-tax income of the household, assuming it rented (and itemized if optimal do to so).

For the annual cost of rental housing, we compute the equilibrium cost for a year in which equilibrium seems to have existed and then extrapolate that cost backward and forward using a real rent series. This series, listed in column 8 of Table A, is the Lowrey index divided by the general price index (CPI-U X1), with both indicies converted to 100 in 1977. This series implies an 8 percent decline in real rents between 1972 and 1975, roughly constant real rents through 1981, and then a 7 percent rise by 1984. Given the constancy of real rents in the late 1970s, we assume equilibrium existed in 1977.

The calculation of 1977 rents employs the following equation:

$$P = -(1-t)CPIT + (1-t)RP\sum_{n=2}^{N}\frac{(1+p-d)^n}{(1+k)^n} - [(1-t)(pt+oe)]P\sum_{n=2}^{N}\frac{(1+q-yd)^n}{(1+k)^n} + t\sum_{n=2}^{N}\frac{DEP_n}{(1+k)^n}$$

$$+ \frac{P(1-B)(1+q-yd)^N}{(1+k)^N} - \frac{g[P(1+q-yd)^N-(P-SL)]}{(1+k)^N} - \frac{t(TD-SL)}{(1+k)^N} .$$

where CPIT = interest and property taxes incurred during the one year construction period,
t = marginal tax rate of the marginal investor in rental property,
R = rent during first year of operation,
p = expected inflation rate in rents,
q = expected inflation rate in asset value,
d = rate of economic depreciation,
k = weighted average cost of capital,
pt = annual property tax rate,
oe = annual operating expense rate,
y = initial structure to value ratio,
DEP_n = tax depreciation in year n,
B = percentage selling cost,
N = optimal expected holding period,
g = capital gains tax rate,
SL = depreciation accumulated under straight-line method, and
TD = accumulated tax depreciation.

The cost of capital (or capital budgeting) approach is employed. Rather than including debt payments in the cash flows, all nondebt payments are discounted by the weighted average cost of capital (average of debt and equity rates), equal to 6.4% in 1977 (Hendershott, Follain and Ling, 1987). Economic depreciation rates of 0.014 for rents and 0.018 for prices are assumed, and the expected rate of inflation in both rents and value is taken to be the general expected inflation rate. Other assumptions include: t=0.5, g=0.25, pt=0.014, oe=0.02, B=0.03, y=0.88 and DEP_n is based on 200% declining balance over 30 years. The holding period, N, is determined endogenously as that which minimizes the rental price. Solving the above equation for R and dividing through by P produces estimates of the 1977 rental price per dollar of purchase price. These results are multiplied by 1.1358, the change in real house prices between 1973 and 1977 (column 7), to obtain the column 9 real rental price estimates of 0.0737 for 1977. This value is extrapolated forward and backward using column 8.

Table A: Data Series

Year	(1) Property Tax Rate	(2) Contract Mtg. Rate	(3) Other Up-Front Costs	(4) CPI-U Xl Expected Gen. Inf.	(5) Expected House Price Inflation	(6) Expected Rent Inflation	(7) Real House Price Ratio	(8) Rent Price Ratio	(9) Rental Index
69	0.0193	0.0765	312	0.0403	0.0504	0.0359	0.9767	1.0397	0.0766
70	0.0205	0.0829	326	0.0438	0.0443	0.0414	0.9572	1.0386	0.0766
71	0.0206	0.0758	337	0.0435	0.0466	0.0464	0.9678	1.0548	0.0778
72	0.0195	0.0743	349	0.0370	0.0465	0.0420	1.0000	1.0671	0.0787
73	0.0179	0.0797	378	0.0506	0.0619	0.0491	1.0226	1.0500	0.0774
74	0.0167	0.0908	420	0.0766	0.0814	0.0639	1.0178	1.0050	0.0741
75	0.0166	0.0900	448	0.0787	0.0856	0.0665	1.0389	0.9867	0.0727
76	0.0161	0.0883	470	0.0682	0.0795	0.0632	1.0710	0.9920	0.0731
77	0.0151	0.0880	500	0.0636	0.0852	0.0641	1.1358	1.0000	0.0737
78	0.0126	0.0956	539	0.0649	0.0936	0.0661	1.2112	0.9998	0.0737
79	0.0113	0.1110	598	0.0805	0.1068	0.0765	1.2659	0.9824	0.0724
80	0.0108	0.1360	662	0.0956	0.1059	0.0892	1.2529	0.9676	0.0713
81	0.0110	0.1634	718	0.0945	0.0964	0.0915	1.2469	0.9698	0.0715
82	0.0110	0.1608	754	0.0758	0.0671	0.0806	1.2104	0.9921	0.0731
83	0.0110	0.1282	783	0.0548	0.0454	0.0646	1.1890	1.0173	0.0750
84	0.0110	0.1374	800	0.0407	0.0390	0.0510	1.2021	1.0360	0.0764

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