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2 The Dynamics of Housing Demand by the Elderly: Wealth, Cash Flow, and Demographic Effects

Jonathan Feinstein and Daniel McFadden

2.1 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 housing complex for the elderly. 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 in this paper 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 does it create barriers to moving? Or, is lack of mobility a "rational" manifestation of tastes?

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The effects of policy interventions in the elderly housing market depend on the answers to these questions. If the stereotype is pervasive, then marketwide policies may be effective; otherwise, concentration on programs directed to individuals in trouble may be indicated. If the elderly face significant imperfections in the housing market, then initiatives that reduce imperfections by providing information, insurance, risk pooling, or licensing may help to reduce the imperfection. 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, thus 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) would impact elderly households through rather narrow windows? Finally, do these variables collectively provide an adequate description of mobility among the elderly, or is there evidence of substantial remaining unexplained variation among households?

The remainder of the paper is organized as follows. Section 2.2 provides descriptive statistics of our data set, which is based on the PSID (Panel Study of Income Dynamics). Section 2.3 presents estimates of a series of models of mobility and changes in housing status among movers. Section 2.4 provides a test for the presence of unobserved heterogeneity among households. Section 2.5 presents some conclusions and section 2.6 a discussion of potential future research. An appendix provides some data details.

2.2 Some Descriptive Statistics

Using the PSID, we have summarized a few features of housing behavior of the elderly. We have used the first fifteen 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 1,131 households meeting this condition. First, what is the mobility of the elderly, and how is it changing over time? Table 2.1 shows mobility

Table 2.1 **Crude Mobility versus Age**

Age	Cases	Mobility Rate	Standard Deviation
1968–72			
55–64	2,148	8.15%	0.59%
65–74	889	6.30%	0.81%
75+	236	3.81%	1.25%
1973–77			
55–64	2,635	9.11%	0.56%
65–74	1,762	6.75%	0.60%
75+	629	8.59%	1.12%
1978–82			
55–64	1,519	8.56%	0.72%
65–74	2,530	7.19%	0.51%
75+	1,185	8.02%	0.79%
1968–82			
55–64	6,302	8.65%	0.35%
65–74	5,181	6.89%	0.35%
75+	2,050	7.71%	0.59%

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 2.1 shows the mobility rate of households with heads over 65 by year. Table 2.2 presents the pattern 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

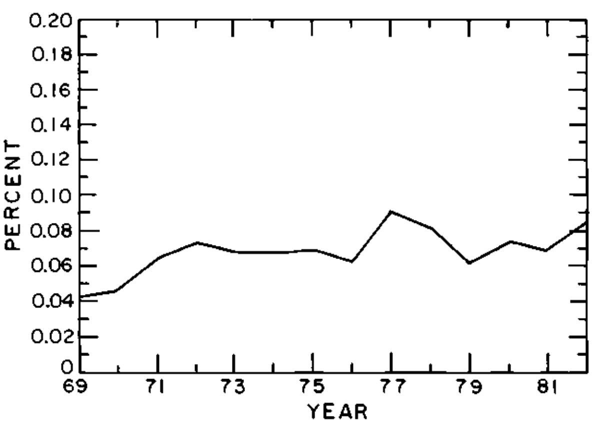

Fig. 2.1 Crude mobility rates, age 65+

Table 2.2 Tenure Changes with Moves, Age 65+ (cell counts, percentages, and standard errors of percentages)

	Move to			
Move From	Own	Rent	Other	Total
Own	141	59	25	225
	62.7%	26.2%	11.1%	43.7%
	(3.2%)	(2.9%)	(2.1%)	(2.2%)
Rent	34	191	11	236
	14.4%	80.9%	4.7%	45.8%
	(2.3%)	(2.6%)	(1.4%)	(2.2%)
Other	14	24	16	54
	25.9%	44.4%	29.6%	10.5%
	(6.0%)	(6.8%)	(6.2%)	(1.4%)
Total	189	274	52	515
	36.7%	53.2%	10.1%	
	(2.1%)	(2.2%)	(1.3%)	

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 (1984) in the Retirement History Survey (RHS).

How pervasive is occupancy of "inappropriate" housing by the elderly? Merrill (1984) reports from RHS data the following median ratios for a sample who 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

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. Table 2.3 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 as current after-tax. Out-

Table 2.3 **Households in Dwellings of "Excess" Size (cases, percentages, and standard errors of percentages)**

Age	1968–72	1973–77	1978–82	1968–82
55–64	2,575	2,614	1,502	6,691
	27.1%	31.1%	34.9%	30.4%
	(0.9%)	(0.9%)	(1.2%)	(0.6%)
65–74	1,043	1,745	2,494	5,282
	40.5%	38.2%	35.7%	37.4%
	(1.5%)	(1.2%)	(1.0%)	(0.7%)
75+	277	627	1,162	2.066
	39.7%	41.0%	38.1%	39.2%
	(2.9%)	(2.0%)	(1.4%)	(1.1%)

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

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 costs 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. Table 2.4 shows the average housing budget share for owners and renters in various age categories in three periods. This table excludes both households in "other" living arrangements and "poverty-level" households with disposable income below $5,000 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+ age category. Over time, renter budget shares have been stable, while owner budget shares have increased.

Table 2.5 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 of an increasing proportion of high-burden households for owners. This is not the case for renters. Third, there

Table 2.4 Average Share of Out-of-pocket cost in After-Tax Income, Households with $5,000 or More After-Tax Income (1982$)

	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%	1,590	19.5%	13.3%	634
65–74	15.9%	14.2%	1,246	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%	1,517	18.4%	13.9%	635
75+	19.5%	14.9%	785	21.4%	17.8%	263
1968–82						
55–64	20.5%	17.2%	3,277	19.3%	12.6%	1,340
65–74	17.7%	15.1%	3,306	17.4%	12.0%	1,122
75+	17.7%	14.2%	1,369	20.1%	16.2%	409

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 dissaving 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 made projections of those income streams beyond the panel. The construction is detailed in the

Table 2.5 Distribution of Share of Out-of-pocket Housing Cost in After-Tax Income

		Owners			Renters		
Period	Budget Share	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

appendix. Table 2.6 shows mobility rates classified by wealth and age categories. There is no uniform pattern of mobility shifts with age within a wealth category. The table 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.

Table 2.6 Mobility by Wealth and Age (rates and standard deviations)

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

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. Table 2.7 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 dollars. 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. Table 2.7 shows no significant decline for liquid versus nonliquid households when wealth is held constant.

Table 2.7 Mobility by Wealth and Liquidity (age 65 +, rates and standard deviations)

Wealth	Illiquid	Liquid
All households		
0–42K	12.52%	10.64%
	(0.65%)	(1.16%)
42–90K	8.79%	8.14%
	(0.72%)	(0.68%)
90–186K	4.95K	5.64%
	(0.79%)	(0.41%)
186K +	5.67%	5.60%
	(1.33%)	(0.43%)
Owners		
0–42K	3.80%	2.49%
	(0.67%)	(0.87%)
42–90K	4.54%	3.39%
	(0.65%)	(0.56%)
90–186K	4.07%	4.26%
	(0.81%)	(0.40%)
186K +	4.91%	4.90%
	(1.33%)	(0.42%)
Renters		
0–42K	16.12%	17.06%
	(0.95%)	(2.04%)
42–90K	17.03%	16.01%
	(1.76%)	(1.59%)
90–186K	8.39%	10.96%
	(2.32%)	(1.46%)
186K +	9.68%	12.70%
	(5.31%)	(2.13%)

For households with head aged 65+, table 2.8 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.

2.3 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

Table 2.8 Mobility Rates by Income and Wealth Composition, Given Wealth Level (Age 65+)

Wealth	Income Class	Liquid Asset Class	Cases	Mobility	Standard Error
0–42K	<$5K	<$10K	110	16.36%	3.53%
	>$5K	<$10K			
	<$5K	>$10K	2,681	15.07%	0.69%
	>$5K	>$10K	1,305	16.17%	1.02%
42–90K	<$5K	<$10K	463	10.37%	1.42%
	>$5K	<$10K			
	<$5K	>$10K	2,522	9.16%	0.57%
	>$5K	>$10K	533	8.82%	1.23%
90–186K	<$5K	<$10K	1,110	5.86%	0.70%
	>$5K	<$10K	106	7.55%	2.57%
	<$5K	>$10K	2,609	6.44%	0.48%
	>$5K	>$10K	458	6.55%	1.16%
186K+	<$5K	<$10K	1,443	6.31%	0.64%
	>$5K	<$10K	154	9.74%	2.39%
	<$5K	>$10K	1,904	6.83%	0.58%
	>$5K	>$10K	428	8.18%	1.32%

subject to intertemporal budget constraints whose structure depends on the capital market. Henderson and Ioannides (1986) 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 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, in particular to the comparison of the expected stream of net cost savings from a move with the direct and indirect moving costs. 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 which 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 because of "self-selection" over time of households more resistant to moving.

In this paper, we do not attempt to deal with unobserved heterogeneity. We 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. Table 2.9 compares the observed number of moves with the numbers predicted by two simple models. The observed counts display the clas-

Table 2.9 **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	1,133	1,133	1,133

Notes: 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).

sic 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 independently modeled as a discrete choice 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 explanatory variables, and then adding variables that may enter if liquidity constraints are binding or if demographics influence consumption decisions. Table 2.10 shows that wealth has a significant

Table 2.10 **Independent Trials Probit Model of Mobility, Wealth Effects**

	Model 1	Model 2
Constant	3.57	3.29
	(1.00)	(1.03)
HEADAGE	−.13*	−.125*
	(.029)	(.03)
HEADAGE2(× 10−3)	.89*	.836*
	(.21)	(.214)
WEALTHLAG (× 10−6)	−.957*	−1.01*
	(.125)	(.133)
ΔWEALTHLAG (× 10−6)		.016
		(.286)
Log likelihood	−3,593	−3,422
# Observations	13,229	12,528
Mobility rate	7.85%	7.91%

*Denotes significant at the 5% level.
Standard errors are in parentheses.

negative effect on mobility. Mobility falls with age of head until age 74, then increases. Mobility is insensitive to changes in wealth.

Table 2.11 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 LIQLAG, indicating either that last period's after-tax income was above $10,000 or that nondwelling 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

Table 2.11 Independent Trials Probit Model of Mobility, Cash Flow Effects

	Model 1	Model 2
Constant	3.44	3.43
	(1.01)	(1.01)
WEALTHLAG (× 10–6)	–.899*	–.903*
	(.148)	(.148)
HEADAGE	–0.129*	–.129*
	(.029)	(.029)
HEADAGE2 (× 10–3)	.869*	.867*
	(.210)	(.210)
LIQLAG	–.114*	–.114*
	(0.041)	(0.041)
CASHLAG (× 10–6)	2.02	2.05
	(1.69)	(.169)
CASHOTHERLAG (× 10–6)		–2.54
		(4.95)
Log likelihood	–3589	–3589
# Observations	13,229	13,229
Mobility rate	7.85%	7.85%

*Denotes significant at the 5% level.
Standard errors are in parentheses.

effect for owners or renters separately would be stronger evidence for capital market problems.

Table 2.12 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), and the change in the number of children living at home (ΔCHILDREN). As in the earlier models, wealth and head age are significant, as are LIQLAG and CASHLAG. The demographic shocks of a wife disappearing or

Table 2.12 Independent Trials Probit Model of Mobility, Family Composition and Retirement Effects

	Model 1
Constant	3.45
	(1.06)
WEALTHLAG (× 10–6)	–.759*
	(.166)
HEADAGE	–.135*
	(.031)
HEADAGE2 (× 10–3)	.934*
	(.220)
LIQLAG	–.135*
	(.043)
CASHLAG (× 10–6)	1.41
	(1.81)
CASHOTHERLAG (× 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	–3,339
# Observations	12,524
Mobility rate	7.91%

*Denotes significant at the 5% level.

Standard errors are in parentheses.

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 ΔCHILDREN variables, the coefficient on MOVEOUT primarily reflects the event of the husband disappearing. This event also increases mobility, but not significantly.

Merrill (1984) found that the event of retiring had a significant effect on mobility in the RHS, with a peak several years after retirement. Table 2.12 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. Table 2.13 shows the basic model of mobility dependence on head age and wealth, estimated separately for owners

Table 2.13 Independent Trials Probit Model of Mobility, Wealth and Cash Flow Effects by Owner/Renter

	Owners	Renters
Constant	3.22	1.39
	(1.46)	(1.57)
WEALTHLAG (× 10–6)	–.0778	–.311
	(.157)	(.289)
HEADAGE	–.143*	–.0646
	(.042)	(.046)
HEADAGE2 (× 10–3)	1.03*	.406
	(.301)	.328
LIQLAG	.003	–.032
	(.060)	(.071)
CASHLAG (× 10–6)	.481	4.32
	(2.02)	(3.76)
CASHOTHERLAG (× 10–6)	1.05	7.09
	(6.20)	(9.04)
Log likelihood	–1666	–1477
# Observations	9096	3597
Mobility rate	4.51%	14.37%

*Denotes significant at the 5% level.

Standard errors are in parentheses.

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 called 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 table 2.12 for these variables is due to 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 endogeneity 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.

Table 2.14 estimates separately for owners and renters the model including family composition effects. The pattern of effects is similar to that observed in table 2.12 estimated on owners and renters together, except that wealth and cash flow effects are both insignificant. The effects of family composition changes are similar for owners and renters.

Estimates of tenure choice of movers are given separately in table 2.15 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 fall more than 5 percent (− 1) or not (0). Table 2.16 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 among owners. HEADAGE 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). Table 2.17 gives the estimates. Wealth is again insignificant. Many of the family composition variables are significant for both owners and renters, while

Table 2.14 **Independent Trials Probit Model of Mobility, Family Composition and Retirement Effects, by Owner/Renter**

	Owners	Renters
Constant	3.59	1.13
	(1.53)	(1.67)
WEALTHLAG (× 10–6)	.149	–.374
	(.159)	(.378)
HEADAGE	–.162*	–.0625
	(.044)	(.048)
HEADAGE2 (× 10–3)	1.19*	.410
	(.315)	(.346)
LIQLAG	–1.21 × 10–3	–.0411
	(.063)	(.073)
CASHLAG (× 10–6)	–1.91	4.47
	(2.14)	(4.16)
CASHOTHERLAG (× 10–6)	1.18	2.93
	(6.44)	(9.21)
WIFEGONE	.337*	.547*
	(.096)	(.125)
MOVEOUT	.119*	.0196
	(.055)*	(.063)
MOVEIN	.270*	.375*
	(.069)	(.073)
HEADRETDUM	.319*	.140
	(.073)	(.114)
WIFERETDUM	.274*	.251*
	(.077)	(.089)
ΔCHILDREN	–.134	–.205
	(.074)	(.083)
Log likelihood	–1,542	–1,372
# Observation	8,600	3,416
Mobility rate	4.55%	14.43%

*Denotes significant at the 5% level.
Standard errors are in parentheses.

the retirement dummies are insignificant. Among the lagged liquidity variables, LIQLAG 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). Table 2.18 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 that existing capital markets provide adequate opportunities for extracting equity. Demographic and retirement variables are insignificant.

Table 2.15 Tenure Choice, Dependent Variable: Owner

	Model 1 (OWNLAG = 1)	Model 2 (RENTLAG = 1)
Constant	−4.08	4.22
	(4.50)	(4.35)
HEADAGE	.118	−.152
	(.131)	(.128)
HEADAGE2 (× 10−3)	−.902	.984
	(.931)	(.925)
WEALTHLAG (× 10−6)	2.07*	3.63*
	(.673)	(.958)
LIQLAG	.318	.298
	(.192)	(.190)
CASHLAG (× 10−6)	2.26	.966
	(8.01)	(9.80)
WIFEGONE	−.075	−.620
	(.254)	(.333)
MOVEOUT	−.280	.117
	(.158)	(.142)
MOVEIN	.593*	.282*
	(.210)	(.139)
HEADRETDUM	−.620*	.224
	(.231)	(.269)
WIFERETDUM	.139	−.111
	(.222)	(.234)
ΔCHILDREN	−.281	0.054
	(.208)	(.183)
Log likelihood	−221	−199
# Observations	391	493
% Owner	65	18

*Denotes significant at the 5% level.
Standard errors are in parentheses.

The effects of age on mobility of owners and renters are summarized in figure 2.2; the mobility of owners rises after age 70, while the mobility of renters falls until age 79. Given a move, the probability that a former owner or renter becomes an owner is given in figure 2.3. The probability of ownership falls steadily with age for owners, and is nearly constant for renters. Figure 2.4 gives the probabilities that when an owner moves, the adjustment maintains the level of expenditures on housing, excess size of housing, and equity in housing. The probability of maintaining housing costs rises with age, while the probability of maintaining excess rooms falls. The probability of maintaining equity falls after age 71. Figures 2.2, 2.3, and 2.4 are calculated for a "standard" low-income household with wealth of $10,000, cash income of $5,000, and population

Table 2.16 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	.115
	(4.27)	(3.66)
WEALTHLAG (× 10−6)	.327	−.836
	(.469)	(.900)
HEADAGE	−.0673	5.51 × 10−3
	(.124)	(.107)
HEADAGE2 (× 10−3)	.550	−.0861
	(.887)	(.776)
LIQLAG	.152	−3.51*
	(.179)	(.159)
CASHLAG (× 10−6)	6.06	18.2
	(6.36)	(9.56)
WIFEGONE	−.188	−.184
	(.240)	(.229)
MOVEOUT	−.0251	−.172
	(.143)	(.124)
MOVEIN	.236	.157
	(.169)	(.122)
HEADRETDUM	−.0256	−.256
	(.189)	(.233)
WIFERETDUM	−.191	−.228
	(.202)	(.182)
ΔCHILDREN	.0413	−.226
	(.186)	(.160)
Log likelihood	−263	−334
# Observations	389	493
Pct down	47.6	48.3

*Denotes significant at the 5% level.
Standard errors are in parentheses.

averages for other variables; the models used are in tables 2.13, 2.16, 2.17, and 2.18.

The mobility of owners varies little with income or wealth, increasing from 0.041 to 0.042 as income rises from $5,000 to $40,000 with wealth fixed at $10,000, and falling from 0.041 to 0.040 as wealth increases from $10,000 to $140,000 with income fixed at $5,000. The mobility of renters increases sharply with income and decreases with wealth, as shown in figure 2.5. In particular, mobility is high for renters with low liquidity. The wealth categories in this figure are $10,000 for "lo W," $70,000 for "mid W," and $140,000 for "hi W." The last wealth level is near the sample median, so these categories all apply to relatively poor families.

Table 2.17 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	9.36
	(4.55)	(4.01)
WEALTHLAG (× 10−6)	.560	−.710
	(.583)	(.930)
HEADAGE	.100	−.246*
	(.132)	(.117)
HEADAGE2 (× 10−3)	−.835	1.65
	(.945)	(.846)
LIQLAG	.395*	−6.51 × 10−3
	(.190)	(.168)
CASHLAG (× 10−6)	2.07	8.93
	(7.02)	(10.2)
WIFEGONE	−.639*	−.527*
	(.262)	(.239)
MOvEOUT	.291	.375*
	(.181)	(.146)
MOvEIN	−.470	−.413*
	(.248)	(.137)
HEADRETDUM	−.177	−.129
	(.193)	(.238)
WIFERETDUM	.128	.117
	(.208)	(.193)
ΔCHILDREN	−.331	−.153
	(.281)	(.208)
Log likelihood	−237	−291
# Oberservations	375	480
Pct down	47.5%	33.5%

*Denotes significant at the 5% level.

Standard errors are in parentheses.

Ownership rates given moves rise with income, particularly for low-wealth families, as figures 2.6 and 2.7 show for owners and renters, respectively. Figure 2.8 gives the probability that the result of a move by a previous owner is housing costs as high as experienced previously; these probabilities rise with income and wealth and are particularly sensitive to low liquidity. Figure 2.9 shows that the probability that a previous owner chooses an "excess size" dwelling after a move is relatively insensitive to wealth and income, except that low-liquidity households have a much lower probability of maintaining excess size. Figure 2.10 shows that the probability of maintaining equity after a move by a previous owner rises sharply with income, and at low incomes is quite sensitive to wealth.

Table 2.18 **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 (× 10−6)	.421
	(.476)
HEADAGE	.141
	(.137)
HEADAGE2 (× 10−3)	−.993
	(9.81)
LIQLAG	.110
	(.194)
CASHLAG (× 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
# Observations	391
Pct down	68.0

*Denotes significant at 5% level.
Standard errors are in parentheses.

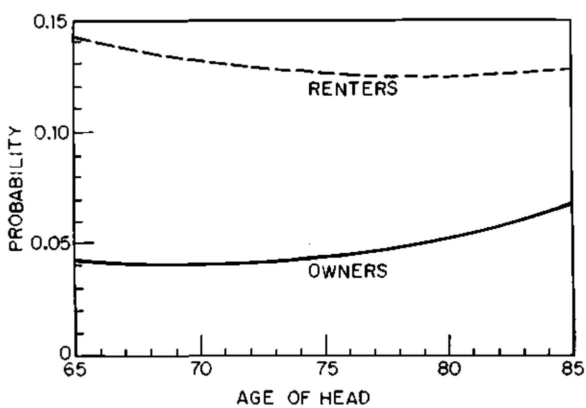

Fig. 2.2 Mobility vs. age

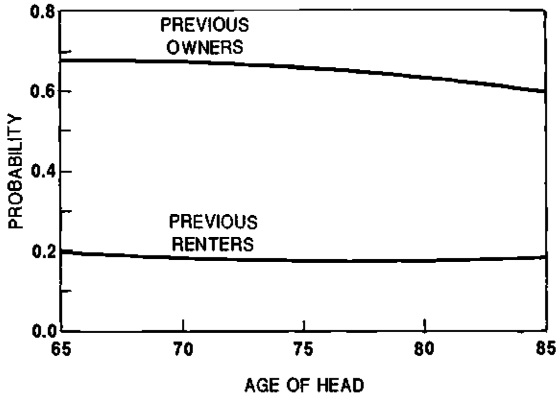

Fig. 2.3 Ownership given move

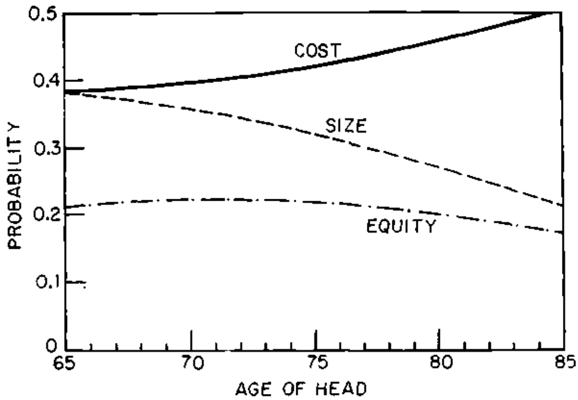

Fig. 2.4 Adjustments given move

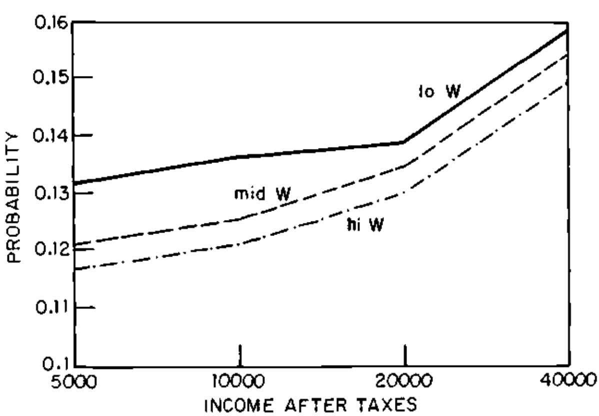

Fig. 2.5 Mobility of renters (W = wealth)

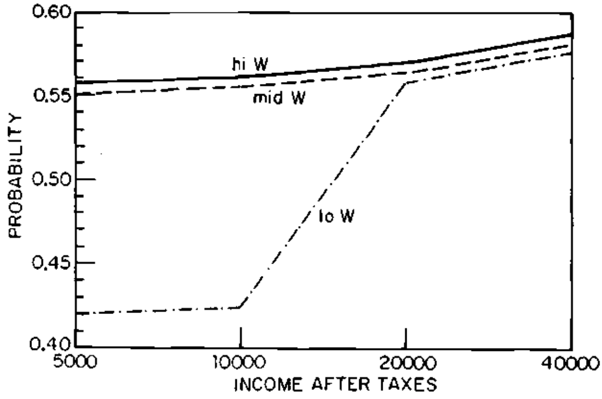

Fig. 2.6 Ownership given owner move (W = wealth)

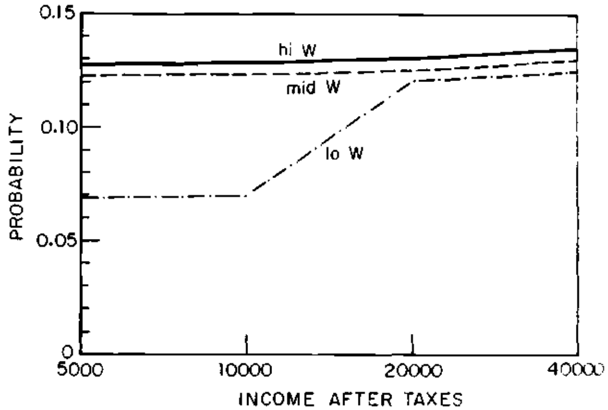

Fig. 2.7 Ownership given renter move (W = wealth)

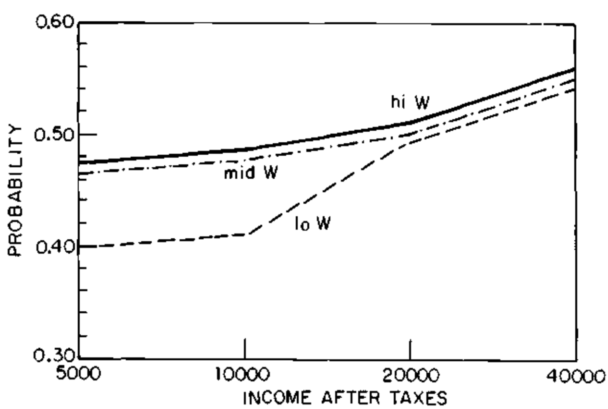

Fig. 2.8 Cost maintained given move (W = wealth)

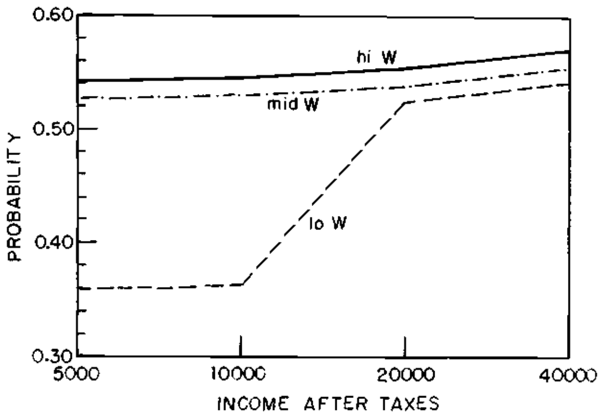

Fig. 2.9 Excess size maintained given move (W = wealth)

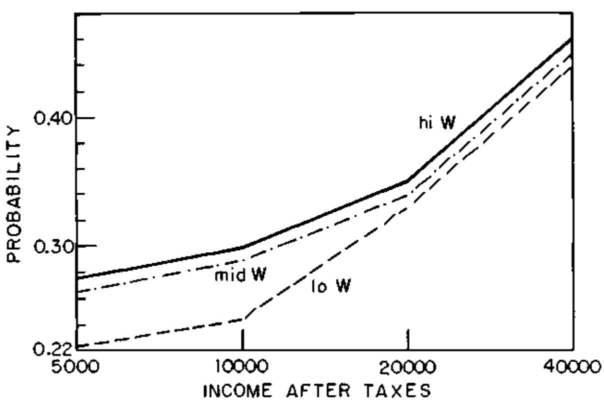

Fig. 2.10 Equity maintained given move (W = wealth)

In sum, these figures suggest that there are economically significant effects of low liquidity leading to downsizing, relative reductions in shelter cost, and extraction of equity. This behavior would be expected from poor households faced with difficult budget choices requiring trade-offs between shelter costs and nonhousing consumption. The absence of a significant effect of low liquidity on mobility suggests that the moves of most elderly homeowners are the result of noneconomic causes and not forced by economic pressure. There do appear to be significant economic pressures on low-liquidity renters to move and reduce shelter costs. These may well involve substantial welfare losses; our results give no indication that this is a result of a market failure calling for policy measures beyond distributional policy.

2.4 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 are quite complicated and computer intensive, we have developed a Lagrange Multiplier test for the presence of unobserved effects which is based on the estimates derived from models which assume no such effects. We assume a normal random effects formulation in which the probability of a move in period t by household n may be written:

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

where F is the standard cumulative normal, $\mathbf{x}_{tn}$ is the vector of time-dependent explanatory variables, z_n is the household effect, assumed to be drawn from some distribution $q(z)$ which has mean 0 and unit variance, and g measures the impact of the household effect on the household's mobility decision. The null hypothesis is $g = 0$. It is assumed that the vector $\mathbf{b}$ has been previously estimated under this assumption (as in section 2.3, tables 2.10–2.14). We construct a Lagrange Multiplier test statistic for the hypothesis that $g = 0$. The derivation, which is presented in McFadden and Feinstein (1987), is complicated by the fact that the score for g is singular at $g = 0$ (due to the fact that the distribution $q(z)$ is mean zero), an issue which has been previously discussed by Breusch and 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:

$$\begin{aligned}
\mathrm{LM2} &= [\Sigma_n lm_n]^2/N[C_N - B_N' A_N{}^{-1} B_N],\\
lm_n &= -\Sigma_t\, a_{tn} d_{tn} h_{tn} m_{tn} + 2\,\Sigma_t\, \Sigma_{s>t}\, d_{tn} d_{sn} h_{tn} h_{sn} m_{tn} m_{sn}\,,\\
a_{tn} &= x_{tn} b,\\
d_{tn} &= 1 \text{ if the household moves, } -1 \text{ if not},\\
h_{tn} &= f[d_{tn}(x_{tn} b)]/F[d_{tn}(x_{tn} b)],\\
m_{tn} &= 1 \text{ if data is present, } 0 \text{ if it is missing},\\
c_n &= \Sigma_t\, x_{tn} d_{tn} h_{tn},\\
A_N &= (1/N)\, \Sigma_n\, c_n c_n',\\
B_N &= (1/N)\, \Sigma_n\, c_n lm_n,\\
C_N &= (1/N)\, \Sigma_n\, lm_n{}^2,
\end{aligned}$$

where there are N individuals (1,131 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 table 2.12. The calculated value far exceeds the 5 percent 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.

2.5 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 (e.g., disappearance of husband or wife).

We have also calculated the changes in mobility rates associated with changes in various explanatory variables. Table 2.19 shows mobility rates by age of head for the model given in table 2.12, 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 nonlinear.) Mobility falls with age until age 72, and then rises slightly.

Table 2.20 shows the effects on mobility of different wealth levels and demographic shocks. These calculations again use the model in

Table 2.19 Projected Mobility Rates: Effect of Head Age

Head Age	Probability of a Move (%) (in a given year)*	Head Age	Probability of a Move (%) (in a given year)*
55	11.0	69	6.8
56	11.0	70	6.8
57	10.0	71	6.7
58	9.5	72	6.7 (minimum)
59	9.1	72	6.7
60	8.7	73	6.7
61	8.4	74	6.8
62	8.1	75	6.9
63	7.8	76	7.0
64	7.6	77	7.1
65	7.4	78	7.3
66	7.2	79	7.5
67	7.0	80	7.7
68	6.9		

*Based on model of table 2.12. All other variables evaluated at their sample means.

Table 2.20 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 table 2.12. All other variables evaluated at their sample means.

table 2.12 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 for 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.

2.6 Future Research

This paper is an initial progress report in a multiyear 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 "nonparametric" 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 we propose to employ a nonparametric ("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 the effects of health. The PSID does not provide adequate information to construct housing prices. Henderson and Ioannides (1986) 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. We 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.

Appendix
Description of the Data

Our primary data source is the first fifteen waves of the PSID study, from 1968 to 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, or "wife" (a term which refers to both spouses by marriage and cohabitors), or both are aged 50 or above in 1968.
(2) The identity of the head of household, or "wife," or both changes during the years 1969–82, and the new head, or "wife," or both were aged 50 or above in 1968.

There are 1,901 households that fulfill at least one of these criteria. Of these, 770 are "split-offs," and most of these split-offs refer to young persons who leave a family in which the parents satisfy either criterion (1) or (2): 668 refer to households for whom, once the split-off occurs, the new head is aged 30 or less, and another 60 refer to households whose new head is aged 30 to 50. We eliminate all split-offs, which leaves us with 1,131 observations.

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_{it} to be household *i's* present discounted wealth as of year t, $t = 1968, \ldots, 1982$. PERM_{it} is defined to be:

$$\begin{aligned}\text{PERM}_{it} = & \sum_{s=t}^{1982} (Y1_{is} + Y2_{is})/\text{DISCOUNT}(t,s) \\ & + \sum_{s=1983}^{1988} (Y1\text{PROJ}_{is} + Y2\text{PROJ}_{is})/\text{DISCOUNT}(t,s) \\ & + \text{ASSET}_{it} + \text{EQUITY}_{it},\end{aligned}$$

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 the "wife" (if there is no "wife," $Y2$ and $Y2PROJ$ are zero).

$Y1_{is}$ and $Y2_{is}$ are constructed as follows. If the head is working in year s ($s < 1983$), $Y1_{is}$ is his wage income; similarly for $Y2_{is}$. If both head and wife are retired, $Y1_{is}$ and $Y2_{is}$ each equal one half of the household's total retirement income. If the head is working and the wife is retired, $Y1_{is}$ is the head's wage income and $Y2_{is}$ is the household's total retirement income; similarly if the head is retired and the wife working.

$Y1PROJ_{is}$ and $Y2PROJ_{is}$ are constructed as follows. If the head retires prior to 1982, $Y1PROJ_{is}$ 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, $Y1PROJ_{is}$ is equal to his wage income as of 1982; after age 70, $Y1PROJ_{is}$ is 0.35 of his wage income. Similarly for the wife.

To construct a measure of financial assets, $ASSET_{it}$, 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. $EQUITY_{it}$ 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 nonwage income is likely to derive from bank accounts, in which case the nominal rate is appropriate. (Source for these numbers is the Data Resources Inc. publication, *Review of the U.S. Economy*.)

Our measure of cash flow income, $CASH_{it}$, 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.

Shelter costs are the sum of property taxes, mortgage payments, utilities, 2 percent of the house value (for maintenance; source for this value is the *U.S. Statistical Abstract*), and rent. The share of cash flow income devoted to shelter costs is this sum divided by $CASH_{it}$.

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Comment Yannis M. Ioannides

The paper by Jonathan Feinstein and Daniel McFadden does an admirable job in addressing two key issues associated with the dynamics

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of housing decisions by the elderly. One is the determinants of the propensity to move. The second is how households adjust their housing consumption when they do move. The nature of the housing commodity and the reality of housing markets make it very likely that these two issues are very much related.

Many commonly held beliefs about the housing behavior of the elderly are explained by the econometric models in this paper. The authors conclude that they found no evidence that housing decisions by the elderly are constrained by imperfections in the capital market. Their results confirm the predictions of the life-cycle theory model that wealth is an important determinant of housing decisions, and that mobility and consumption level changes are prompted by retirement and by changes in household composition.

This comment addresses some primarily methodological issues. I argue that a more general analysis of the propensity to move jointly with housing consumption changes would improve our understanding of the behavior of the elderly and could be easily implemented. Furthermore, I direct attention to some implications of portfolio-theoretic considerations within the life-cycle model. This would help to strengthen the authors' conclusions regarding the impact of capital market imperfections.

Life-cycle theory suggests that households form a lifetime investment plan together with a consumption plan. Stylized facts about the path of income over time would imply that households save the excess of income receipts over desired expenditures earlier in life and invest them in a portfolio of assets. Later on in life, households decumulate by liquidating assets. The actual extent of decumulation depends critically on the bequest motive. The time pattern of accumulation may be affected critically by changes in life-cycle characteristics (e.g., when children or other dependents leave the household, or the death of a spouse).

Certain nontrivial characteristics of housing require modifications of the standard life-cycle model. Some such modifications are necessary for a deep understanding of the particular problems and circumstances of the elderly. In order to change the quantity and quality of services generated by a particular dwelling unit, one may either have to move or to modify structurally an existing unit. In both those cases, costs are involved which may contain a fixed component, and the optimal adjustment is complicated by the lumpiness of housing. Another factor which complicates the analysis of housing decisions is that the amount of housing owned by households may reflect investment motives, too. The inflationary experiences of the 1970s and the early 1980s have shown that housing performed well with respect to inflation adjustment, and thus its attractiveness as an asset has been well deserved. Yet, it must be emphasized that there is a substantial geographical variation in the performance of housing as an inflation hedge, which may in fact be important in the context of housing decisions by the elderly.

It is well known that a dynamic programming formulation of households' life-time allocation decisions which explores the above features quickly becomes intractable. This is recognized in the paper. The only way analysis can proceed further is to work with reduced forms. This is, in fact, what the authors pursue. In particular, the paper investigates separately the households' propensity to move per unit of time and their choice of whether to reduce or increase their consumption of housing when moves occur. A number of difficulties are inherent in this separation, which researchers familiar with these issues are well aware of. Even so, discussing them further here may be helpful in interpreting the results in the paper.

I will start with the authors' analysis of the propensity to move. The authors use a Bernoulli model to analyze the propensity to move per year. This model implies that the duration of stay in a given dwelling and for a given set of characteristics of the household is geometrically distributed. (If time were continuous, it would be exponentially distributed.) It is straightforward to show that for the geometric distribution, the hazard rate (i.e., the probability of moving in a particular period given that no move has already taken place) is constant over time. However, it is well known that with heterogeneity and duration dependence, the hazard rate may be an increasing or a decreasing function of duration. Forcing a constant hazard rate on duration data makes it quite likely that important dynamic relationships are being missed. It is not surprising, therefore, that the hypothesis of a constant hazard rate can be easily rejected.

More general models for the propensity to move characterized by a richer dynamic structure may be easily utilized, especially since reduced forms are used anyway (Heckman 1981). An alternative way to easily introduce heterogeneity, duration, and state dependence would be to look at mobility through the duration of residence spells. Prior experience from applications of such an approach and the richness of the PSID data are quite encouraging (see Henderson and Ioannides 1988; Ioannides 1987; Rosenthal 1986). Competing risks models, which are also reduced form, may also be applied fruitfully (Pickles and Davies 1985). In contrast, the attractiveness of the model underlying the Feinstein-McFadden formulation is that mobility in effect follows from comparing every period's utilities from different alternative courses of action. In fact, it is important to direct attention to the remarkably good fit obtained by Model 2, table 2.9. The authors' reduced-form model seems to perform quite well.

I will now discuss results reported in the paper regarding changes in housing consumption among elderly movers. It would, of course, be desirable to have a full model of the demand for housing by the elderly, but that requires availability of housing price data. The authors state they wish to investigate only whether significant changes in housing consumption take place when elderly do change residences. Such changes may take the form of changes in mode (owners becoming renters and vice versa) or of changes in the quantity of housing services consumed. Both kinds of changes may coexist. The latter are emphasized, and the corresponding results are reported in tables 2.15 and 2.16. A probit model for the changes in housing expenditure as a function of wealth, of various socioeconomic characteristics, and of two measures of liquidity constraints gives similar results to those obtained by Venti and Wise (ch. 1, in this volume). This is all the more interesting and significant because key wealth variables—like earned income wealth and, especially, financial wealth—had to be constructed by the authors from other data available in the PSID. Assets data are readily available in the Retirement History Survey (RHS), which is the data used by Venti and Wise. (Further work in the future along such lines can take advantage of the availability of assets data within the PSID, starting from the 1984 wave of interviews).

There is, of course, no unambiguous way to define what constitutes substantial change in shelter costs or dwelling size. The authors' arbitrary, and yet reasonable, definitions for such changes do throw light on the underlying question about the behavior of the elderly. The relative magnitudes of such changes must be related to typical magnitudes of transactions costs associated with these changes. While realtor fees and moving costs may be estimated with some accuracy, there is no clue as to how to account for the nonpecuniary costs of moving. Thus, observed reluctance by the elderly to downsize their dwelling units may, in principle, be interpreted as large perceived transactions costs.

However, large perceived transactions costs are not the whole story. In adjusting their housing expenditure after substantial changes in socioeconomic characteristics relevant to housing demand, households are motivated by the dual role of housing as a consumer durable and an investment good. That is, within a life-cycle theory model, we could consider the quantity of housing stock desired for consumption purposes (h_C) and, separately, the amount of housing stock desired for portfolio purposes (h_I) (Henderson and Ioannides 1983). For a number of reasons which are characteristic of housing markets, such as transactions costs and moral hazard, households may have an incentive to equate h_C to h_I. However, in general, households that want to have $h_C > h_I$ would rent the respective amount of housing services. On the other hand, those who desire $h_C < h_I$ would typically use part of the housing stock they own to produce housing services for their own consumption.

I will now utilize these considerations to examine whether the behavior of the elderly, as portrayed by the paper, does conform to the prediction of life-cycle theory. In particular, since the desire to adjust housing consumption does indeed constitute a primary impetus to move, do elderly households change their holdings of housing when they do move in the direction predicted by the life-cycle model, as augmented by the above considerations peculiar to housing? Some of the special circumstances of the elderly allow us to test, in a somewhat unique fashion, some key predictions of the theory. Elderly who are close to retirement (or have already retired) operate with considerably reduced uncertainty with respect to income. They are also forced to consider the composition of their wealth portfolios, within which housing figures prominently.

A key prediction of the theory is that households should decumulate later in life by liquidating some of their wealth. Thus, as wealth decreases with age, so should its housing component—unless, of course, housing behaves in an extraordinary way within wealth portfolios. The amount of housing stock desired for consumption purposes, on the other hand, should not vary very much with age. To the extent that many households find it attractive to equate h_C to h_I, the resulting decrease in housing stock held, $h^* = h_C = h_I$, is not as pronounced as decumulation of wealth required by the life-cycle model. Therefore, failure to sell and move into smaller quarters, which is what we typically observe, is not inconsistent with perfect capital markets as long as one recognizes certain characteristic rigidities of housing. Furthermore, the above observation along with a bequest motive may make h^* completely invariant with age (see figure 2.11). Nonpecuniary transactions costs contribute further to this noted tendency. The authors' conclusions are thus strengthened by this argument.

The probit model of choosing whether to downsize or upsize would be much more revealing if price comparisons had also been included. Furthermore, because several of the determinants of changes in shelter costs may also contribute to the decision of whether or not to change mode, a bivariate probit model would be a simple way to model those joint discrete decisions.

Finally, I would like to direct attention to the test for unobserved heterogeneity conducted in section 2.4. This test is novel and very powerful, as it tests a particular hypothesis—in the present case, the Bernoulli model for households' propensity to move—against a random effects alternative with an *arbitrary* distribution. Models involving time

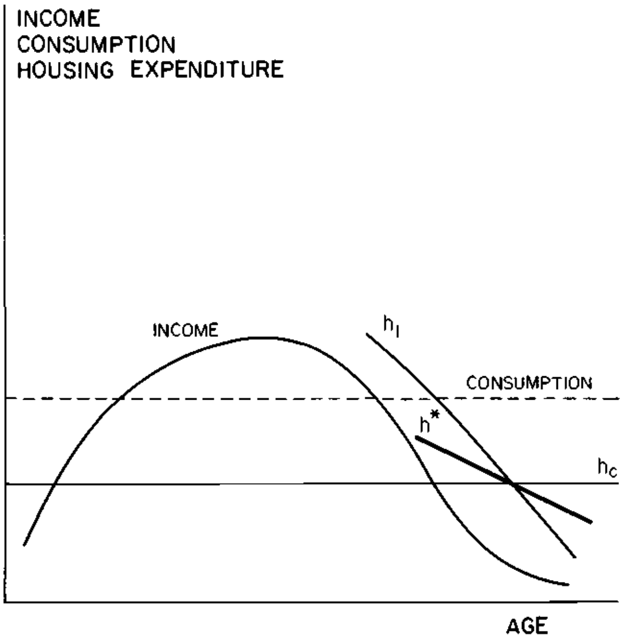

Fig. 2.11 Housing and wealth

processes (or duration data) are typically very complicated. Therefore such a simple test is a most welcome addition to our arsenal.

To conclude, I should emphasize that all-in-all the paper does an impressive job of illuminating housing decisions of the elderly by striking a remarkable economy between data utilization and complexity of econometric modeling.

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