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THE DYNAMICS OF HOUSING DEMAND BY THE ELDERLY: WEALTH, CASH FLOW, AND DEMOGRAPHIC EFFECTS

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ABSTRACT

Using Waves one through fifteen of the PSID data set, we investigate the pattern of housing mobility amongst the elderly. We focus especially on two issues: (1) Determining which household characteristics tend to increase the probability of a move; and (2) Whether elderly households systematically move to smaller, less expensive dwellings when they do move, and, if so, which characteristics make such "downsizing" particularly likely. We find that wealthier households are less likely to move and to downsize, and that changes in family composition or retirement status significantly increase the likelihood of a move. We do not find much evidence of imperfections in the housing market, or of pervasive liquidity constraints. Finally, we develop a Lagrange Multiplier test for unobserved heterogeneity amongst elderly households, and strongly reject the null hypothesis of homogeneity.

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THE DYNAMICS OF HOUSING DEMAND BY THE ELDERLY
I. WEALTH, CASH FLOW, AND DEMOGRAPHIC EFFECTS

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I. INTRODUCTION

The stereotype of the housing problem of the elderly is the following case:

> Mrs. R is a 74 year old widow who continues to live alone in the four bedroom family home. She has difficulty paying the utilities on this dwelling, and has been unable to adequately maintain the property. Because of arthritis, she has increasing difficulty with the stairs. Mrs. R's house is fully paid for. If she were to sell it, she could easily afford the rent on an apartment in a nearby elderly housing complex. However, despite the urging of her children, she has resisted moving, claiming the alternative is "too expensive" and she is "not sure she would like it".

The main question we will address is whether this stereotype is accurate. Is there a significant elderly population living in housing that appears to be inappropriate in terms of physical needs and financial resources? Are the elderly constrained by illiquidity of assets, and therefore forced to move to smaller properties or rentals to dissave? If so, does the market fail to provide alternatives, or through some imperfection create barriers to moving? Or, is lack of mobility a "rational" manifestation of tastes?

The appropriateness of policy initiatives in the elderly housing market depend on the answers to these questions. If the stereotype is pervasive, then market-wide policies may be called for; otherwise, it may be more appropriate to concentrate on programs directed to individuals in trouble. If there are significant imperfections in the housing market the elderly face, then initiatives that reduce imperfections by providing information, insurance, risk pooling, or licensing should be considered. If tastes are the source of the problem, then the question is whether one can, or should, modify tastes through promotional campaigns. If intervention appears appropriate, should it be directed to programs that permit the elderly to stay on in their homes, such as reverse annuity mortgages and home care services? Or, is it better to encourage trading down to more suitable facilities, freeing larger dwellings for the market, by policies such as deferral of capital gains taxes, assistance in searching for housing, and reverse annuity mortgages applied to trade-downs?

This investigation concentrates on the effects of wealth, cash flow, and changes in household demographics on mobility and housing expenditure decisions of the elderly. We examine several issues. First, do mobility patterns suggest the presence of significant capital market imperfections that prevent elderly owners from life-cycle dissaving? Second, are moves closely associated with demographic shocks such as retirement, death of a spouse, or children leaving home, so that economic incentives (and policies that affect these incentives) impact elderly households through rather narrow windows? Finally, do these variables collectively provide an adequate description of mobility amongst the elderly, or is there evidence of substantial remaining unexplained variation amongst households?

The remainder of the paper is organized as follows. The next section provides descriptive statistics of our data set, which is based on the PSID (Panel Study of Income Dynamics). Section III presents estimates of a series of models of mobility and changes in housing status amongst movers. Section IV provides a test for the presence of unobserved heterogeneity amongst households. Section V presents some conclusions, Section VI a discussion of potential future research, and an appendix provides some data details.

II. SOME DESCRIPTIVE STATISTICS

Using the PSID, we have summarized a few features of housing behavior of the elderly. We have used the first 15 waves of the panel, from 1968 through 1982. We confine our attention to households that in 1968 had either head or wife over 50 years of age; there are 1131 households meeting this condition. First, what is the mobility of the elderly, and how is it changing over time? FIGURE 1 shows mobility rates by age of head in each of three periods. Mobility rates decline from the 55-64 age bracket to the 65-74 age bracket, but rise (insignificantly) in the 75+ age bracket. Mobility appears to be slightly higher after 1972 than before; FIGURE 2 shows the mobility rate of households with heads over 65 by year. FIGURE 3 tables the patterns of tenure changes with moves for households with heads over 65. The "other" category in this table encompasses a variety of arrangements, such as living with relatives, living in a place of business, or living on a working farm. The table shows 32.4 percent of moves result in tenure changes. There is a modest net flow from owning to the remaining categories. Thus, the crude evidence suggests only weak disaccumulation of real assets by exiting ownership. This pattern is consistent with that found by Merrill (1982) in the Retirement History Survey.

How pervasive is occupancy of "inappropriate" housing by the elderly? Merrill (1982) reports from Retirement History Survey data the following median ratios for a sample that were between ages 66 and 71 in 1977, and who were homeowners in 1969, or 1977, or both:

Home equity as a proportion of wealth	0.763
Ratio of shelter cost/income	0.167
Persons per room	0.333

FIGURE 1

CRUDE MOBILITY VERSUS AGE

AGE	CASES	MOBILITY RATE	STANDARD DEVIATION
1968-72			
55-64	2148	8.15%	0.59%
65-74	889	6.30%	0.81%
75 +	236	3.81%	1.25%
1973-77			
55-64	2635	9.11%	0.56%
65-74	1762	6.75%	0.60%
75 +	629	8.59%	1.12%
1978-82			
55-64	1519	8.56%	0.72%
65-74	2530	7.19%	0.51%
75 +	1185	8.02%	0.79%
1968-82			
55-64	6302	8.65%	0.35%
65-74	5181	6.89%	0.35%
75 +	2050	7.71%	0.59%

FIGURE 2. CRUDE MOBILITY RATES, AGE 65+

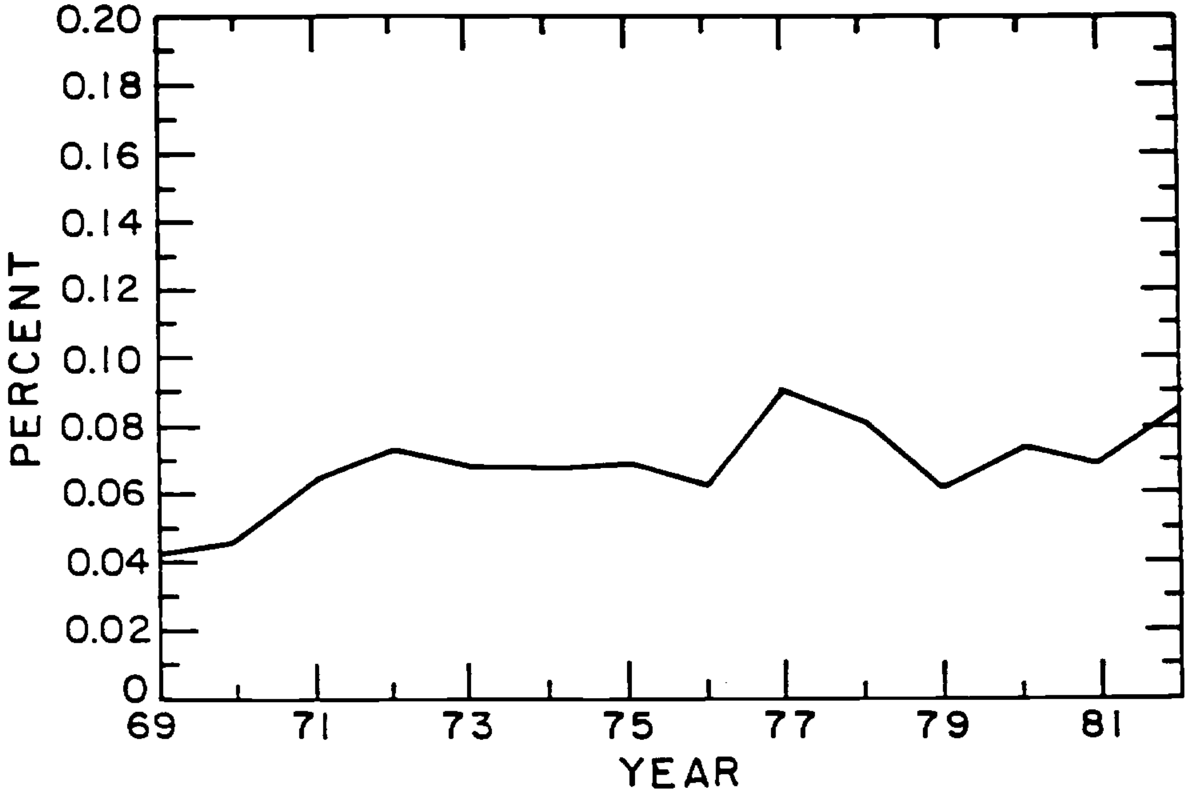

FIGURE 3

TENURE CHANGES WITH MOVES, AGE 65 +
(Cell counts, Percentages, and Standard Errors of Percentages)

	MOVE TO			
MOVE FROM	OWN	RENT	OTHER	TOTAL
OWN	141 62.7% (3.2%)	59 26.2% (2.9%)	25 11.1% (2.1%)	225 43.7% (2.2%)
RENT	34 14.4% (2.3%)	191 80.9% (2.6%)	11 4.7% (1.4%)	236 45.8% (2.2%)
OTHER	14 25.9% (6.0%)	24 44.4% (6.8%)	16 29.6% (6.2%)	54 10.5% (1.4%)
TOTAL	189 36.7% (2.1%)	274 53.2% (2.2%)	52 10.1% (1.3%)	515

Consider the information on dwelling size in the PSID. Define, arbitrarily, excess size to be a dwelling with a number of rooms exceeding the number of residents plus three. FIGURE 4 shows for three periods the proportion of households of each age living in dwellings of excess size. First, note that the proportion of households in large dwellings is substantial. While this may simply reflect tastes for consumption of housing services in a well-functioning market, it nevertheless indicates the potential for substantial transfers of housing services to younger families. The proportion in units of excess size increases with age. The pattern has not shifted substantially over time.

How pervasive is occupancy of "unaffordable" housing by the elderly? To answer this question, we have compared income with out-of-pocket housing costs. Income is measured current after-tax. Out-of-pocket housing costs for homeowners are the sum of utility costs, mortgage payments, property taxes, and maintenance and insurance costs. Maintenance and insurance costs are imputed to equal 2 percent of house value. This is based on a maintenance rate of 1.5 percent of house value, obtained from unit expenditures given in the U.S. Bureau of the Census Construction Reports (Series C50). For renters, the housing cost variable is the sum of utility cost and rent. Construction of these variables is detailed in the Appendix. Housing budget share is defined as the ratio of out-of-pocket housing costs to current after-tax income. FIGURE 5 shows the average housing budget share for owners and renters in various age categories in three periods. This figure excludes households in "other" living arrangements, and also excludes "poverty-level" households with disposable income below $5000 in 1982 dollars. Renter budget shares are comparable to those for owners. (Remember that these are cash flow shares, and do not reflect capital gains to owners.) For the entire 1968-82 period, there is a decline in budget share from the 55-64 age category to the 65-74 category, then a marginal increase to the 75+

FIGURE 4

HOUSEHOLDS IN DWELLINGS OF "EXCESS" SIZE
(Cases, Percentages, and Standard Errors of Percentages)

Age	1968-72	1973-77	1978-82	1968-82
55-64	2575 27.1% (0.9%)	2614 31.1% (0.9%)	1502 34.9% (1.2%)	6691 30.4% (0.6%)
65-74	1043 40.5% (1.5%)	1745 38.2% (1.2%)	2494 35.7% (1.0%)	5282 37.4% (0.7%)
75 +	277 39.7% (2.9%)	627 41.0% (2.0%)	1162 38.1% (1.4%)	2066 39.2% (1.1%)

NOTE: **A dwelling is defined to be of "excess" size if the number of rooms less the family size exceeds 3 .**

FIGURE 5

AVERAGE SHARE OF OUT OF POCKET COST IN AFTER-TAX INCOME,
HOUSEHOLDS WITH $5000 OR MORE AFTER-TAX INCOME (1982$)

	OWNERS			RENTERS		
AGE	SHARE	STD DEV	CASES	SHARE	STD DEV	CASES
1968-72						
55-64	19.1%	14.1%	970	19.6%	11.3%	421
65-74	15.1%	11.5%	543	15.9%	10.0%	105
75 +	16.0%	11.5%	125	18.4%	10.4%	31
1973-77						
55-64	19.1%	15.7%	1590	19.5%	13.3%	634
65-74	15.9%	14.2%	1246	16.2%	8.6%	382
75 +	14.9%	13.1%	459	17.6%	13.2%	115
1978-82						
55-64	25.5%	22.4%	717	18.2%	12.9%	285
65-74	20.2%	16.6%	1517	18.4%	13.9%	635
75 +	19.5%	14.9%	785	21.4%	17.8%	263
1968-82						
55-64	20.5%	17.2%	3277	19.3%	12.6%	1340
65-74	17.7%	15.1%	3306	17.4%	12.0%	1122
75 +	17.7%	14.2%	1369	20.1%	16.2%	409

age category. Over time, renter budget shares have been stable, while owner budget have increased.

FIGURE 6 gives the distribution of the share of out-of-pocket housing costs in income by age bracket for homeowners and for renters. Note first that 8.8 percent of renters and 10.8 percent of owners have budget shares exceeding 0.4. For owners, there are mitigating factors, including capital gains in equity and the possibility of deferring maintenance. Nevertheless, there is an economically significant elderly population for whom financing shelter costs from cash flow is burdensome. Second, there is a clear pattern for owners of an increasing proportion of high-burden households. This is not the case for renters. Third, there is no evidence of increasing burden with age; the proportion of high-burden households in the 75+ age category is less than that for households in the 55-65 category.

The life-cycle theory of consumption implies that expenditures on housing services should be determined by lifetime wealth (and life-cycle demographics) rather than by current income or wealth composition, with transitory income fluctuations smoothed by asset changes. The operation of this theory requires good capital markets, without credit rationing or wedges between buying and selling prices for assets. In particular, for individuals whose assets are primarily an owner-occupied dwelling, life-cycle planning would often require the market to finance dis-saving by the elderly through borrowing secured by equity in the dwelling; e.g., reverse annuity mortgages. Alternatives are for the elderly to extract equity by trading-down to smaller owner-occupied housing, moving to a rental, or deferring maintenance and repair. On the other hand, bequest motives may encourage ownership as a convenient channel for holding assets.

Using the PSID data, we have constructed a measure of wealth from age-specific income and assets, observed future wage and transfer income during the period of the panel, and projections of these income streams beyond the panel. The construction is detailed in the Ap-

FIGURE 6

DISTRIBUTION OF SHARE OF OUT-OF-POCKET HOUSING COST IN AFTER-TAX INCOME

PERIOD	BUDGET SHARE	OWNERS			RENTERS		
		55-64	65-74	75 +	55-64	65-74	75 +
1968-72							
	0.0-0.2	49.1%	61.7%	60.0%	39.7%	58.1%	48.4%
	0.2-0.3	28.4%	26.7%	21.6%	34.9%	29.5%	38.7%
	0.3-0.4	12.3%	7.2%	11.2%	14.0%	8.6%	3.2%
	0.4-0.5	5.7%	2.2%	4.0%	8.3%	1.9%	3.2%
	0.5 +	4.6%	2.2%	3.2%	3.1%	1.9%	6.5%
		970	543	125	421	105	31
1973-77							
	0.0-0.2	50.8%	61.8%	66.9%	44.5%	51.6%	56.5%
	0.2-0.3	25.3%	23.2%	19.6%	31.2%	33.8%	29.6%
	0.3-0.4	13.0%	8.5%	6.1%	14.4%	10.7%	5.2%
	0.4-0.5	5.6%	2.8%	3.3%	4.9%	3.7%	3.5%
	0.5 +	5.3%	3.7%	4.1%	5.0%	0.3%	5.2%
		1590	1246	459	634	382	115
1978-82							
	0.0-0.2	37.4%	45.7%	48.8%	54.0%	52.8%	46.4%
	0.2-0.3	28.2%	30.3%	28.0%	26.3%	26.9%	28.9%
	0.3-0.4	11.7%	11.5%	12.6%	9.8%	12.1%	13.7%
	0.4-0.5	9.1%	5.7%	5.0%	4.9%	3.6%	4.6%
	0.5 +	13.7%	6.7%	5.6%	4.9%	4.6%	6.5%
		717	1517	785	285	635	263
1968-82							
	0.0-0.2	47.3%	54.4%	55.9%	45.0%	52.9%	49.4%
	0.2-0.3	26.8%	27.0%	24.6%	31.3%	29.5%	29.8%
	0.3-0.4	12.5%	9.7%	10.3%	13.3%	11.3%	10.5%
	0.4-0.5	6.4%	4.1%	4.3%	6.0%	3.5%	4.2%
	0.5 +	7.0%	4.8%	4.9%	4.4%	2.9%	6.1%
		3277	3306	1369	1340	1122	409

pendix. FIGURE 7 shows mobility rates classified by wealth and age categories. There is no uniform pattern of mobility shifts with age within a wealth category. The figure indicates sharply decreasing mobility with increasing wealth for renters, but relatively little effect of wealth on owner mobility. With owners concentrated in higher wealth brackets, the mobility variation with wealth for all households combined is a correlate of the differences of mobility between owners and renters. To a considerable extent, tenure choice is endogenously related to the propensity to move, with the transactions costs of ownership encouraging renting by highly mobile households, and the lower costs of moving encouraging more frequent "fine tuning" of housing consumption by renters. Self-selection into the population of owners is likely to yield low-wealth households that have a low propensity to move. These results indicate that association of wealth and mobility in the elderly population as a whole operates primarily through tenure choice.

The existence of substantial assets other than an owner-occupied dwelling should facilitate decumulation of wealth, and reduce the need for owners to downsize their houses or switch tenure. FIGURE 8 shows mobility rates classified by wealth and liquidity, where a household is classified as "liquid" if it has after-tax income above $10,000 or assets (other than an owner-occupied dwelling) exceeding $20,000, in 1982$. Mobility rates are significantly elevated for renters with less than $90,000 in wealth; there is no consistent pattern of declining mobility with increasing liquidity.

If life-cycle theory applies, and the elderly are able directly or indirectly to dissave at rates that depend only on wealth, then mobility rates given wealth should be independent of current income and the composition of wealth. Then, in particular, mobility should be independent of the liquidity of the household. FIGURE 8 shows no significant decline in mobility for liquid versus non-liquid households when wealth is held constant.

FIGURE 7

MOBILITY BY WEALTH AND AGE
(Rates and standard deviations)

WEALTH	AGE		
ALL HOUSEHOLDS	55-64	65-74	75 +
0-42K	13.32% (0.93%)	11.01% (0.85%)	11.92% (1.32%)
42-90K	10.55% (0.84%)	6.11% (0.67%)	8.75% (1.17%)
90-186K	6.38% (0.60%)	5.12% (0.56%)	4.08% (0.80%)
186K +	6.07% (0.54%)	5.12% (0.69%)	3.98% (1.23%)
OWNERS			
0-42K	3.79% (0.99%)	2.48% (0.71%)	4.59% (1.24%)
42-90K	5.81% (0.86%)	2.43% (0.51%)	4.04% (0.96%)
90-186K	4.83% (0.60%)	3.96% (0.53%)	3.47% (0.78%)
186K +	5.19% (0.53%)	4.72 (0.69%)	3.43% (1.19%)
RENTERS			
0-42K	16.17% (1.25%)	15.92% (1.34%)	17.95% (2.51%)
42-90K	15.70% (1.57%)	15.76% (2.07%)	20.98% (3.40%)
90-186K	10.06% (1.59%)	11.24% (2.37%)	9.52% (3.70%)

FIGURE 8

MOBILITY BY WEALTH AND LIQUIDITY
(Age 65 +, Rates and Standard Deviations)

WEALTH	ILLIQUID	LIQUID
ALL HOUSEHOLDS		
0-42K	12.52% (0.65%)	10.64 (1.16%)
42-90K	8.79% (0.72%)	8.14% (0.68%)
90-186K	4.95K (0.79%)	5.64% (0.41%)
186K +	5.67% (1.33%)	5.60% (0.43%)
OWNERS		
0-42K	3.80% (0.67%)	2.49% (0.87%)
42-90K	4.54% (0.65%)	3.39% (0.56%)
90-186K	4.07% (0.81%)	4.26% (0.40%)
186K +	4.91% (1.33%)	4.90% (0.42%)
RENTERS		
0-42K	16.12% (0.95%)	17.06% (2.04%)
42-90K	17.03% (1.76%)	16.01% (1.59%)
90-186K	8.39% (2.32%)	10.96% (1.46%)
186K +	9.68% (5.31%)	12.70% (2.13%)

For households with head aged 65+, FIGURE 9 shows mobility by current income and asset class for various wealth classes. The evidence suggests no variation in mobility rates with income or wealth composition once wealth is fixed. Thus, these data are generally consistent with the life-cycle theory, and suggest that liquidity constraints on the elderly are not pervasive.

III. SIMPLE MODELS OF ELDERLY HOUSING DYNAMICS

In this section, we estimate simple models of a rational life-cycle household facing the decision of whether to move, and if moving whether to "downsize" to a smaller or less expensive dwelling. Economic theory indicates that the consumer will choose lifetime consumption profiles, including choice of housing, by solving a dynamic programming problem to optimize an intertemporal utility function subject to intertemporal budget constraints whose structure depends on the capital market. Henderson and Ioannides (1984) have developed a model with this structure; related models have been proposed by Artle and Varaiya (1978) and Hu (1980). In principle, these models can explain joint choice of shelter consumption levels, moving, and tenure. In practice, the models are intractable except for special cases, such as stationarity assumptions that allow application of renewal theory. Consequently, these models must be used primarily to motivate the qualitative features of empirical demand models. This problem is particularly acute when the assumption of a perfect capital market is relaxed to permit liquidity constraints and wedges between borrowing and lending rates.

Consider the decision to move. The life-cycle model suggests that in each period, the household starts from a state described by wealth (measured as the sum of home equity, other assets, and the expected present value of future income flows), characteristics of current dwelling, and demographic characteristics. For these state variables, the household calculates the present value of remaining utility for optimal consumption plans with and without a current period

FIGURE 9

MOBILITY RATES BY INCOME AND WEALTH COMPOSITION GIVEN WEALTH LEVEL

WEALTH	INCOME CLASS	LIQUID ASSET CLASS	CASES	MOBILITY	STANDARD ERROR
0-42K	<$5K	<$10K	110	16.36%	3.53%
	>$5K	<$10K			
	<$5K	>$10K	2681	15.07%	0.69%
	>$5K	>$10K	1305	16.17%	1.02%
42-90K	<$5K	<$10K	463	10.37%	1.42%
	>$5K	<$10K			
	<$5K	>$10K	2522	9.16%	0.57%
	>$5K	>$10K	533	8.82%	1.23%
90-186K	<$5K	<$10K	1110	5.86%	0.70%
	>$5K	<$10K	106	7.55%	2.57%
	<$5K	>$10K	2609	6.44%	0.48%
	>$5K	>$10K	458	6.55%	1.16%
186K +	<$5K	<$10K	1443	6.31%	0.64%
	>$5K	<$10K	154	9.74%	2.39%
	<$5K	>$10K	1904	6.83%	0.58%
	>$5K	>$10K	428	8.18%	1.32%

move, taking into account the cost of a move. A move is made if it yields the higher expected utility. In a perfect capital market, the consumer's intertemporal consumption plans, including move decisions, depend only on total wealth, not on its composition. (We abstract from the implications of portfolio composition for risk.) In particular, cash flow or holdings of liquid assets should affect consumption decisions, once the effects of wealth are taken into account, only if there are capital market imperfections. Capital market failure is most likely for low-income households with limited assets other than home ownership. Welfeld and Struyk (1978) have pointed out that a significant number of elderly households below the poverty line have this wealth configuration. The efficacy of the policy initiative to promote reverse annuity mortgages depends on whether liquidity constraints are in fact binding on these households.

In addition to wealth, and possibly cash flow and liquidity measures, the life-cycle model suggests that housing choice behavior will depend on demographic characteristics of the household, possibly interacting with features of the dwelling. Changes in household composition that alter the need for housing services should be important, as should retirement decisions that relax locational constraints. An interesting question for policy is whether these demographic changes affect mobility only over a limited period of time, giving only a narrow window in which programs to influence the destination of moves can be effective. The life-cycle model also suggests that housing choices will be sensitive to prices, and in particular to the relationship between the expected stream of net cost savings from a move compared to the direct and indirect moving cost. Housing prices are difficult to construct for the full panel of elderly households in the PSID, and analysis of their effect is left for future research.

An econometric model that captures the qualitative features of the life-cycle consumer model can be defined in terms of the marginal probability that a household will move in a year times the conditional probability, given a move, that various alternatives are chosen. The marginal probability of a move is a function of the variables described above, and in general can depend on previous state, including dwelling size, shelter expenditure, tenure, and dwelling type. The alternatives available given a move range in principle over the full set of features entering the description of the household's state. In particular, the set of alternatives includes both discrete variables such as tenure, dwelling type, and number of rooms, and continuous variables such as shelter expenditure. The current analysis will be limited to one aspect of dwelling choice, an indicator for changes in shelter expenditure. This permits us to examine the phenomenon of "downsizing" to extract equity or reduce shelter cost. Other aspects of choice among housing alternatives will be left for future research, and will examine the effects of housing prices on choices. It will be of particular interest to estimate fully specified models for transitions between alternative states that can be used in dynamic policy simulation of the housing behavior of the elderly.

In addition to dependence on demographic and housing state of mobility probabilities and conditional probabilities for choice among housing alternatives, there may be unobserved variations across households in tastes for moving, a "mover-stayer" effect. The combination of dependence on previous state and population heterogeneity creates the econometrically difficult "initial values problem" discussed by Heckman (1981). In addition, statistical dependence across states induced by the heterogeneity makes it necessary to model the probabilities of entire panel decision sequences, which may be computationally burdensome. Further, the effect of heterogeneity is to bias estimates of durations of spells between moves, due to "self-selection" over time of households more resistant to moving.

In this paper, we do not attempt to deal with unobserved heterogeneity, and instead assume housing choice behavior can be modeled as an independent Bernoulli process over years (with time-dependent explanatory variables). This simplistic modeling assumption permits us to examine some of the qualitative features predicted by the life-cycle model that are not particularly sensitive to the time profile of mobility rates for a single household. However, it should be noted that the resulting estimated models are likely to be badly biased for describing features that depend critically on time dependence, such as duration of spells between moves or number of moves. Some sense of the quality of the assumption of no unobserved heterogeneity can be obtained by examining the numbers of multiple moves made in the PSID panel. FIGURE 10 compares the observed number of moves with the numbers predicted by two simple models. The observed counts display the classic long tail characteristic of heterogeneity. Model 1 is a homogeneous Bernoulli model, estimated by maximum likelihood. A goodness of fit test strongly rejects the Bernoulli model. Model 2 is a mixture of stayers and two Bernoulli populations, one with a mobility rate of 12 percent and the second with a mobility rate of 42.4 percent, with the mixing probabilities and mobility rates fitted by minimum chi-square. This model is accepted by a goodness of fit test at the 95 percent significance level. This model corresponds very roughly to a population of "owners" who are either stayers or have the 12 percent mobility rate, and a population of "renters" with the 42.4 percent mobility rate. Neither model is a good test for unobserved heterogeneity in the PSID sample, since variation in explanatory variables which will also tend to produce rejections of simple Bernoulli models is not accounted for. However, the very poor fit of Model 1, and the significant fraction of stayers in Model 2 suggest that unobserved heterogeneity is likely to be significant. Later in this paper, we carry out a more precise Lagrange Multiplier test for the presence of unobserved heterogeneity.

Consider first the marginal move decision. Under the assumptions set out above, this can be modeled as a discrete choice, independently for each household and each period of observation. We assume a probit functional form. We fit this model to the pooled PSID data, beginning with lagged wealth (the household's assets as of last period) and head age as explana-

FIGURE 10

INDEPENDENT BERNOULLI MODEL OF NUMBER OF MOVES

NUMBER OF MOVES	OBSERVED	PREDICTED, MODEL 1	PREDICTED, MODEL 2
0	388	146	385
1	239	322	221
2	170	330	199
3	123	208	118
4	72	90	62
5	42	29	44
6	34	7	39
7	38	1	31
8	11	0	20
9	9	0	10
10	3	0	3
11	4	0	1
12-14	0	0	0
TOTAL	1133	1133	1133

MODEL 1: Bernoulli model with mobility rate 13.6 percent (maximum likelihood estimate), goodness-of-fit statistic 971 (chi-square with 12 degrees of freedom).

MODEL 2: Mixture of 0.238 "stayers", 0.61 with mobility rate 12.0 percent, 0.152 with mobility rate 42.4 percent (minimum chi-square estimates), goodness-of-fit statistic 14.7 (chi-square with 8 degrees of freedom).

tory variables, and then adding variables that may enter if liquidity constraints are binding or if demographics influence consumption decisions. FIGURE 11 shows that wealth has a significant negative effect on mobility. Mobility falls with age of head until age 74, then increases. Mobility is insensitive to changes in wealth.

FIGURE 12 introduces cash flow and an indicator for liquidity to test for the significance of capital market imperfections that introduce liquidity constraints. The new variables are LIQ-LAG, indicating either that last period's after-tax income was above $10,000 or that non-dwelling assets were above $20,000, in 1982 dollars, as of last period, and CASHLAG, measuring after-tax income of the head and spouse last period, and CASHOTHERLAG, measuring after-tax income of other household members last period (These variables are lagged, as is the wealth variable, to avoid simultaneity biases in estimation.). The LIQLAG variable is found to have a significant effect on mobility rates, with mobility falling for liquid households; CASHLAG and CASHOTHERLAG are insignificant. This provides mixed evidence that capital market imperfections may be a quantitatively significant constraint on behavior in the elderly population. However, there is some confounding of the effects of liquidity when owners and renters who face different moving costs are pooled. If liquidity is positively associated with ownership, and hence lower mobility due to higher moving costs, then LIQLAG will display a negative coefficient for this reason, and may not represent capital market imperfections. A significant liquidity effect for owners or renters separately would be stronger evidence for capital market problems.

FIGURE 13 introduces family composition effects, including a dummy variable that indicates that a wife who was present in one of the previous two periods has now gone (WIFEGONE), the number of persons who have moved out of the household since the previous period (MOVEOUT), the number of persons who have moved in (MOVEIN), the change in the number of children living at home (DELCHILDREN). As in the earlier models, wealth and head

FIGURE 11

INDEPENDENT TRIALS PROBIT MODEL OF MOBILITY

WEALTH EFFECTS

	Model 1	Model 2
CONSTANT	3.57 (1.00)	3.29 (1.03)
HEADAGE	-.13* (.029)	-.125* (.03)
$HEADAGE^2$ ($\times 10^{-3}$)	.89 (.21)	.836 (.214)
WEALTHLAG ($\times 10^{-6}$)	-.957 (.125)	-1.01 (.133)
ΔWEALTHLAG ($\times 10^{-6}$)		.106 (.286)
LOG LIKELIHOOD	-3593	-3422
# OBS	13229	12528
MOBILITY RATE	7.85%	7.91%

†Standard errors are in parentheses.

*Denotes significant at the 5% level.

FIGURE 12

INDEPENDENT TRIALS PROBIT MODEL OF MOBILITY

CASH FLOW EFFECTS

	Model 1	Model 2
CONSTANT	3.44 (1.01)	3.43 (1.01)
WEALTHLAG ($\times 10^{-6}$)	-.899 (.148)	-.903 (.148)
HEADAGE	0.129* (.029)	-.129* (.029)
HEADAGE^2 ($\times 10^{-3}$)	.869 (.210)	.867 (.210)
LIQLAG	-.114* (0.41)	-.114* (.041)
CASHLAG ($\times 10^{-6}$)	2.02 (1.69)	2.05 (1.69)
CASHOTHERLAG ($\times 10^{-6}$)		-2.54 (4.95)
LOG LIKELIHOOD	-3589	-3589
# OBS	13229	13229
MOBILITY RATE	7.85%	7.85%

FIGURE 13

INDEPENDENT TRIALS PROBIT MODEL OF MOBILITY FAMILY COMPOSITION & RETIREMENT EFFECTS

	Model 1
CONSTANT	3.45 (1.06)
WEALTHLAG ($\times 10^{-6}$)	-.759 (.166)
HEADAGE	-.135* (.031)
HEADAGE^2 ($\times 10^{-3}$)	.934 (.220)
LIQLAG	-.135* (.043)
CASHLAG ($\times 10^{-6}$)	1.41 (1.81)
CASHOTHERLAG ($\times 10^{-6}$)	-5.74 (5.12)
WIFEGONE	.349* (.071)
MOVEOUT	.076* (.039)
MOVEIN	.334* (.046)
HEADRETDUM	.198* (.057)
WIFERETDUM	.271* (.055)
ΔCHILDREN	-.170* (.051)
LOG LIKELIHOOD	-3339
# OBS	12524
MOBILITY RATE	7.91%

age are significant, as are LIQLAG and CASHLAG. The demographic shocks of a wife disappearing or individuals moving into the household significantly increase mobility, as does a decrease in the number of children living at home. Positive values of the variable MOVEOUT usually occur because the husband disappears, the wife is gone, or a child moves out. Since the latter two events are captured by the WIFEGONE and DELCHILDREN variables, the coefficient on MOVEOUT primarily reflects the event of the husband disappearing. This event also increases mobility, but not significantly.

Merrill (1982) found that the event of retiring had a significant effect on mobility in the Retirement History Survey, with a peak several years after retirement. FIGURE 13 includes dummy variables indicating whether the head or the wife have retired within the past three years. Both husband and wife retirement dummies are found to significantly increase mobility. Hence, there appears to be a window of relatively high mobility for several years after retirement, as households optimize after being freed of the locational constraints imposed by workplace.

The preceding models do not distinguish tenure state as a factor influencing mobility. Since moving costs are considerably higher for owners than for renters, one expects the former group to have lower transition probabilities. FIGURE 14 shows the basic model of mobility dependence on head age and wealth, estimated separately for owners and for renters. In these models, head age remains significant for owners, with mobility minimized at age 70. For renters, mobility declines (insignificantly) until age 83. Wealth is not significant for either owners or renters. Of course, this does not indicate wealth has an insignificant effect on the dynamics of rental housing demand, since tenure choice is endogenous, and wealth is likely to strongly influence tenure choice conditioned on moves. The variables CASHLAG, LIQLAG, and CASHOTHERLAG measuring liquidity are found to be insignificant for both owners and renters. This supports the view that the significance found in FIGURE 13 for these variables is due to

FIGURE 14

INDEPENDENT TRIALS PROBIT MODEL OF MOBILITY

WEALTH AND CASH FLOW EFFECTS BY OWNER/RENTER

	Owners	Renters
CONSTANT	3.22 (1.46)	1.39 (1.57)
WEALTHLAG ($\times 10^{-6}$)	-.0778 (.157)	-.311 (.289)
HEADAGE	-.143* (.042)	-.0646 (.046)
HEADAGE^2 (x 10^{-3})	1.03 (.301)	.406 .328
LIQLAG	3.26 (.060)	-.0324 (.071)
CASHLAG ($\times 10^{-6}$)	.481 (2.02)	4.32 (3.76)
CASHOTHERLAG ($\times 10^{-6}$)	1.05 (6.20)	7.09 (9.04)
LOG LIKELIHOOD	-1666	-1477
# OBS	9096	3597
MOBILITY RATE	4.51%	14.37%

FIGURE 15
INDEPENDENT TRIALS PROBIT MODEL OF MOBILITY
FAMILY COMP RETIREMENT EFFECTS BY OWNER/RENTER

	Owners	Renters
CONSTANT	3.59 (1.53)	1.13 (1.67)
WEALTHLAG ($\times 10^{-6}$)	.149 (.159)	-.374 (.378)
HEADAGE	-.162* (.044)	-.0625 (.048)
$HEADAGE^2$ ($\times 10^{-3}$)	1.19 (.315)	.410 (.346)
LIQLAG	-1.21×10^{-3} (.063)	-.0411 (.073)
CASHLAG ($\times 10^{-6}$)	-1.91 (2.14)	4.47 (4.16)
CASHOTHERLAG ($\times 10^{-6}$)	1.18 (6.44)	2.93 (9.21)
WIFEGONE	.337* (.096)	.547* (.125)
MOVEOUT	.119* (.055)	.0196 (.063)
MOVEIN	.270* (.069)	.375* (.073)
HEADRETDUM	.319* (.073)	.140 (.114)
WIFERETDUM	.274* (.077)	.251* (.089)
ΔCHILDREN	-.134 (.074)	-.205* (.083)
LOG LIKELIHOOD	-1542	-1372
# OBS	8600	3416
MOBILITY RATE	4.55%	14.43%

their correlation with moving costs through the association of liquidity and ownership. While this conclusion should be interpreted with caution in light of the issues of endogenicity of tenure choice and population heterogeneity, it has a potentially important policy implication that programs such as reverse annuity mortgages designed to allow the elderly to extract equity from their homes are unlikely to be utilized by most of the elderly population.

FIGURE 15 estimates separately for owners and renters the model including family composition effects. The pattern of effects is similar to that observed in FIGURE 13 estimated on owners and renters together, except that wealth and cash flow effects are both insignificant. The effects of family composition change are similar for owners and renters.

Estimates of tenure choice of movers are given separately in FIGURE 16 for previous owners and for previous renters. The effect of liquidity constraints or low cash income is to discourage ownership, but the effects are statistically insignificant. Increasing wealth increases ownership for both previous owners and renters, as does a family composition change increasing household size. Retirement of the head significantly discourages ownership by previous owners.

Next consider the conditional probability of changing consumption of housing services, given a move. We consider first a categorical variable (RECOST) that indicates whether expenditures on shelter falls more than 5 percent (-1) or not (0). FIGURE 17 gives the results of estimation, separately for owners and renters. Wealth has a weak positive effect on maintaining expenditures by owners. The variable LIQLAG has a significant negative effect among renters, and both LIQLAG and CASHLAG are insignificant amongst owners. Head age is statistically insignificant, as are the family composition variables.

Second, consider the conditional probability of reducing dwelling size, measured relative to family size, given a move. The dependent variable (DEXSIZE) is categorical, indicating whether number of rooms minus family size falls with the move (-1) or not (0). FIGURE 18 gives

FIGURE 16

TENURE CHOICE

Dependent Variable: OWNER

	Model 1 (OWNLAG = 1)	Model 2 (RENTLAG = 1)
CONSTANT	-4.08 (4.50)	4.22 (4.35)
HEADAGE	.118 (.131)	-.152 (.128)
HEADAGE^2 ($\times$ 10^{-3})	-.902 (.931)	.984 (.925)
WEALTHLAG ($\times$ 10^{-6})	2.07 (.673)	3.63 (.958)
LIQLAG	.318 (.192)	.298 (.190)
CASHLAG ($\times$ 10^{-6})	2.26 (8.01)	.966 (9.80)
WIFEGONE	-.075 (.254)	-.620 (.333)
MOVEOUT	-.280 (.158)	.117 (.142)
MOVEIN	.593* (.210)	.282* (.139)
HEADRETDUM	-.620* (.231)	.224 (.269)
WIFERETDUM	.139 (.222)	-.111 (.234)
ΔCHILDREN	-.281 (.208)	0.054 (.183)
LOG LIKELIHOOD	-221	-199
# OBS	391	493
% OWNER	65	18

FIGURE 17
CHANGES IN SHELTER COST AMONG MOVERS
(Independent Probit, Dependent Variable is -1 if shelter cost falls more than 5 percent, 0 otherwise)

	Owners	Renters
CONSTANT	1.70 (4.27)	.115 (3.66)
WEALTHLAG ($\times$ 10^{-6})	.327 (.469)	-.836 (.900)
HEADAGE	-.0673 (.124)	5.51×10^{-3} (.107)
HEADAGE^2 ($\times$ 10^{-3})	.550 (.887)	-.0861 (.776)
LIQLAG	.152 (.179)	-3.51* (.159)
CASHLAG ($\times$ 10^{-6})	6.06 (6.36)	18.2 (9.56)
WIFEGONE	-.188 (.240)	-.184 (.229)
MOVEOUT	-.0251 (.143)	-.172 (.124)
MOVEIN	.236 (.169)	.157 (.122)
HEADRETDUM	-.0256 (.189)	-.256 (.233)
WIFERETDUM	-.191 (.202)	-.228 (.182)
ΔCHILDREN	.0413 (.186)	-.226 (.160)
LOG LIKELIHOOD	-263	-334
# OBS	389	493
PCT DOWN	47.6	48.3

FIGURE 18

CHANGES IN NUMBER OF EXCESS ROOMS AMONG MOVERS
(Independent Probit, Dependent Variable is -1 if number of Rooms - family size falls, 0 otherwise)

	Owners	Renters
CONSTANT	-3.23 (4.55)	9.36 (4.01)
WEALTHLAG ($\times 10^{-6}$)	.560 (.583)	-.710 (.930)
HEADAGE	.100 (.132)	-.246* (.117)
HEADAGE^2 ($\times 10^{-3}$)	-.835 (.945)	1.65 (.846)
LIQLAG	.395* (.190)	-6.51×10^{-3} (.168)
CASHLAG ($\times 10^{-6}$)	2.07 (7.02)	8.93 (10.2)
WIFEGONE	-.639* (.262)	-.527* (.239)
MOVEOUT	.291 (.181)	.375* (.146)
MOVEIN	-.470 (.248)	-.413* (.137)
HEADRETDUM	-.177 (.193)	-.129 (.238)
WIFERETDUM	.128 (.208)	.117 (.193)
ΔCHILDREN	-.331 (.281)	-.153 (.208)
LOG LIKELIHOOD	-237	-291
# OBS	375	480
PCT DOWN	47.5%	33.5%

FIGURE 19

CHANGES IN EQUITY AMONG MOVERS WHO WERE OWNERS
(Independent Probit, Dependent variable is -1 if equity falls, 0 otherwise)

CONSTANT	-5.69 (4.72)
WEALTHLAG ($\times 10^{-6}$)	.421 (.476)
HEADAGE	.141 (.137)
HEADAGE2 ($\times 10^{-3}$)	-.993 (9.81)
LIQLAG	.110 (.194)
CASHLAG ($\times 10^{-6}$)	14.2 (6.56)
WIFEGONE	-.170 (.270)
MOVEOUT	-.370 (.193)
MOVEIN	-.00257 (.187)
HEADRETDUM	.0566 (.192)
WIFERETDUM	-.0692 (.210)
ΔCHILDREN	.190 (.252)
LOG LIKELIHOOD	-229
# OBS	391
PCT DOWN	68.0

the estimates. Wealth is again insignificant. Many of the family composition variables are significant for both owners and renters, while the retirement dummies are insignificant. Among the lagged liquidity variables, LIGLAG is positive and significant among owners and insignificant among renters, while CASHLAG is insignificant.

Finally, consider changes in equity given a move. We consider a categorical variable (DEQUITY) that indicates whether equity falls (-1) or not (0). Figure 19 gives the estimation results for owners. Wealth is again insignificant; the estimates indicate no significant effect of liquidity, suggesting either that most owners have sufficient cash flow or liquid assets to make extraction of equity unnecessary, or else that existing capital markets provide adequate opportunities for extracting equity. Demographic and retirement variables are insignificant.

IV. TEST FOR UNOBSERVED HETEROGENEITY

As mentioned above, all of the models in this paper have been estimated under the assumption that there are no unobserved household effects. If such effects are present, they invalidate our assumption that the conditional probability of a household moving in any particular year is independent of that household's prior mobility decisions (though it may depend upon previous year household characteristics through time-dependent explanatory variables). Since estimating models which allow for unobserved household effects is quite complicated and computer intensive, we have developed a Lagrange Multiplier test for the presence of unobserved effects which is based upon the estimates derived from models which assume no such effects. We assume a random effects formulation in which the probability of a move may be written:

$F(x_{tn}b + z_n g)$

where x_{tn} is the vector of time-dependent explanatory variables for household n in period t, z_n is the household effect, assumed to be drawn from an arbitrary distribution q(z) which has mean 0 and finite variance, and g measures the impact of the household effect on the household's mobility decision. The null hypothesis is that g equals zero, and it is assumed that the vector b has been previously estimated under this assumption (as in the last section, figures 11-15). Next we construct a test statistic for the hypothesis that g is zero. The derviation, which is presented in McFadden and Feinstein (1987), is complicated by the fact that the score for g is singular at the value g equal to zero (due to the fact that the distribution q(z) is mean zero), an issue which has been previously discussed by Breusch-Pagan (1980), Chesher (1984), and Lee and Chesher (1986) in other contexts. The appropriate test is therefore based on the second derivative of the log likelihood function. The test statistic is:

$$LM2 = [(1/sqrt(N)) \quad lm_n]^2 / [C_N - B_N' A_N^{-1} B_N]$$

$$lm_n = - \quad a_{tn} d_{tn} h_{tn} m_{tn} + \quad d_{tn} d_{sn} h_{tn} h_{sn} m_{tn} m_{sn}$$

$a_{tn} = x_{tn}b$

d_{tn} = 1 is the household moves, -1 if not

$h_{tn} = f(d_{tn}(x_{tn}b))/F(d_{tn}(x_{tn}b))$

m_{tn} = 1 is data is present, 0 if it is missing

$c_n = \quad x_{tn} d_{tn} h_{tn}$

$A_N = (1/N) \quad c_n c_n'$

$B_N = (1/N) \quad c_n lm_n$

$C_N = (1/N) \quad lm_n^2$

where there are N individuals (1131 in our case) and T time periods (15 in our case). LM2 is asymptotically distributed as chi-squared with 1 degree of freedom.

We have calculated LM2 for the model of figure 13. The calculated value far exceeds the 5% critical value and decisively rejects the null of no heterogeneity. This finding indicates that future efforts to model elderly mobility must come to grips with the statistical issues involved in estimating models which allow for household effects.

V. CONCLUSIONS

This paper has given a preliminary analysis of the effects of wealth, cash flow, and demographic shocks on decisions of the elderly on whether to move, whether to adjust housing consumption up or down when moving, and whether to extract equity when moving from an owner-occupied dwelling. The analysis of price effects has been left for future research. The current paper makes the simplistic assumption of no unobserved heterogeneity. Consequently, the resulting models are unlikely to be reliable predictors of the life-cycle dynamics of mobility of the elderly. In particular, the models are unlikely to predict accurately the number of moves or the durations of spells between moves for households observed through time. However, it is more reasonable to use these models to draw conclusions on the qualitative impacts of wealth, cash flow, and demographic shocks on mobility and housing consumption levels.

The models suggest that with the possible exception of downsizing decisions by renters, conditioned on a decision to move, there is no evidence that housing choice behavior is affected by capital market imperfections. Wealth has a generally strong effect on housing choices, as predicted by the life-cycle model. Mobility and consumption level decisions are both strongly influenced by some demographic shocks, notably recent retirement or changes in household size or composition (disappearance of husband or wife).

To assess some of the policy implications of our results, we have calculated the changes in mobility rates associated with changes in various explanatory variables. FIGURE 20 shows mobility rates by age of head for the model given in FIGURE 13, with all other explanatory variables set to sample means. (Note that this is not the same as calculating the sample average of the individual household probabilities, with ages varied parametrically and remaining variables set to actual values for the household, since the probit model is non-linear.) Mobility falls with age until age 72, and then rises slightly.

FIGURE 21 shows the effects on mobility of different wealth levels, and of demographic shocks. These calculations again use the model in FIGURE 13, and set all remaining variables to sample means. The demographic shocks of disappearance of the wife or individuals moving into the household have a substantial effect on mobility, as does recent retirement. The other demographic variables, changes in number of children and persons moving out, have modest effects. While wealth is an important determinant of mobility, small changes in wealth have small mobility effects.

In summary, we conclude from the analysis of housing behavior of the elderly completed to date that this population group does not appear to be substantially disadvantaged by capital market imperfections that limit the ability to extract equity or dissave, and that mobility is strongly concentrated in windows opened by demographic shocks, particularly recent retirement, or recent changes in family composition.

VI. FUTURE RESEARCH

FIGURE 20:

PROJECTED MOBILITY RATES: EFFECT OF HEAD AGE

HEAD AGE	PROBABILITY OF A MOVE (%) (in a given year)*
55	11
56	11
57	10
58	9.5
59	9.1
60	8.7
61	8.4
62	8.1
63	7.8
64	7.6
65	7.4
66	7.2
67	7.0
68	6.9
69	6.8
70	6.8
71	6.7
72	6.7 (minimum)
72	6.7
73	6.7
74	6.8
75	6.9
76	7.0
77	7.1
78	7.3
79	7.5
80	7.7

*Based on Model of Figure 13
All other variables evaluated at their sample means.

FIGURE 21

PROJECTED MOBILITY RATES
EFFECTS OF WEALTH AND FAMILY COMPOSITION

	Probability of a Move (%) (in a given year)*
WEALTH	
$10,000	9.1
$70,000	8.4
$140,000 (mean)	7.6
$200,000	6.9
$300,000	6.0
WIFEGONE	
= 0 (Base)	7.3
= 1 (wife left in last 2 years	13.5
MOVEIN	
= 0	7.2
= 1 (1 person)	12.9
MOVEOUT	
= 0	7.5
= 1 (1 person)	8.6
ΔCHILDREN	
= 0	7.5
= 1 (1 child leaves)	10.2
RETIREMENT	
Of Neither	7.1
Of person 1 only	10.3
Of person 2 only	11.6
Of both	16.0

* Based on Model of Figure 14
All other variables evaluated at their sample means.

This paper is an initial progress report in a multi-year program of research into the dynamics of housing behavior of the elderly. Future research plans can be divided into extensions of the simple mobility and housing consumption level models described above to incorporate population heterogeneity and model other aspects of choice of housing state, and extensions to incorporate the effects of price and health.

Extensions of the analysis of the effects of wealth, demographics, and liquidity will concentrate, first, on removing the assumption of unobserved population homogeneity. Parametric and "non-parametric" models with heterogeneity will be estimated. To manage the computational problems, McFadden's method of simulated moments estimation will be used. We do not have a fully satisfactory method for handling the initial values problem when both unobserved heterogeneity and state dependence are present, but propose to employ a non-parametric ("flexible") estimator for the initial value distribution, with dimensionality restricted by plausible conditional independence assumptions.

A second part of these extensions will concentrate on refining the explanatory variables, particularly the lag structure of demographic shocks, the description of the housing state, and nonlinearities in the effects of wealth and wealth composition. The third part will concentrate on developing a complete transition model between housing states, including tenure choice and housing consumption level, measured by real expenditure and dwelling size. These extensions will be limited by the PSID data.

The final area of future research will concentrate on the effects of housing prices and on the effects of health. The PSID does not provide adequate information to construct housing prices. Henderson and Iaonnides (1984) confine attention to PSID households living in identifiable SMSAs, and use Annual Housing Survey data to calculate housing prices in these locations. We have not done this because it would substantially reduce the smaller sample of elderly households, and will instead use hedonic price equations estimated from Annual Housing Survey data. Health status is also poorly measured in the PSID. We will attempt to use limited data on hospitalization, which is available in only one year, and self-rated level of disability.

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Appendix

Description of the Data

Our primary data source is waves one through fifteen of the PSID study, comprising years 1968 through 1982. We restrict ourselves to elderly households, defined as those households which satisfy at least one of the following criteria:

(1) The head of household, his "wife" (a term which refers to both wives by marriage and cohabitors), or both are aged 50 or above in 1968.

(2) The identity of the head of household, the "wife", or both changes during the years 1969-82, and the new head, wife, or both, were aged 50 or above in 1968.

1901 households fulfill at least one of these criteria. Of these, 770 are "splitoffs", and most of these splitoffs refer to young persons who leave a family in which the parents satisfy one of criteria (1) or (2): 668 refer to households for whom, once the splitoff occurs, the new head is aged 30 or less, and another 60 to households whose new head is aged 30 to 50. We eliminate all splitoffs, which leaves us with 1131 observations.

The PSID variables which we use are listed in Table A1, identified by their 1983 PSID code number; the variables' means as of 1983 are also listed.

We have used the PSID variables to construct a number of additional variables, which we now describe. An important variable in our models is the present discounted value of household wealth, which is our measure of permanent income. Set $PERM_{i,t}$ to be household i's present discounted wealth as of year t, t=1968,...,1982. $PERM_{i,t}$ is defined to be:

$$PERM_{i,t} = \sum_{s=t}^{1982} (Y1_{i,s} + Y2_{i,s})/DISCOUNT(t,s)$$

$$+ \sum_{s=1983}^{1988} (Y1PROJ_{i,s} + Y2PROJ_{i,s})/DISCOUNT(t,s)$$

$$+ ASSET_{i,t} + EQUITY_{i,t}$$

where the first term refers to the future horizon up to the end of the PSID data, 1982, the second term refers to an extension of the household's horizon to 1988, using projections based on the PSID of earlier years, and the last two terms to the household's financial assets and home equity in year t. Y1 and Y1PROJ refer to the household head, and Y2 and Y2PROJ to his "wife" (if there is no wife Y2 and Y2PROJ are zero). $Y1_{i,s}$ and $Y2_{i,s}$ are constructed as follows. If the head is working in year s (s < 1983), $Y1_{i,s}$ is his wage income; similarly for $Y2_{i,s}$. If both head and wife are retired, $Y1_{i,s}$ and $Y2_{i,s}$ each equal one half of the household's total retirement income. If the head is working and the wife is retired, $Y1_{i,s}$ is the head's wage income and $Y2_{i,s}$ is the household's total retirement income; similarly if the head is retired and the wife working. $Y1PROJ_{i,s}$ and $Y2PROJ_{i,s}$ are constructed as follows. If the head retires prior to 1982, $Y1PROJ_{i,s}$ is his retirement income as of 1982; and similarly for the wife (if both are retired each of these is one half of total retirement income as of 1982). If the head has not retired as of 1982, he is assumed to retire at age 70, or, if above age 70 as of 1983, at 1983. Until age 70, $Y1PROJ_{i,s}$ is equal to his wage income as of 1982; after age 70, $Y1PROJ_{i,s}$ is 0.35 of his wage income. Similarly for the wife.

To construct a measure of financial assets, $ASSET_{i,t}$, we add up the separate asset income measures for business income, farm income, garden income, roomer income, and interest, dividends and rental income provided by the PSID, and divide by year t's treasury bill rate (described below), which provides a measure of the wealth generating the year t asset income. $EQUITY_{i,t}$ is just house value minus the outstanding mortgage.

Finally, DISCOUNT(t,s) is the discount rate: for s < 1983, it is the nominal rate on treasury bills, while for s > 1983, it is the nominal t-bill rate minus the consumer price index (to allow for the fact that real income post 1982 is in 1982 dollars). Some ambiguity attaches to the choice of DISCOUNT, as arguments can be made for choosing it to be the real rather than the nominal rate; however, we have felt that the majority of non-wage income is likely to derive from bank accounts, in which case the nominal rate is appropriate. [Source for these numbers is the DRI publication Review of the US Economy.]

Our measure of cash flow income, $CASH_{i,t}$, is defined to be: the household's gross year t income, which includes husband and wife's taxable income, the taxable income of other household members, husband and wife's transfer income, the transfer income of other household members, husband and wife's social security income, and the social security income of other household members; minus the husband and wife's federal taxes, and the federal taxes of other household members.

The share of cash flow income devoted to shelter costs is defined as follows. Shelter costs are the sum of property taxes, mortgage payments, utilities, 2% of the house value (for maintenance) [Source for this value is the U.S. Statistical Abstract], and rent. The share of cash flow is then simply this sum divided by $CASH_{i,t}$.