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2 The Dynamics of Housing Demand by the Elderly: User Cost Effects

Chunrong Ai, Jonathan Feinstein, Daniel McFadden, and Henry Pollakowski

2.1 Introduction

This paper is the second in a series of reports on the economic environment in which the elderly must make housing decisions, on the choices they make, and on the consequences of these choices. This report concentrates on the construction of housing prices and user costs faced by the elderly. Section 2.4 of the paper reports some preliminary results on elderly behavior, based on analysis in progress on the 1984 wave of the Panel Study on Income Dynamics (PSID).

2.1.1 Housing Decisions and User Cost

Moving between dwellings and buying or selling a residence are major choices in the life cycle of a consumer. Because of high transactions costs in housing decisions, these choices become important instruments for management of risk and will be strongly influenced by expectations of future income, costs, and health. A fully articulated model of life-cycle housing choices will treat the consumer's problem as a dynamic stochastic program. The discreteness of housing choices introduces nonlinearities that in general will make current decisions dependent on the complete distribution of future cost components, conditioned on current information. As a result, there will be no

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one-dimensional statistics on costs that are sufficient (in the statistical sense) to explain behavior. Nevertheless, it is likely that summary cost measures, obtained by using population probabilities to form expected present values, will capture the principal component of costs and thus be excellent instruments for explaining behavioral response to expected costs.

The approach of this paper is to define and calculate for an elderly population measures of expected user cost that incorporate considerable detail on the cost components facing each household. These user costs should then be good instruments for explaining housing decisions of the elderly. They will, however, be appropriate inputs to a dynamic stochastic programming model of behavior only as leading components of more inclusive vectors of information.

This study employs the 1984 wave of the PSID. This panel was started in 1968 with approximately five thousand households and has since interviewed these and split-off households annually. The original sample contained one subsample that was a clustered random sample of U.S. households and a second subsample that oversampled the poor and minorities. Aside from this oversampling, the panel appears to remain representative of U.S. households. This paper provides expected user costs by year, as well as ex post realized user costs, for each elderly household in the PSID, from 1975 through 1984. Because of data limitations, we are unable to extend the series back before 1975. Some of the components entering user cost could be obtained, within the scope of this project, only at a state or non-SMSA census region level of geographic detail. To provide a broad base for some of the cost calculations, we have included in the analysis all households with a family member over age 35 in 1968.[1] The analysis in this paper is based on 2,089 households, of which 960 had a member of age above 50, and 193 above 65, in 1968.

2.1.2 Ingredients of User Cost Calculation

The first component in a calculation of the expected present value of user cost of housing is a stream of out-of-pocket costs that will be incurred as long as the current dwelling is occupied. For renters, this is simply rent plus utilities. In a few states, there is some state income tax offset for rental expenses. For homeowners, the out-of-pocket costs include mortgage payments, real estate taxes, utilities, maintenance, and insurance. The deducibility of homeowner interest and real estate tax expenses in federal income taxes and some state income taxes is an important offsetting factor in calculating out-of-pocket expenses.

The second major element in user cost is the transaction cost associated with moves, purchases, or sales. A house purchase involves loan fees, title insurance, and other closing costs. A sale involves real estate broker's fees. Moving between dwellings involves direct moving expenses, less easily measured time and money costs in setting up the household, and psychic costs of disruption.

A third component in user cost for owners is capital gains on the housing asset. An increase in the present value of net equity resulting from sale of a home at a future date, rather than immediately, is an additional component that offsets the cost of ownership. Calculation of capital gains is complicated by their tax treatment, particularly the one-time exemption for elderly households that was in effect during the period of this study. A second complication arises in the treatment of homes sold as part of the household's estate after the death of the household. In our analysis, we take a "Ricardian equivalence" view that bequests, including home equity, have utility to the household, and are determined jointly with lifetime consumption. With further simplifications, this leads us to treat capital gains from sale of a house symmetrically whether the household is living or not. Alternatively, the household may treat bequests as the unintended residual of a "self-insured annuity" that contributes little to utility. This would increase the perceived cost of options in which the household owns its home until death, at least to the extent that increases in home equity are not offset dollar for dollar by decreases in liquid assets. A test that capital gains are weighed differently by the household than other housing cost components, for this or other reasons, can be tested empirically.

In calculating the present value of expected user cost of housing, important factors will be the discount rate that the consumer uses, the length of time the household stays in the current dwelling, and the likely transitions after the household leaves the current dwelling. First, the Fisherian consumer in an imperfect capital market will use a discount rate that depends endogenously on lending or borrowing status, credit limits, and instruments available in each period. The length of time the household stays in the dwelling will be influenced by largely exogenous factors such as death of one or more household members, job changes or retirements, and changes in health status (i.e., ability to live unaided in a dwelling with specific characteristics). It will also be influenced by endogenous response to factors such as realized cost of current dwelling and alternatives and life-cycle issues involving current income, portfolio of assets (including equity in owner-occupied housing), and bequest motives.

The approach taken in this paper is to calculate an annualized expected present value of user cost taking all the factors outlined above into account, in a fashion that mimics the calculations of a representative household. However, the endogenous interactions between life-cycle income and consumption patterns that enter the discount rate, and the endogenous decisions on length of stay that would enter the actual calculation of a consumer that solves a life-cycle dynamic stochastic program, are replaced by exogenous rates and probabilities based on statistical averages from a population of similarly situated individuals. The idea is that this "population average" user cost should be a good instrument for the true, endogenous user cost calculated by the life-cycle optimizer. In fact, if consumers are not rational optimizers but are rather "Bayesian learners" who use the observed experiences of others as a basis for forming expectations, then user cost instruments of the form constructed in this paper may come very close to the form in which information is synthesized in housing decisions.

2.2 Housing Prices and Operating Costs[2]

2.2.1 Quality-adjusted Housing Costs

Careful analysis of housing cost changes requires the use of a hedonic rental or housing price index to assure that differences in the unit price of housing are not confused with differences in housing quality. Recent house selling values are available in selected metropolitan areas, and the American Housing Survey (AHS) contains both dwelling characteristics and the occupant's reported rent or property value.[3] However, construction of hedonic costs has in most cases been limited in location or time. Hedonic indices have been developed for a single market over time (Ferri 1977; Palmquist 1980; Bryan and Colwell 1982; and Mark and Goldberg 1984). Metropolitan housing markets have also been segmented into a number of submarkets, and indices have been created (Schnare and Struyk 1976; and Pollakowski 1982). Gillingham (1975), who used census data to develop housing price indices for 1970, was the first to develop price indices for multiple markets. The AHS SMSA files have been used to develop owner-occupied and rental housing price indices for up to fifty-nine medium- and large-sized metropolitan areas. Owner-occupied housing price indices for a single year have been constructed by Follain and Ozanne (1979), Malpezzi, Ozanne, and Thibodeau (1980), Ozanne and Thibodeau (1983), and Goodman and Kawai (1984). Blackley, Follain, and Lee (1986) have used the AHS SMSA files to construct indices for two points in time, 1974–75 and 1977–78, for thirty-four SMSAs.

To provide cost indices for our analysis that cover all locations in the PSID and all years from 1974 through 1984, we have done a hedonic analysis of rents and house prices, using the AHS national sample. Details of the analysis are given below.

2.2.2 Hedonic Rents

The Bureau of Labor Statistics (BLS) prices a standard rental unit for the larger cities. However, such a measure is not available for the rest of the nation. We did not find in the literature any reliable rental price index for the 1974–84 period that covered the entire United States at the required level of geographic detail or any index that reflected price differentials across dwelling size. To provide the indices needed, we carried out a hedonic analysis using rental data from the AHS.

The national file of the American (formerly Annual) Housing Survey consists of a representative panel of about 75,000 dwelling units, of which approximately 40 percent are rented. The survey was conducted annually for the years 1974–81. Subsequently, it has been conducted every second year. Data were available for the years 1974–81 and 1983, when this study was undertaken. Description of individual dwellings is quite thorough, although lot size and certain "upscale" housing characteristics were not added until 1985. Metropolitan-area location is identified for the largest 126 metropolitan areas. Remaining locations are identified by census region and metropolitan/nonmetropolitan status. The rental unit data were aggregated into five large metropolitan areas and eight remaining zones, each containing approximately 2,000 households. This was the minimum sample size judged necessary to obtain reliable coefficient estimates. The aggregation was carried out by first estimating the hedonic equations at a more disaggregated level, testing for common coefficients across geographically contiguous areas, and combining the areas for which the hypothesis of common coefficients is accepted. The final rental analysis regions are shown in table 2.1.

Table 2.1 State and County Aggregates for Which Rental Indices Are Defined

Code	Location
1	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, unless classified elsewhere
2	Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, unless classified elsewhere. Also, Henderson in Kentucky; Brooke, Hancock in West Virginia
3	Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, unless classified elsewhere. Also, Belmont in Ohio
4	Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, unless classified elsewhere
7	Alameda, Contra Costa, Marin, San Francisco, San Mateo in California
9	Bronx, Kings, New York, Queens, Richmond, Nassau, Rockland, Suffolk, Westchester in New York
10	Los Angeles in California
13	Cook, Du Page, Kane, Lake, McHenry, Will in Illinois
15	Bucks, Chester, Delaware, Montgomery, Philadelphia in Pennsylvania; Burlington, Camden, Cloucester in New Jersey
19	Albany, Rensselaer, Saratoga, Schenectady, Broome, Tioga, Washington, Erie, Niagara, Madison, Onondaga, Oswego, Livingston, Monroe, Orleans, Wayne, Herkimer, Oneida in New York; Lehigh, Northampton, Erie, Cumberland, Dauphin, Perry, Cambria, Somerset, Lancaster, Allegheny, Beaver, Washington, Westmoreland, Berks, Luzerne, Adams, York in Pennsylvania; Warren, Hudson, Essex, Morris, Union, Bergen, Passaic, Mercer, Salem in New Jersey; Essex, Middlesex, Norfolk, Plymouth, Suffolk, Bristol, Hampden, Hampshire, Worcester in Massachusetts; Fairfield, Hartford, Middlesex, Tolland, New Haven in Connecticut; Bristol, Kent, Newport, Providence, Washington in Rhode Island; New Castle in Delaware; Cecil in Maryland

(*continued*)

Table 2.1 (continued)

Code	Location
20	Portage, Summit, Stark, Clermont, Hamilton, Warren, Cuyahoga, Geauuga, Lake, Medina, Delaware, Franklin, Pickaway, Greene, Miami, Montegomery, Preble, Lorain, Lucas, Wood, Mahoning, Trumbull in Ohio; Calumet, Outagamie, Winnebago in Wisconsin; Mclean, Henry, Rock Island, Peoria, Tazewell, Woodford, Boone, Winnebago, Madison, St. Clair in Illinois; Boone, Campbell, Kenton in Kentucky; Dearborn, Allen, Lake, Porter, Boone, Hamilton, Hancock, Hendricks, Johnson, Marion, Morgan, Shelby, Marshall, St. Joseph in Indiana; Scott, Polk, Pottawattamie in Iowa; Macomb, Oakland, Wayne, Genesee, Lapeer, Kent, Ottawa, Clinton, Eaton, Ingham, Monroe in Michigan; St. Louis, Anoka, Dakota, Hennepin, Ramsey, Washington in Minnesota; Douglas, Dane, Milwaukee, Ozaukee, Washington, Waukesha in Wisconsin; Cass, Clay, Jackson, Platte, St. Louis, Franklin, Jefferson, St. Charles in Missouri; Johnson, Wyandotte, Butler, Sedgwick in Kansas; Douglas, Sarpy in Nebraska
21	Clayton, Cobb, De Kalb, Fulton, Gwinnett, Richmond, Walker in Georgia; Aiken, Berkely, Charleston, Lexington, Richland, Greenville, Pickens, in South Carolina; Travis, Jefferson, Orange, Nueces, San Patricio, Collin, Dallas, Denton, Ellis, Kaufman, Rockwall, El Paso, Johnson, Brazoria, Fort Bend, Harris, Liberty, Montgomery, Bexar, Guadalupe in Texas; Baltimore, Anne Arundel, Carroll, Harford, Howard, Montgomery, Prince, Georges in Maryland; East Baton Rouge, Jefferson, Orleans, St. Bernard, St. Tammany in Louisiana; Jefferson, Shelby, Walker, Baldwin, Mobile in Alabama; Mecklenberg, Union, Forsyth, Guilford, Randolph, Yadkin, Wake in North Carolina; Hamilton, Anderson, Blount, Knox, Shelby, Davidson, Sumner, Wilson in Tennessee; Broward, Duval, Dade, Orange, Seminole, Hillsborough, Pinellas, Palm Beach in Florida; Cabell, Wayne in West Virginia; Boyd, Jefferson in Kentucky; Lawrence in Ohio; Hinds, Rankin in Mississippi; Pulaski, Saline, Crittenden in Arkansas; Clark, Floyd in Indiana; Hampton, Newport News, York, Chesapeake, Norfolk, Portsmouth, Virginia Beach, Richmond, Chesterfield, Hanover, Henrico, Alexandria, Fairfax, Falls Church, Arlington, Fauquier, Loudoun, Prince William in Virginia; Canadian, Cleveland, Oklahoma, Creek, Osage, Tulsa in Oklahoma; Bossier, Caddo in Louisiana; District of Columbia
22	Bernalillo in New Mexico; Orange, Kern, Fresno, Ventura, Placer, Sacramento, Yolo, Monterey, Riverside, San Bernardino, San Diego, Santa Clara, Santa Barbara, San Joaquin in California; Ada in Idaho; El Paso, Adams, Arapahoe, Boulder, Denver, Jefferson in Colorado; Honolulu in Hawaii; Clark in Nevada; Maricopa, Pima in Arizona; Clackamas, Multnomah, Washington in Oregon; Clark, King, Snohomish, Spokane, Pierce in Washington; Davis, Salt Lake in Utah

Note: States listed in codes 1–4 include all areas in those states except those areas referred to by other codes.

In the hedonic analysis, the logarithm of the contract rent of a dwelling unit is regressed on a set of hypothesized determinants representing characteristics of the structure, land, and location. We assume a linear specification in which the coefficients are the implicit prices of the various characteristics. The specification used here is an adaptation of the specification used in earlier work with the metropolitan files of the AHS (see, e.g., Malpezzi, Ozanne, and Thibodeau 1980; and Blackley, Follain, and Lee 1986). Table 2.2 presents the

Table 2.2 Explanatory Variables Used in the Hedonic Rental Equation

Variables	Median
Constant	1.000
One and a half baths	.063
Two baths	.075
More than two baths	.011
Number of rooms	4.000
Multifamily	.721
Age of structure	29.8
Age of structure squared	886
Structure built before 1940	.392
Wall or room heater	.168
Room air conditioning	.298
Central air conditioning	.224
Rooms without electric outlets	.421
Poor structural features index	.105
Poor hallway conditions index	.091
Poor condition index	.487
Length of tenure	3.6
Length of tenure squared	12.9
Black household head	.144
Spanish household head	.052
Abandoned or boarded-up housing on street	.091
Heat included in contract rent	.355
Water included in rent	.043
Dummies for 1975–81 and 1983	
Dummies for 1975–81 and 1983 times number of rooms	

Note: Median values are the median, across 34 SMSAs, of SMSA means (from Blackley, Follain, and Lee 1986).

explanatory variables used in the hedonic price equation for rental housing units. Dummy variables for each year enter the equation as intercepts and in interaction with number of rooms, permitting construction of cost indices by size class. Some tenant characteristics are included that are expected to be correlated with unobserved quality variations or with duration-of-residence discounts. In general, the signs and magnitudes of estimated coefficients and the overall fit are comparable to results from earlier studies of selected metropolitan areas. The occurrence of unreasonable coefficients is about what one would expect by chance. Note that a hedonic equation such as this is most appropriately viewed as the reduced form of a structural system containing supply-and-demand equations for housing. As such, its estimated parameters should not be viewed as solely representing either supply or demand factors.

Once the hedonic equations were estimated, rental indices were constructed for a representative rental housing bundle (described in table 2.2 and taken from Blackley, Follain, and Lee [1986]). This bundle is described as the median over thirty-four metropolitan areas of the area means of each characteristic. An index of the marginal rent for an additional room is also calculated at the median bundle. The rent for dwellings of different sizes is then approximately the median bundle rent, multiplied by a year-specific marginal cost factor for size. The resulting average and marginal rents (in current year dollars) are given in table 2.3. Figure 2.1 compares our rental price index for mid-size dwellings in Los Angeles with the BLS rental cost index in a standard unit; the two series are normalized to be equal in 1979. The two series are in close agreement prior to 1980, with our index showing much sharper cost increases in 1980 and 1981. Figure 2.2 makes the same comparison for New York and again shows our cost index rising more sharply than the BLS index after 1980. Comparing figures 2.1 and 2.2, one notes striking differences across the two locations both in the decade growth rate and in the timing of surges; this is typical across regions.

2.2.3 Hedonic Housing Prices

We have constructed quality-adjusted prices of owner-occupied dwellings by a hedonic analysis that parallels the analysis of rental housing. We used the

Table 2.3 **Log of Monthly Rent for "Median" Dwelling and Marginal Rent per Additional Room**

Location	1974	1975	1976	1977	1978	1979	1980	1981	1983
Median dwelling:									
1	4.458	4.625	4.736	4.750	4.733	4.893	4.948	4.996	5.217
2	4.548	4.644	4.714	4.784	4.877	4.910	4.982	5.085	5.194
3	4.435	4.524	4.560	4.669	4.710	4.849	4.926	5.055	5.210
4	4.626	4.782	4.828	4.926	5.022	5.063	5.251	5.254	5.369
7	5.158	5.153	5.248	5.294	5.429	5.482	5.540	5.811	5.907
9	5.281	5.380	5.411	5.478	5.577	5.641	5.705	5.849	6.005
10	4.844	4.904	4.997	5.123	5.211	5.303	5.514	5.630	5.705
13	5.021	5.005	5.065	5.050	5.224	5.327	5.373	5.507	5.618
15	4.678	4.695	4.860	4.891	5.020	4.992	5.111	5.227	5.319
19	4.659	4.744	4.774	4.851	4.969	5.025	5.100	5.245	5.383
20	4.742	4.782	4.833	4.922	4.997	5.065	5.187	5.262	5.396
21	4.464	4.514	4.575	4.675	4.740	4.794	4.939	5.017	5.254
22	4.614	4.732	4.795	4.926	4.999	5.150	5.263	5.360	5.541
Additional room:									
1	.07	.05	.07	.03	.11	.05	.05	−.01	.01
2	.07	.08	.05	.06	.07	.05	.11	.04	.11
3	.05	.06	.09	.08	.08	.08	.09	.08	.06
4	.05	.05	.10	.10	.13	.14	.08	.08	.09
7	.10	.09	.07	.15	.07	.09	.08	.07	.11
9	.06	.11	.07	.09	.07	.04	.05	.05	.04
10	.11	.17	.12	.11	.10	.10	.11	.13	.08
13	.08	.07	.09	.03	.06	.08	.04	.07	.08
15	.04	.07	.11	.10	.13	.10	.14	.13	.14
19	.07	.06	.09	.07	.06	.07	.06	.06	.04
20	.08	.10	.09	.10	.07	.05	.07	.09	.09
21	.07	.09	.10	.07	.07	.06	.08	.07	.09
22	.09	.08	.08	.10	.09	.08	.11	.11	.08

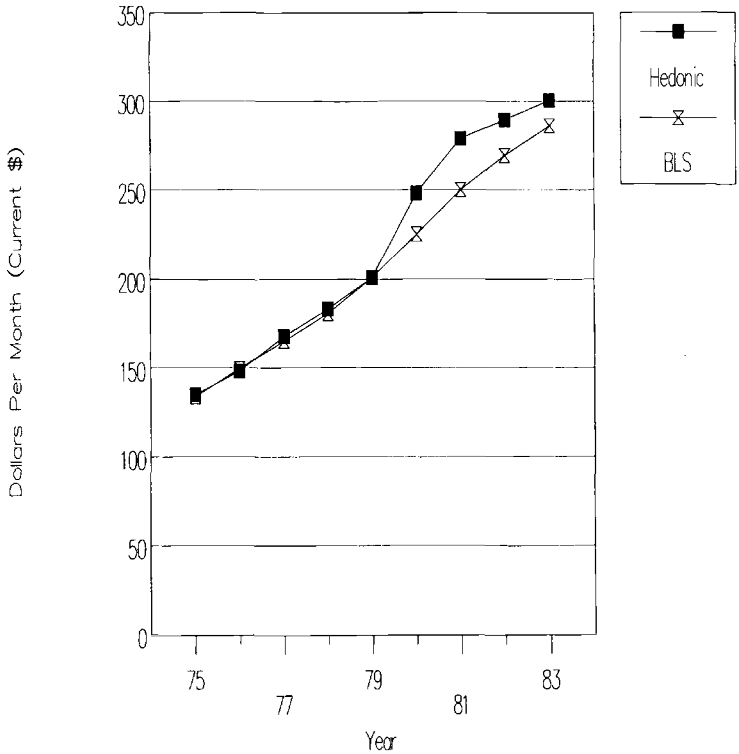

Fig. 2.1 Los Angeles monthly rent

approximately 45,000 owner-occupied dwellings in the national sample of the AHS. A hedonic regression model linear in housing characteristics, with the logarithm of owner-reported current dollar house value as the dependent variable, was estimated. Regressions were done for twelve large metropolitan areas, along with ten additional zones representing the remainder of the United States, as shown in table 2.4. Again, the final zones were obtained by first running the regressions on more disaggregated areas and then combining contiguous areas where the hypothesis of common coefficients could be accepted.

Table 2.5 lists the explanatory variables used in the model. Again, dummy variables for year are introduced as intercepts and in interaction with number of rooms to yield a price index sensitive to size. Condominiums are excluded from the analysis, as are dwellings located on more than ten acres of land.

A median bundle of owner-occupied housing characteristics is defined by forming area means for each of the twenty-six areas in our final hedonic analysis and taking the median of these averages.[4] This bundle is described in table 2.5. The result of this calculation is very close to the median bundle for owner-occupied dwellings obtained by Blackley, Follain, and Lee (1986). The average house price and the marginal price per room are then

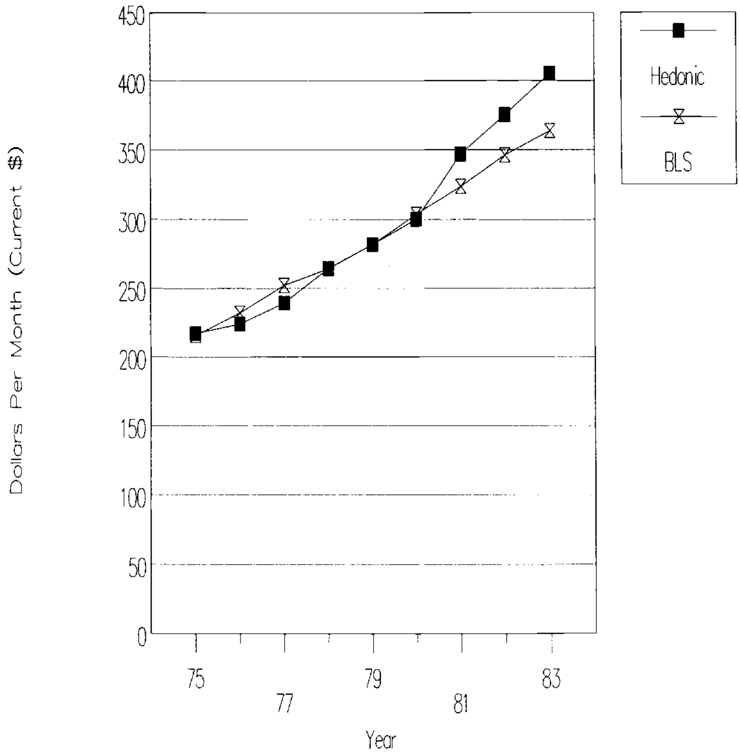

Fig. 2.2 New York monthly rent

Table 2.4 State and County for Which Price Indices Are Defined

Code	Location
1	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, unless elsewhere classified
2	Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, unless elsewhere classified. Also, Henderson in Kentucky; Brooke, Hancock in West Virginia
3	Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, unless elsewhere classified. Also, Belmont in Ohio
4	Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, unless elsewhere classified
5	Brazoria, Fort Bend, Harris, Liberty, Montgomery in Texas
6	Essex, Middlesex, Norfolk, Plymouth, Suffolk in Massachusetts
7	Alameda, Contra Costa, Marin, San Francisco, San Mateo in California
8	District of Columbia; Montgomery, Prince Georges in Maryland; Alexandria, Fairfax, Falls Church, Arlington, Fauquier, Loudoun, Prince William in Virginia
9	Bronx, Kings, New York, Queens, Richmond, Nassau, Rockland, Suffolk, Westchester in New York
10	Los Angeles in California
11	Baltimore, Anne Arundel, Carroll, Harford, Howard in Maryland

Table 2.4 (continued)

Code	Location
12	Collin, Dallas, Denton, Ellis, Kaufman, Rockwall, El Paso, Johnson in Texas
13	Cook, Du Page, Kane, Lake, McHenry, Will in Illinois
14	Macomb, Oakland, Wayne in Michigan
15	Bucks, Chester, Delaware, Montgomery, Philadelphia in Pennsylvania; Burlington, Camden, Cloucester in New Jersey
16	Anoka, Dakota, Hennepin, Ramsey, Washington in Minnesota
17	Fairfield, Hartford, Middlesex, Tolland, New Haven in Connecticut; Hudson, Essex, Morris, Union, Bergen, Passaic, Mercer in New Jersey
18	Albany, Rensselaer, Saratoga, Schenectady, Broome, Tioga, Washington, Erie, Niagara, Madison, Onondaga, Oswego, Livingston, Monroe, Orleans, Wayne, Herkimer, Oneida in New York; Lehigh, Northampton, Erie, Cumberland, Dauphin, Perry, Cambria, Somerset, Lancaster, Allegheny, Beaver, Washington, Westmoreland, Berks, Luzerne, Adams, York in Pennsylvania; Warren, Salem in New Jersey; Bristol, Hampden, Hampshire, Worcester in Massachusetts; Bristol, Kent, Newport, Providence, Washington in Rhode Island; New Castle in Delaware; Cecil in Maryland
23	Portage, Summit, Stark, Clermont, Hamilton, Warren, Cuyahoga, Geauuga, Lake, Medina, Delaware, Franklin, Pickaway, Greene, Miami, Montegomery, Preble, Lorain, Lucas, Wood, Mahoning, Trumbull in Ohio; Calumet, Outagamie, Winnebago in Wisconsin; Mclean, Henry, Rock Island, Peoria, Tazewell, Woodford, Boone, Winnebago, Madison, St. Clair in Illinois; Boone, Campbell, Kenton in Kentucky; Dearborn, Allen, Lake, Porter, Boone, Hamilton, Hancock, Hendricks, Johnson, Marion, Morgan, Shelby, Marshall, St. Joseph in Indiana; Scott, Polk, Pottawattamie in Iowa; Genesee, Lapeer, Kent, Ottawa, Clinton, Eaton, Ingham, Monroe in Michigan; St. Louis in Minnesota; Douglas, Dane, Milwaukee, Ozaukee, Washington, Waukesha in Wisconsin; Cass, Clay, Jackson, Platte, St. Louis, Franklin, Jefferson, St. Charles in Missouri; Johnson, Wyandotte, Butler, Sedgwick in Kansas; Douglas, Sarpy in Nebraska
25	Clayton, Cobb, De Kalb, Fulton, Gwinnett, Richmond, Walker in Georgia; Aiken, Berkely, Charleston, Lexington, Richland, Greenville, Pickens, in South Carolina; Travis, Jefferson, Orange, Nueces, San Patricio, Bexar, Guadalupe in Texas; East Baton Rouge, Jefferson, Orleans, St. Bernard, St. Tammany in Louisiana; Jefferson, Shelby, Walker, Baldwin, Mobile in Alabama; Mecklenberg, Union, Forsyth, Guilford, Randolph, Yadkin, Wake in North Carolina; Hamilton, Anderson, Blount, Knox, Shelby, Davidson, Sumner, Wilson in Tennessee; Broward, Duval, Dade, Orange, Seminole, Hillsborough, Pinellas, Palm Beach in Florida; Cabell, Wayne in West Virginia; Boyd, Jefferson in Kentucky; Lawrence in Ohio; Hinds, Rankin in Mississippi; Pulaski, Saline, Crittenden in Arkansas; Clark, Floyd in Indiana; Hampton, Newport News, York, Chesapeake, Norfolk, Portsmouth, Virginia Beach, Richmond, Chesterfield, Hanover, Henrico in Virginia; Canadian, Cleveland, Oklahoma, Creek, Osage, Tulsa in Oklahoma; Bossier, Caddo in Louisiana
27	Bernalillo in New Mexico; Kern, Fresno, Placer, Sacramento, Yolo, Riverside, San Bernardino in California; Ada in Idaho; El Paso, Adams, Arapahoe, Boulder, Denver, Jefferson in Colorado; Clark in Nevada; Maricopa, Pima in Arizona; Clackamas, Multnomah, Washington in Oregon; Clark, King, Snohomish, Spokane, Pierce in Washington; Davis, Salt Lake in Utah
28	Orange, Ventura, Monterey, San Diego, Santa Clara, Santa Barbara, San Joaquin in California; Honolulu in Hawaii

Note: States listed in codes 1–4 include all areas in those states except those areas referred to by other codes.

Table 2.5 Explanatory Variables Used in Hedonic Price Equation

Variables	Median
Constant	1
One and a half baths	.174
Two baths	.218
More than two baths	.116
Number of rooms	6.24
Single-family attached	.0147
Garage present	.809
Basement present	.688
Age of structure	28.6
Age of structure squared	818
Age of structure cubed	23,400
Structure built before 1940	.225
Wall or room heater	.0163
Steam or hot water heat	.0386
Electric heat	.0639
Room air conditioning	.325
Central air conditioning	.319
Rooms without electric outlets	.0172
Poor structural features index	.0153
Cook with electricity	.421
Length of tenure	11.6
Length of tenure squared	135
Black household head	.0904
Spanish household head	.015
Abandoned or boarded-up housing on street	.0355
Dummies for 1975–81 and 1983	
Dummies for 1975–81 and 1983 times number of rooms	

Note: Median values are the median, across 34 SMSAs, of SMSA means (from Blackley, Follain, and Lee 1986).

calculated for each location and year. The housing price indices are given in table 2.6. Hedonic housing prices for Los Angeles and New York are shown in figures 2.3 and 2.4. For comparison, the BLS homeowner cost index, available for the years 1975–82, was spliced to a series on sales prices of existing homes (without quality adjustment) from 1982 to 1984. For Los Angeles, the two series are comparable. However, in New York, the hedonic index shows lower increases than the BLS index and sharply lower increases from 1981 to 1983, when the spliced BLS index is not quality adjusted.

2.2.4 Mortgage Rates, Closing Costs, and Selling Expense

Residential real estate markets exhibit substantial transactions costs and capital market restrictions. Closing costs associated with purchases, including mortgage points, title insurance, and legal fees, are typically 1 or 2 percent of

Table 2.6 **Log of Price of "Median" Dwelling and Log Marginal Cost of an Additional Room**

Location	1974	1975	1976	1977	1978	1979	1980	1981	1983
Median dwelling									
1	3.506	3.510	3.598	3.640	3.796	3.914	3.901	4.073	4.197
2	3.158	3.262	3.364	3.505	3.586	3.741	3.704	3.843	3.860
3	3.150	3.172	3.256	3.425	3.563	3.677	3.784	3.984	4.072
4	3.224	3.320	3.416	3.643	3.888	3.928	3.970	4.334	4.302
5	2.965	3.105	3.213	3.430	3.510	3.595	3.721	3.905	3.979
6	3.614	3.633	3.676	3.778	3.815	3.974	4.038	4.181	4.355
7	3.654	3.703	3.859	4.103	4.290	4.443	4.690	4.806	4.852
8	3.737	3.846	3.905	3.958	4.038	4.184	4.327	4.390	4.397
9	3.727	3.783	3.803	3.829	3.904	3.943	4.040	4.120	4.344
10	3.598	3.660	3.836	4.102	4.334	4.538	4.709	4.790	4.768
11	3.336	3.447	3.518	3.686	3.748	3.884	3.963	4.056	4.088
12	3.001	3.053	3.150	3.275	3.431	3.636	3.737	3.903	4.052
13	3.639	3.721	3.767	3.920	4.079	4.169	4.249	4.208	4.267
14	3.340	3.407	3.433	3.477	3.608	3.779	3.840	3.994	3.958
15	3.489	3.559	3.673	3.737	3.770	3.900	3.983	4.026	4.153
16	3.368	3.455	3.585	3.731	3.903	4.015	4.107	4.199	4.232
17	3.720	3.768	3.845	3.913	4.084	4.189	4.261	4.371	4.516
18	3.298	3.345	3.422	3.560	3.625	3.772	3.832	3.960	4.008
23	3.245	3.340	3.404	3.517	3.671	3.745	3.845	3.960	4.001
25	3.164	3.239	3.290	3.407	3.504	3.612	3.695	3.846	3.944
27	3.204	3.270	3.420	3.595	3.808	3.924	4.078	4.241	4.294
28	3.747	3.892	4.051	4.345	4.451	4.622	4.748	4.979	4.964
Additional room									
1	.05	.08	.06	.09	.11	.09	.12	.08	.02
2	.08	.10	.11	.06	.11	.09	.07	.03	.08
3	.07	.11	.11	.14	.13	.06	.08	.13	.11
4	.06	.06	.03	.04	.02	.02	.03	.08	.05
5	.12	.12	.12	.10	.15	.13	.11	.11	.10
6	.05	.06	.06	.09	.07	.08	.10	.09	.08
7	.13	.09	.09	.13	.09	.08	.08	.09	.11
8	.06	.06	.06	.09	.10	.09	.08	.09	.10
9	.04	.06	.07	.08	.06	.07	.06	.08	.09
10	.07	.08	.11	.14	.15	.14	.11	.12	.03
11	.09	.08	.09	.03	.06	.04	.07	.07	.06
12	.10	.12	.13	.10	.12	.09	.09	.11	.11
13	.05	.07	.07	.08	.09	.12	.09	.08	.09
14	.03	.05	.05	.10	.08	.09	.09	.11	.11
15	.08	.09	.08	.06	.05	.06	.08	.10	.09
16	.07	.07	.05	.07	.06	.05	.06	.04	.06
17	.04	.06	.06	.08	.05	.05	.11	.12	.09
18	.06	.08	.05	.04	.07	.06	.05	.03	.05
23	.08	.08	.08	.07	.07	.07	.07	.06	.07
25	.08	.10	.10	.11	.10	.09	.10	.10	.10
27	.08	.08	.06	.07	.10	.06	.08	.07	.07
28	.03	.06	.08	.06	.10	.14	.08	.10	.10

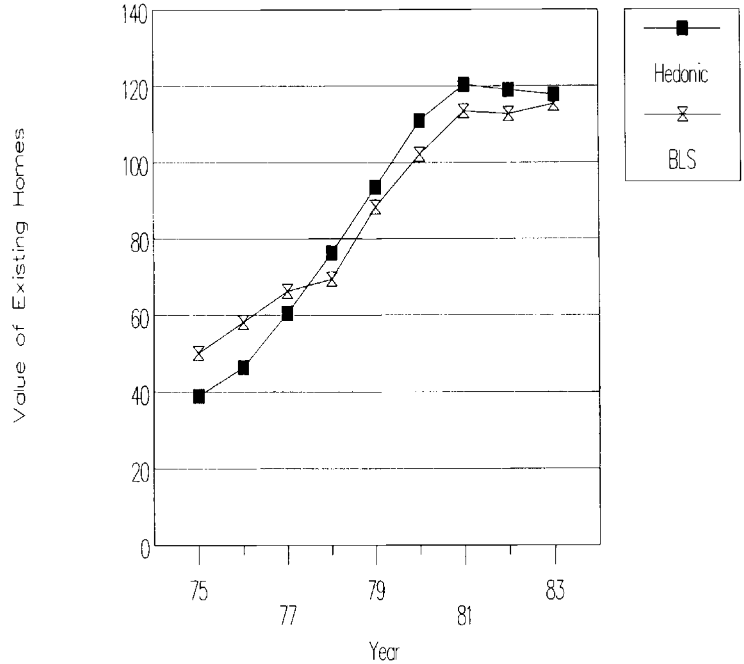

Fig. 2.3 Los Angeles housing prices (current dollars, in thousands)

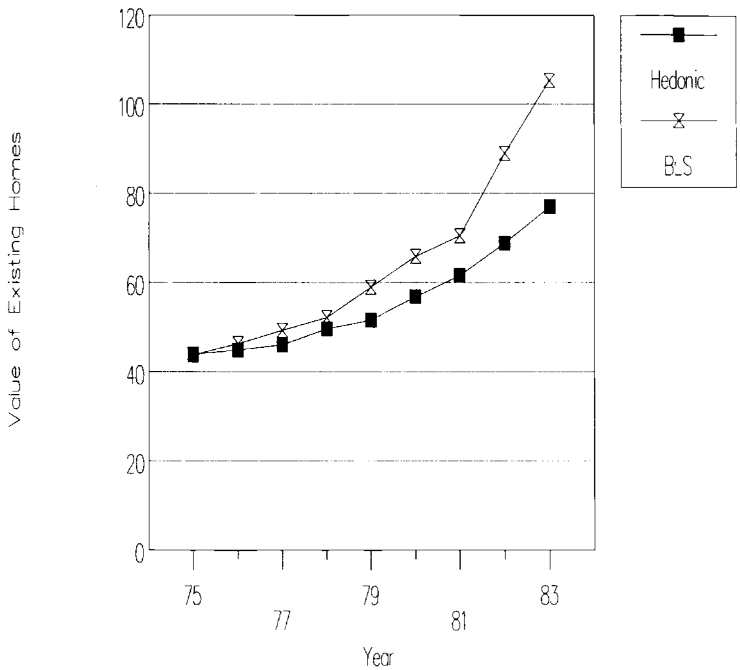

Fig. 2.4 New York housing prices (current dollars, in thousands)

price. Selling expenses, including real estate broker fees, are typically 5–7 percent of price. Mortgages in the period 1974–84 were predominantly issued at fixed interest rates. Prior to deregulation of financial markets, mortgage rates were somewhat more favorable than other interest rates, reflecting restrictions on interest paid on savings deposits, restrictions on lending by savings and loan associations, and federal insurance programs for mortgages. Buyers typically face an earnings test to qualify for a mortgage, and the amount of a mortgage is limited to a fraction of the property value.

For the period 1954–84, we have collected state average data on FHA insured, conventional new-home, and conventional existing-home mortgage interest rates on residential property. These rates are highly correlated, and a sales-weighted rate is close to the conventional existing-home rate. We use the conventional existing-home rate. Where calculations require interest rates after 1984, we assume that the ratio of state to national rates is constant from 1984 on, use data on observed national average mortgage rates from 1984 through 1988 (from the *Federal Reserve Bulletin*), and assume that the real national mortgage rate is constant from 1988 on. Table 2.7 gives the data on mortgage rates through the period of the panel.

For the period 1954–84, the U.S. Federal Home Loan Bank Board *Savings and Home Financing Source Book* gives national average data on initial fees,[5] term to maturity, and loan-to-price ratio. These data are summarized in table 2.8.[6]

Regional data on title insurance and transfer fees for purchasers, or broker fees for sellers, have not been found for the period 1974–84. Consequently, we assume that closing costs other than initial fees (transfer fees, title insurance, and attorney's fees) are 1 percent of purchase price and that real estate brokerage fees paid by sellers are 6 percent of selling price.

2.2.5 Maintenance and Insurance

Dwelling maintenance required to keep quality of a structure constant is typically 1–2 percent of value. Data from the *Construction Reports* published by the U.S. Bureau of the Census give national expenditures on maintenance and repair. Table 2.9 expresses these data as percentages of the value of the residential owner-occupied housing stock. We have not found a source that permits geographic disaggregation of these ratios.

Homeowner insurance rates are typically .2–.5 percent of value. We have not found data on homeowner insurance rates by year and state. Consequently, we have omitted this cost component from the homeowner calculation, leaving its effect to be captured by ownership dummies.

2.2.6 Real Estate Taxes

Property taxes are a significant component of homeowner cost that vary substantially across localities. In some locations, there have also been substantial variations over time. We have collected data from 1974–84 on

Table 2.7 **Mortgage Interest Rate (%), by State**

State	Code	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
AL	1	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
AZ	2	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.9	9.4	10.7	12.0	14.2	15.0	12.0	12.1
AR	3	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
CA	4	6.9	7.7	8.2	7.5	7.4	5.4	6.3	6.2	6.1	9.1	9.7	10.9	12.8	14.7	14.6	11.9	11.7
CO	5	6.9	7.7	8.2	7.5	7.4	8.3	9.2	9.1	9.0	9.0	9.7	10.8	11.7	13.1	14.1	12.3	12.0
CT	6	6.9	7.7	8.2	7.5	7.4	7.5	8.5	8.7	8.6	8.5	8.7	9.9	12.2	15.1	15.5	12.4	12.0
DE	7	6.9	7.7	8.2	7.5	7.4	7.7	8.9	9.2	9.1	8.8	9.1	10.2	12.2	14.5	15.0	12.6	12.6
DC	8	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.1	9.0	8.9	9.5	10.7	12.5	14.1	14.5	12.3	11.7
FL	9	6.9	7.7	8.2	7.5	7.4	3.9	4.5	4.4	4.3	8.5	9.0	10.6	12.9	14.8	15.1	12.2	11.7
GA	10	6.9	7.7	8.2	7.5	7.4	8.0	8.7	8.7	8.7	8.7	9.3	10.4	12.4	14.0	14.5	12.4	11.8
ID	11	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
IL	12	6.9	7.7	8.2	7.5	7.4	7.5	8.2	8.9	8.9	8.7	9.3	10.2	12.3	14.2	14.3	12.3	11.9
IN	13	6.9	7.7	8.2	7.5	7.4	2.5	2.8	3.0	2.9	8.7	9.3	10.4	12.2	13.9	14.2	12.3	11.8
IA	14	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
KS	15	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.5	10.3	11.9	13.2	13.4	12.0	11.8
KY	16	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.2	10.2	11.6	14.1	14.4	12.5	11.8
LA	17	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
ME	18	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
MD	19	6.9	7.7	8.2	7.5	7.4	7.8	8.8	9.2	9.0	8.8	9.3	10.5	12.3	14.2	14.7	12.4	12.1
MA	20	6.9	7.7	8.2	7.5	7.4	7.7	8.9	9.1	8.8	8.5	8.9	10.8	13.0	15.8	15.8	12.8	12.8
MI	21	6.9	7.7	8.2	7.5	7.4	7.9	9.1	9.0	9.0	8.8	9.4	10.9	12.7	14.3	14.1	11.7	11.6
MN	22	6.9	7.7	8.2	7.5	7.4	7.8	8.1	8.1	8.5	8.8	9.4	10.3	11.9	13.5	13.7	11.8	11.4
MS	23	6.9	7.7	8.2	7.5	7.4	3.8	4.0	4.5	4.5	8.8	9.4	10.3	12.2	13.9	14.0	12.2	11.9
MO	24	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0

MT	25	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
NE	26	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
NV	27	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
NH	28	6.9	7.7	8.2	7.5	7.4	7.7	8.9	9.1	8.8	8.5	8.9	10.8	13.0	15.8	15.8	12.8	12.8
NJ	29	6.9	7.7	8.2	7.5	7.4	7.6	8.7	8.9	8.9	8.6	8.9	10.0	12.2	14.8	15.2	12.5	12.3
NM	30	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
NY	31	6.9	7.7	8.2	7.5	7.4	3.8	4.2	4.3	4.3	8.5	8.6	9.8	12.2	14.9	15.3	12.0	11.3
NC	32	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.8	12.3	14.6	14.9	12.4	12.3
ND	33	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
OH	34	6.9	7.7	8.2	7.5	7.4	3.8	4.3	4.5	4.4	8.7	9.4	10.7	12.6	14.1	14.3	12.2	12.2
OK	35	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
OR	36	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	9.0	9.6	10.6	12.1	13.7	14.5	12.2	11.9
PA	37	6.9	7.7	8.2	7.5	7.4	3.8	4.5	4.6	4.6	8.6	9.1	10.3	12.3	14.5	15.1	12.3	12.1
RI	38	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
SC	39	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
SD	40	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
TN	41	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
TX	42	6.9	7.7	8.2	7.5	7.4	8.1	8.9	8.9	9.0	8.9	9.5	10.0	11.8	13.3	14.1	12.3	11.9
UT	43	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	9.1	9.7	10.8	11.7	13.3	13.3	12.5	11.8
VT	44	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
VA	45	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.1	9.0	8.9	9.5	10.7	12.5	14.1	14.5	12.3	11.7
WA	46	6.9	7.7	8.2	7.5	7.4	3.9	4.5	4.7	4.6	9.0	9.6	10.6	12.2	13.9	14.7	12.3	11.8
WV	47	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0
WI	48	6.9	7.7	8.2	7.5	7.4	3.9	4.0	4.0	4.2	8.7	9.4	10.5	12.1	14.2	13.9	11.8	11.7
WY	49	6.9	7.7	8.2	7.5	7.4	7.9	8.8	9.0	8.9	8.8	9.4	10.6	12.5	14.5	14.8	12.3	12.0

Source: Federal Home Loan Bulletin, 1968–86, interpolated in missing years and averaged over reported locations in the state. For states without reported locations, the national average is used. Prior to 1973, state data were unavailable.

Table 2.8 Interest Rate, Fees, Term to Maturity, and Loan/Price Ratio Average over Years 1965–86

State	Code	Interest (%)	Fees (%)	Term to Maturity	Loan/Price (%)
AL	1	9.40	1.40	25	73.67
AZ	2	9.36	1.61	26	75.10
AR	3	9.40	1.40	25	73.67
CA	4	8.92	1.24	25	70.70
CO	5	9.33	1.38	27	76.13
CT	6	9.32	1.26	25	67.94
DE	7	9.44	1.41	24	71.69
DC	8	9.33	1.32	27	75.44
FL	9	8.56	1.79	24	67.98
GA	10	9.27	2.00	26	76.53
ID	11	9.40	1.40	25	73.67
IL	12	9.27	1.56	24	72.54
IN	13	8.24	1.46	22	64.23
IA	14	9.40	1.40	25	73.67
KS	15	9.19	1.41	26	75.42
KY	16	9.31	1.35	25	73.90
LA	17	9.40	1.40	25	73.67
ME	18	9.40	1.40	25	73.67
MD	19	9.38	1.25	25	73.76
MA	20	9.59	1.06	25	71.25
MI	21	9.38	1.24	26	73.89
MN	22	9.07	1.34	26	73.49
MS	23	8.46	1.30	22	68.03
MO	24	9.40	1.40	25	73.67
MT	25	9.40	1.40	25	73.67
NE	26	9.40	1.40	25	73.67
NV	27	9.40	1.40	25	73.67
NH	28	9.59	1.06	25	71.25
NJ	29	9.38	1.33	25	69.82
NM	30	9.40	1.40	25	73.67
NY	31	8.44	1.20	23	63.75
NC	32	9.43	1.16	25	74.50
ND	33	9.40	1.40	25	73.67
OH	34	8.59	1.57	23	66.81
OK	35	9.40	1.40	25	73.67
OR	36	9.30	1.44	26	75.51
PA	37	8.60	1.36	22	65.86
RI	38	9.40	1.40	25	73.67
SC	39	9.40	1.40	25	73.67
SD	40	9.40	1.40	25	73.67
TN	41	9.40	1.40	25	73.67
TX	42	9.26	1.93	27	78.89
UT	43	9.26	1.50	26	75.35
VT	44	9.40	1.40	25	73.67
VA	45	9.33	1.32	27	75.44
WA	46	8.57	1.49	24	69.30
WV	47	9.40	1.40	25	73.67
WI	48	8.42	1.29	23	66.22
WY	49	9.40	1.40	25	73.67

Source: Conventional first mortgage contract interest rate and terms, Federal Home Loan Bank Board, *Savings and Loan Financing Source Book*, 1967–87.

Table 2.9 **Maintenance as a Proportion of House Value, by Region**

Region	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Northeast	.006	.006	.006	.006	.006	.006	.005	.005	.006	.006	.009
North central	.007	.007	.007	.006	.006	.006	.006	.006	.008	.007	.012
South	.008	.008	.008	.007	.007	.007	.006	.005	.005	.006	.008
West	.010	.009	.008	.007	.006	.006	.005	.005	.004	.004	.006

Source: For maintenance, U.S. Bureau of the Census, *Construction Reports*, ser. C-50, various years. For house value, U.S. Bureau of the Census, 1980 Census of Housing, vol. 1. For owner-reported value, adjusted to various years using the median sales price of new one-family homes, U.S. Bureau of the Census, *Construction Reports*, ser. C-25.

average residential property tax rates, by state. There is substantial intrastate variation in property tax rates, but collecting property tax rates and assessment rates by locality was beyond the scope of the project. Statistics on property tax rates are given in table 2.10.

2.2.7 Income Tax Deductions and Treatment of Capital Gains

We adopt the general approach of Hendershott and Slemrod (1983) for the calculation of income tax offsets to mortgage interest and property taxes and the calculation of capital gains taxes. For a given stream of future tenure states and projected income, we calculate the federal and state tax liability of the household in each year, with and without itemization of deductions. We have developed a tax program that determines the federal and state income taxes for a household with specified income, exemptions, mortgage interest, property taxes, and other potential deductible expenses. Inputs to this program are federal and state tax schedules, exemption allowances, and rules for itemizing deductions, by year. Potential deductible expenses other than mortgage interest and property taxes are estimated as a function of income from a sample of individual tax returns in 1982. Let N^* denote nonhomeowner potential deductible expenses, H denote mortgage interest and property taxes for a homeowner, S denote the standard deduction, and Y denote taxable income. Then, the filer itemizes deductions if $N^* + H > S$, in which case $N = N^*$ is observed. Assume N^* given Y is normally distributed in the population with mean $\alpha + \beta Y$ and variance σ^2. Then the probability of itemizing is

$$P = \Phi[(\alpha + \beta Y + H - S)/\sigma], \quad (1)$$

the density of N given itemization is

$$\sigma^{-1}\phi[(N - \alpha - \beta Y)/\sigma]/\Phi[(\alpha + \beta Y + H - S)/\sigma], \quad (2)$$

and the expectation of N given itemization is

$$\alpha + \beta Y + \sigma\phi[(\alpha + \beta Y + H - S)/\sigma]/\Phi[(\alpha + \beta Y + H - S)/\sigma]. \quad (3)$$

Table 2.10 **Property Tax Rate (percentage of market value) 1974–84, by State**

State	Code	74	75	76	77	78	79	80	81	82	83	84
AL	1	.75	.75	.74	.74	.73	.70	.56	.38	.41	.42	.41
AZ	2	1.54	1.54	1.63	1.72	1.69	1.37	1.16	.74	.56	.71	.71
AR	3	1.41	1.41	1.45	1.49	1.48	1.54	1.53	1.42	1.42	1.29	1.35
CA	4	2.08	2.08	2.14	2.21	2.26	.94	.98	1.04	1.03	1.05	1.02
CO	5	1.99	1.99	1.90	1.80	1.74	1.22	1.05	1.01	1.01	.95	.98
CT	6	1.94	1.94	2.05	2.17	1.94	1.64	1.55	1.53	1.56	1.60	1.68
DE	7	.92	.92	.90	.88	.89	.89	.85	.79	.75	.76	.71
DC	8	1.78	1.78	1.77	1.77	1.76	1.60	1.30	1.22	1.15	1.17	1.14
FL	9	1.18	1.18	1.16	1.13	1.14	1.11	1.02	.92	1.03	.92	.79
GA	10	1.33	1.33	1.30	1.27	1.28	1.23	1.24	1.21	1.21	1.16	1.08
ID	11	1.86	1.86	1.66	1.46	1.57	1.29	.96	.94	1.04	1.02	1.01
IL	12	2.21	2.21	2.06	1.90	1.81	1.48	1.50	1.47	1.59	1.72	1.63
IN	13	1.64	1.64	1.65	1.66	1.61	1.14	1.19	1.13	1.19	1.23	1.22
IA	14	2.20	2.20	2.08	1.76	1.59	1.39	1.48	1.75	1.64	1.67	1.63
KS	15	1.55	1.55	1.46	1.37	1.28	.98	.94	.93	.97	1.00	1.11
KY	16	1.23	1.23	1.24	1.25	1.26	1.26	1.19	1.14	1.11	1.02	.95
LA	17	.64	.64	.62	.61	.47	.29	.26	.28	.15	.14	.16
ME	18	1.86	1.86	1.76	1.65	1.58	1.58	1.25	1.42	1.52	1.52	1.31
MD	19	2.01	2.01	1.85	1.69	1.72	1.53	1.61	1.25	1.37	1.38	1.26
MA	20	3.26	3.26	3.38	3.50	3.64	3.28	2.51	2.43	2.14	1.85	1.57
MI	21	2.38	2.38	2.50	2.63	2.63	2.45	2.54	2.74	2.68	2.68	2.78
MN	22	1.58	1.58	1.49	1.39	1.33	1.04	.93	.79	.77	.85	.99
MS	23	1.12	1.12	1.11	1.10	1.12	.94	.93	.86	.76	.82	.77
MO	24	1.85	1.85	1.72	1.59	1.45	1.03	1.00	.95	1.17	1.09	1.02
MT	25	1.60	1.60	1.45	1.31	1.23	1.05	1.11	1.08	1.14	1.17	1.14
NE	26	2.50	2.50	2.49	2.48	2.43	2.28	2.37	2.31	2.23	2.12	2.11
NV	27	1.53	1.53	1.62	1.71	1.72	1.53	1.22	1.13	.77	.68	.63
NH	28	2.38	2.38	2.24	2.10	1.96	1.82	1.73	2.06	2.39	2.23	2.02
NJ	29	3.15	3.15	3.23	3.31	3.30	2.82	2.60	2.53	2.55	2.54	2.62
NM	30	1.56	1.56	1.60	1.65	1.47	1.30	1.12	1.14	.93	.90	.76
NY	31	2.56	2.56	2.72	2.89	3.02	2.76	2.75	2.75	2.57	2.66	2.80
NC	32	1.51	1.51	1.43	1.35	1.35	1.15	.95	1.07	.97	.96	1.01
ND	33	1.53	1.53	1.40	1.26	1.18	1.01	1.00	1.01	1.10	1.26	1.25
OH	34	1.29	1.29	1.28	1.26	1.20	1.09	1.08	1.07	1.15	1.15	1.03
OK	35	1.27	1.27	1.11	.95	.95	.95	.91	.82	.74	.89	.95
OR	36	2.18	2.18	2.21	2.25	2.18	1.86	1.72	1.56	2.06	2.27	2.22
PA	37	1.71	1.71	1.78	1.85	1.91	1.67	1.57	1.50	1.63	1.71	1.53
RI	38	2.27	2.27	2.12	1.97	1.82	1.67	1.93	1.90	1.88	2.01	2.01
SC	39	1.07	1.07	.95	.82	.80	.83	.81	.84	.92	.85	.81
SD	40	2.14	2.14	1.97	1.79	1.69	1.63	1.70	1.69	1.77	1.75	1.63
TN	41	1.31	1.31	1.35	1.40	1.40	1.27	1.27	1.42	1.24	1.17	.97
TX	42	2.06	2.06	1.95	1.84	1.66	1.60	1.57	1.68	1.40	1.36	1.32
UT	43	1.20	1.20	1.11	1.03	.99	1.05	1.02	1.03	.92	.97	.87
VT	44	2.21	2.21	2.04	1.87	1.70	1.54	1.60	1.60	1.60	1.60	1.60
VA	45	1.32	1.32	1.27	1.21	1.20	1.23	1.26	1.39	1.44	1.28	1.00
WA	46	1.86	1.86	1.81	1.75	1.78	1.50	1.06	.95	1.01	1.03	1.01
WV	47	.78	.78	.71	.64	.56	.49	.43	.37	.52	.68	.68
WI	48	2.63	2.63	2.43	2.22	2.12	1.66	1.67	1.75	2.01	1.90	2.00
WY	49	1.12	1.12	1.01	.87	.76	.58	.50	.47	.48	.45	.45

Source: Property tax rates for selected metropolitan areas, Advisory Committee on Intergovernmental Relations, *Government Fiscal Federalism, 1974–1985*. Missing values are interpolated. State rates average reported areas or the national average for states without covered metropolitan areas.

We estimate this model by maximum likelihood Tobit; the results are given in table 2.11. This model is used to predict nonhomeowner itemized deductions. The household is assigned the lesser of the calculated tax with predicted itemized deductions, including predicted mortgage interest and property tax for owner alternatives, and with the standard deduction.

The mortgage interest deduction for owner housing will depend on the mortgage/price ratio, the interest rate, and the length and age of the mortgage. We assume that new house purchasers always take the maximum mortgage available. We assume that current owners who buy a new dwelling first roll over those capital gains from their previous dwelling that are not exempted from capital gains taxation and then take a mortgage for the remainder of the new dwelling, up to the maximum available. We use the data from table 2.9 for mortgage length and mortgage/price ratio.[7] We use the standard amortization formula

$$R_t = rM_0(1 - e^{-r(L-t)})/(1 - e^{-rL}), \tag{4}$$

where R_t is interest payment, t is mortgage age, L is mortgage length, M_0 is initial mortgage amount, and r is interest rate, to calculate deductible mortgage interest.

The tax laws in the period 1974–84 gave special treatment to long-term capital gains. Table 2.12 details the year-by-year tax treatment of capital gains from the sale of residential real estate.

We repeat all tax calculations assuming that capital gains in an owned dwelling are realized and taxed immediately and that thereafter the household has no deductible mortgage interest or property taxes. The *difference* of the tax

Table 2.11 **A Tobit Model for Nonhomeowner Income Tax Deductions**

	Status		
	Single	Head	Married Joint and Widows
Standard deduction ($)	2,300	2,300	3,400
Number in sample (total 2,267)	598	82	1.564
Number of itemizers (total 1,305)	202	44	1,049
Estimated coefficients (SE):			
Constant	−658	1295	−1534
	(3,370)	(81,500)	(105)
Taxable income	.195	.125	.150
	(.038)	(.910)	(.0003)
Standard error of regression	3,835	1,574	2,437
	(1,600)	(158)	(5.9)
Weighted sum of squared residuals	1,906	3,820	20,280

Source: Internal Revenue Service, Taxpayer Compliance Measurement Program 1982 database. Four representative geographic districts comprising 2,267 observations (out of approximately 52,000) were selected.

Table 2.12 **Tax on Capital Gains from Resale of Residential Real Estate, By Year**

Tax:	
1974–80	.5 · (capital gain) should be included in taxable income
1981–84	.4 · (capital gain) should be included in taxable income
Deduction:	
1974–76	Person aged 65 or older can deduct any gains if adjusted selling price is not more than 20,000. Otherwise, he or she can deduct (20,000/selling price) · capital gain
1977–78	Person aged 65 or older can deduct any gains if adjusted selling price is not more than 35,000. Otherwise, he or she can deduct (35,000/selling price) · capital gain
1979–81	Person aged 55 or older can exclude $100,000 from capital gain
1982–84	Person aged 55 or older can exclude $125,000 from capital gain

Source: Standard Federal Tax Reports: United States Master Tax Guide, 1974–1985.

streams in these two cases is entered as a component in the out-of-pocket cost stream that appears in the user cost calculation. For renters, this difference is zero; for owners, it is the *incremental* offset, relative to renting, resulting from the tax treatment of ownership.

The statement of tax rates in nominal terms, and the taxation of nominal capital gains, introduces inflationary effects into the calculation of ownership costs. As a consequence, expectations about both future real housing prices and the rate of inflation will enter user cost calculations. We assume that households have perfect foresight on both nominal housing prices and the rate of inflation. To implement this for years after 1984, we assume actual inflation rates through 1988 and inflation at the 1988 rate thereafter. Real housing prices in a region are assumed to grow at rates that are linearly interpolated between a zero annual rate in 1989 and their observed annual rate in 1982–84. After 1989, real housing prices are assumed constant.

2.3 Dynamic Optimization and User Cost

2.3.1 A Definition of User Cost in Life-Cycle Housing Decisions

In this section, we describe a stylized household life-cycle model formulated as a dynamic stochastic program, in which the only discrete decision is tenure and in which the household faces perfect capital markets, except for the fixed costs of real estate transactions. We begin by abstracting from the complexities of tax offsets, letting these be defined implicitly as part of the net out-of-pocket costs of housing. A *life-cycle housing strategy* is defined to be a plan that specifies the current period tenure decision and a probability distribution of future decisions, conditioned on current information. This strategy will take into account contingent responses to future news. The *user cost* of a life-cycle housing strategy will be defined as a nonstochastic life annuity that, if paid by the household in lieu of the actual distribution of current and future out-of-pocket housing costs, would yield the same expected utility. We set out some rather stringent assumptions under which user cost given by this definition can be calculated as a present value, independently of the parameters of the utility function of the household. Our interpretation of this result is that it defines a "point of expansion" of Bellman's equation for the stochastic program in which only the one-dimensional calculated user cost enters the leading term. We believe that this provides a justification for calculated user cost as a good instrument in reduced-form models of housing choices. We have not, however, established that there is a useful solution algorithm for the dynamic stochastic program based on this "expansion"; this question is beyond the scope of this paper.

Suppose discrete time, divided into periods of one year. In period t, the household's consumption policy is described by an indicator for tenure, $d_t = 1$ for a homeowner and $d_t = 0$ for a renter; an "inclusive" out-of-pocket cost for housing, C_t, which depends on current and past tenure and incorporates realized net capital gains from purchase or sale of housing; and a real consumption expenditure level, G_t. The household has an atemporal partial indirect utility function $\psi(G_t - C_t, d_t)$, given consumption expenditures net of housing and tenure. Commodity prices other than housing are assumed constant in real terms and are suppressed as an argument of ψ. Household deaths are assumed to occur at the end of a year, after a full year's consumption, with the liquidation of the household's estate yielding bequests at the time of death. The household has an atemporal utility $\psi^b(B_T)$ for bequests B_T made on death of the household at the end of period T. Let y_t denote income in period t and r_t the one-period real interest rate for liquid assets held from year $t - 1$ to year t. Let δ denote the household's personal discount factor, reflecting impatience. The liquid (nonhousing) assets of the household satisfy the equation of motion

$$A_t = (1 + r_t)A_{t-1} + y_t - G_t . \tag{5}$$

The bequest of a household that dies at the end of year t is the sum of liquid assets and home equity,

$$B_t = A_t + 1(d_t > 0)E_t ; \tag{6}$$

in this formula, $1(Q)$ is an indicator that is one when the event Q is true and zero otherwise, and E_t is end-of-year equity. Equations (5) and (6) imply

$$A_t = A_0 \prod_{\tau=1}^{t} (1 + r_\tau) + \sum_{s=1}^{t} (y_s - G_s) \prod_{\tau=s+1}^{t} (1 + r_\tau). \tag{7}$$

Combining these formulae, the partially indirect utility of a household with a given housing plan (d_t) and expenditure stream (G_t) and with death in period T is

$$(8) \qquad U_T = \sum_{t=1}^{T} \delta^{t-1}\psi(G_t - C_t, d_t) + \delta^{T-1}\psi^B[A_T + 1(d_T > 0)E_T].$$

At $t = 1$, the household does not know its date of death or the sequence d_τ for $\tau > 1$. It may also be uncertain about some variables in the economic environment, such as future income, interest rates, and net housing costs. Let λ_t denote the probability of household death in year t, given survival up until t, and let $\kappa_t = (1 - \lambda_1) \cdot \ldots \cdot (1 - \lambda_{t-1})$ denote the probability of survival until t. Then the household seeks to maximize expected utility

$$(9) \qquad \mathcal{U} = E_1 \sum_{t=1}^{\infty} \kappa_t \lambda_t U_t$$

$$\equiv E_1[\sum_{t=1}^{\infty} \kappa_t \delta^{t-1}\psi(G_t - C_t, d_t) + \sum_{t=1}^{\infty} \kappa_t \lambda_t \delta^{t-1}\psi^B(B_t)],$$

where E_1 denotes expectation of future variables and events, conditioned on information available in period 1.

From (7) and (6), a first-order condition for optimization is

$$(10) \qquad 0 = \partial\mathcal{U}/\partial G_n \equiv E_1[\kappa_n \delta^{n-1}\psi_1(G_n - C_n, d_n) - \sum_{t=n}^{\infty} \kappa_t \lambda_t \delta^{t-1}\psi_1^B(B_t) \prod_{\tau=n+1}^{t} (1 + r_\tau)].$$

An arbitrage argument gives a useful alternative form for this condition. Suppose that the household survives until t and considers shifting one unit of expenditure to the following year. The marginal utility of the unit of expenditure this year is $\psi_1(G_t - C_t, d_t)$. This foregone unit yields $1 + r_{t+1}$ units in the following year. If the household survives, this has marginal utility with present value $\delta\psi_1(G_{t+1} - C_{t+1}, d_{t+1})$ $(1 + r_{t+1})$. If the household does not survive, the bequest B_{t+1} rises by the amount $1 + r_{t+1}$, yielding marginal utility with present value $\delta\psi_1^B(B_{t+1})$ $(1 + r_{t+1})$. Then, arbitrage implies

$$(11) \qquad \psi_1(G_t - C_t, d_t) = (1 - \lambda_t)\delta(1 + r_{t+1})\psi_1(G_{t+1} - C_{t+1}, d_{t+1}) + \lambda_t\delta(1 + r_{t+1})\psi_1^B(B_{t+1}).$$

Now, suppose that, instead of facing the actual stream of housing costs, the household faces a hypothetical alternative with the same tenure pattern but with equity converted to liquid assets and with a real life annuity implicit rental, or *user cost, R*. In this alternative, the household will adjust life-cycle expenditures to maximize

$$(12)\qquad \tilde{\mathcal{U}} = E_1\left[\sum_{t=1}^{\infty} \kappa_t \delta^{t-1} \psi(\tilde{G}_t - R, d_t) + \sum_{t=1}^{\infty} \kappa_t \lambda_t \delta^{t-1} \psi^B(\tilde{B}_t)\right]$$

subject to

$$(13)\qquad \tilde{B}_t = (A_0 + E_0) \prod_{\tau=1}^{t} (1 + r_\tau) + \sum_{s=1}^{t} (y_s - \tilde{G}_s) \prod_{\tau=s+1}^{t} (1 + r_\tau).$$

Now, equate the optimized values of $\tilde{\mathcal{U}}$ from (12) and $\mathcal{U}$ from (9). Make a first-order Taylor's expansion of (12), evaluated at its optimal path, around the optimal path for (9), and let ξ denote the remainder:

$$(14)\qquad \xi = E_1\left[\sum_{t=1}^{\infty} \kappa_t \delta^{t-1} \psi_1(G_t - C_t, d_t)\left\{\tilde{G}_t - G_t - R + C_t\right\}\right.$$
$$+ \sum_{t=1}^{\infty} \kappa_t \lambda_t \delta^{t-1} \psi_1^B(B_t)\left\{\sum_{s=1}^{t} (G_s - \tilde{G}_s) \prod_{\tau=s+1}^{t} (1 + r_\tau)\right.$$
$$\left.\left. + E_0 \prod_{\tau=1}^{t} (1 + r_\tau) - E_t 1(d_t > 0)\right\}\right].$$

Using (10), this equation yields a solution for R,

$$(15)\qquad R = \left\{E_1 \sum_{t=1}^{\infty} \kappa_t \delta^{t-1} \psi_1(G_t - C_t, d_t)\right\}^{-1}$$
$$\left\{E_1\left[\sum_{t=1}^{\infty} \kappa_t \delta^{t-1} \psi_1(G_t - C_t, d_t) C_t + \sum_{t=1}^{\infty} \kappa_t \lambda_t \delta^{t-1} \psi_1^B(B_t)\right.\right.$$
$$\left.\left.\left\{E_0 \prod_{\tau=1}^{t} (1 + r_\tau) - E_t 1(d_t > 0)\right\}\right] - \xi\right\}.$$

Write the marginal utility of bequests in the event of nonsurvival as the marginal utility of expenditure in the event of survival plus a remainder,

$$(16)\qquad \psi_1^B(B_t) = \psi_1(G_t - C_t, d_t) + \zeta_t .$$

If the remainder is small, then the household views the marginal utility of an additional unit of bequest in the event of nonsurvival as nearly equal to the marginal utility of an additional unit of expenditure in the event of survival. Combining (16) and (11),

$$(17) \quad \psi_1 (G_t - C_t, d_t) = \delta(1 + r_{t+1})\psi_1(G_{t+1} - C_{t+1}, d_{t+1}) + \lambda_t \delta \zeta_t ,$$

implying

$$(18) \quad \psi_1(G_t - C_t, d_t) = \psi_1(G_1 - C_1, d_1)/\delta^{t-1}\prod_{\tau=2}^{t} (1 + r_\tau) + \chi_t ,$$

with χ_t again denoting a remainder. Substituting in (15) and dropping the remainder, this yields

$$(19) \quad R = \left\{E_1 \sum_{t=1}^{\infty} \kappa_t / \prod_{\tau=1}^{t} (1 + r_\tau)\right\}^{-1} \left\{E_1 \left[\sum_{t=1}^{\infty} \kappa_t C_t / \prod_{\tau=1}^{t} (1 + r_\tau) + \sum_{t=1}^{\infty} \kappa_t \lambda_t \left\{E_0 - E_t 1(d_t > 0) / \prod_{\tau=1}^{t} (1 + r_\tau)\right\}\right]\right\} .$$

Then (19) is simply the value of a life annuity that has the same expected present value as the actual stream of housing costs, including capital gains and losses on transactions during the household's lifetime and including capital gains and losses from liquidation of the housing component of bequests on the death of the household. In this formula, future costs are discounted at a rate reflecting the market interest rate and the household's survival probability. For the critical assumption of a small remainder, the household's marginal utility of expenditure must be relatively insensitive to consumption level; hence, the household must be nearly risk neutral, and the "Ricardian equivalence" property must hold that a unit consumed by descendants in period t has the same marginal utility for the nonsurviving household as own consumption of this unit by the surviving household. If the marginal utility of expenditure is constant and the "Ricardian equivalence" is exact, then (19) is exact.

Our calculated user costs correspond to (19), with some modifications. First, we consider discrete choice among three dwelling sizes, as well as tenure, so that in each year the household has the alternative of not moving or of moving to one of the six possible size/tenure combinations. Second, we incorporate a relatively complete model of the offsets resulting from federal and state treatment of property taxes, mortgage interest, and capital gains. Third, we incorporate concrete models of expectations about future incomes, price levels, interest rates, and mobility. These models assume that households are Bayesian "imitators" who use the experiences of similarly situated households in the past to forecast the distribution of their own responses in the future. We note that these are not necessarily "rational expectations" and that in the implementation they are not based solely on information available prior to the decision year.

2.3.2 Discounting, Mobility, and Survival

The user cost formula (19) assumes discounting at market rates of interest common to all households in a region. In fact, households face a variety of interest rates and credit constraints, with the mortgage rate somewhat above the lending rate on savings and substantially below the borrowing rate on unsecured loans. In our user cost calculations, we use the regional mortgage rate for discounting, independently of the tenure status of the individual household. This will be accurate for most mature or elderly households of at least modest means, who are typically homeowners or who have sufficient liquid assets so a rate near the mortgage rate characterizes their intertemporal trade-off. However, our calculations will understate the effective interest rate to households that are in poverty or who face credit constraints, and thus understate the user cost to these households of alternatives with "front loaded" cost streams.

Consider household expectations on the future path of housing states, conditioned on current information. Mobility among elderly households is relatively low and most commonly has one of the following patterns:

(*a*) Initial owners either stay until death, move to a rental unit and then stay until death, or move to a new owned unit, followed possibly by a move to a rental unit.
(*b*) Initial renters either stay until death, move to a new rental unit and then stay until death, or move to an owned unit, followed possibly by a move to a rental unit.

We assume that these are the *only* paths considered in the formation of expectations. By doing so, we are ignoring a small percentage of households that have high mobility rates and may anticipate this mobility in forming their expectations. Table 2.13 gives the frequency of patterns observed over the seventeen years of the PSID panel and provides some empirical justification for limiting paths to patterns *a* and *b*.[8] Our motivation for adopting this restriction is first that it drastically limits the branches of future paths the household is assumed to consider when forming expectations, making it practical to calculate expected futures without backward recursion. One could make a "bounded rationality" argument that individuals do prune decision trees before forming expectations about the future, although we cannot claim that the particular pruning we use has behavioral support. Second, the high empirical frequency of patterns *a* and *b* reflects unobserved "mover-stayer" heterogeneity in the population, in the presence of which an independent trials Bernoulli hazard model, even with duration dependence, will underestimate survival probabilities in the tail. The restriction to patterns *a* and *b* partially compensates for this bias.

We estimate simple discrete-time Bernoulli multiple hazard models for stays or moves to six possible tenure/size states, where tenure is own or rent and size

Table 2.13 **Mobility Patterns**

Pattern	Number	Percentage
Owner	777	38.0
Owner > renter	36	1.8
Owner > owner	220	10.8
Owner > owner > renter	4	0.2
Renter	292	14.3
Renter > renter	89	4.4
Renter > owner	96	4.7
Renter > owner > renter	6	.3
Subtotal, common patterns	1,520	74.3
Owner > owner > owner	62	3.0
Owner > renter > owner	23	1.1
Owner > renter > renter	25	1.2
Renter > owner > owner	42	1.9
Renter > renter > owner	2	.1
Renter > renter > renter	56	2.7
Owner, 3 moves	51	2.5
Renter, 3 moves	84	4.1
Owner, 4 moves	30	1.5
Renter, 4 moves	51	2.5
Owner, 5 + moves	34	1.7
Renter 5 + moves	65	3.2
Subtotal, complex patterns	525	25.7
Total	2,045	

is small, medium, or large. Define a rental unit of three rooms or fewer as *small* and one of five rooms or more as *large*. Define an owner-occupied house of four rooms or fewer as *small* and one of six rooms or more as *large*. The models are fitted as seven-alternative multinomial logits. The models are specified as functions of age of head and duration of the spell in the current dwelling and are assumed to be stationary with respect to calendar time. They are estimated using data on transitions in the PSID sample. We do not exclude multiple moves in the estimation data set. Thus the probability of moving yielded by this model is elevated slightly owing to the presence of frequent movers, relative to the mobility that would be observed if all households followed patterns *a* or *b*. Table 2.14 summarizes the period-to-period transitions in the sample. Table 2.15 gives multinomial logit transition probabilities for each of the six originating tenure/size states.

The expectation in the user cost formula (19), elaborated to include dwelling size, is approximated using the possible paths *a* and *b* described above. The probability distribution of duration in each state in a path is obtained using the multiple hazard models in table 2.15, conditioned on the destinations available from the state as specified by the possible paths. For example, a current owner in a small dwelling, when evaluating the alternative of staying for at least one more period, will have a probability distribution of moving in future years to

Table 2.14 Transition Frequencies Between Housing State, All Households, 1968–83

	Previous State						
Current State	Rent Small	Rent Medium	Rent Large	Own Small	Own Medium	Own Large	Row Total
Rent small	260	103	91	33	33	63	583
	(10.3)	(4.1)	(2.1)	(.97)	(.6)	(.5)	(1.8)
Rent medium	99	131	117	18	22	41	428
	(3.9)	(5.2)	(2.6)	(.5)	(.4)	(.3)	(1.3)
Rent large	71	144	382	10	19	89	655
	(2.8)	(5.7)	(8.7)	(.3)	(.3)	(.7)	(2.1)
Own small	30	22	34	63	27	54	230
	(1.2)	(.9)	(.8)	(1.86)	(.5)	(.4)	(.7)
Own medium	11	31	62	36	75	75	290
	(.4)	(1.2)	(1.4)	(1.06)	(1.4)	(.6)	(.9)
Own large	26	41	138	34	81	288	608
	(1.0)	(1.6)	(3.2)	(1.0)	(1.46)	(2.1)	(1.9)
Stay	2,033	2,035	3,554	3,192	5,307	13,007	29,128
	(80.4)	(81.2)	(81.2)	(94.27)	(95.4)	(95.5)	(91.1)
Column total	2,530	2,507	4,378	3,386	5,564	13,617	31,982
	(7.9)	(7.8)	(13.7)	(10.6)	(17.4)	(42.6)	

Note: Numbers in parentheses are column percentages.

any of the six tenure/size combinations. Using the patterns in a, if a transition to a rental unit is made, then the household expects to remain there until death. If a transition to another owned unit is made, then, according to a, the household considers further the possibility of a second move to a rental unit but excludes the possibility of a move to a third unit or further moves from a rental unit. The multiple hazard model is again applied to give a distribution of durations in the second owned unit; the *conditional* transition probability from ownership to a rental/size combination, given that the destination is a rental, is used for this calculation.

We define household death for a couple to be the death of the last survivor. Using U.S. mortality tables and demographic projections of future mortality patterns, we calculate survival probabilities $\kappa_S(t; A)$ for males $(S = 0)$ and females $(S = 1)$ starting from period $t = 0$, with starting age A. We use fifth-degree polynomials for interpolation of the mortality tables. The survival probability for a couple is calculated from the survival probabilities of the individuals using

$$(20) \qquad \kappa_H(t; A_0, A_1) = \kappa_0(t, A_0) + \kappa_1(t; A_1) - \kappa_0(t; A_0) \cdot \kappa_1(t; A_1),$$

where κ_H denotes the household survival probability. The survival probabilities κ_0, κ_1, and κ_H enter the discount factor in the user cost formula (19) and

Table 2.15 Multinomial Logit Transition Probabilities, Variables, and Spline Functions Used in Model

Variable:

Variable	
Choice	Choice variable—0, rent small; 1, rent medium; 2, rent large; 3, own small; 4, own medium; 5, own large; 6, stay
dur	Duration since last move

	Spline Functions of Age		
	Center	Left Limit	Right Limit
Variable:			
d1	35	35	45
d2	45	35	55
d3	55	45	65
d4	65	55	75
d5	75	65	85
d6	85	75	98
d7	98	85	98
d51	75	65	98
d61	98	75	98
d42	65	55	98
d52	98	65	98
d23	45	35	98
d33	98	45	98

	Alternative-Specific Variables: Value by Alternative						
	0	1	2	3	4	5	6
Variable:							
q1	0	1	2	0	0	0	0
q2	0	0	0	1	1	1	0
q3	0	0	0	1	2	3	0
q4	0	0	0	0	0	0	1

	Model					
	Rent Small		Rent Medium		Rent Large	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
Variable:						
q1 · d1	−.053	.441	.139	.396	1.161	.327
q1 · d2	−.168	.180	.448	.159	1.128	.149
q1 · d3	−.478	.137	−.092	.147	.799	.142
q1 · d4	−.961	.179	−.216	.218	.325	.211
q1 · d51	−1.065	.290	.300	.322	1.275	.431
q1 · d61	−3.823	1.924	−1.501	1.253	.678	2.221
q2 · d1	2.048	1.978	.303	1.613	−.112	.974
q2 · d2	−1.472	1.032	−.128	.781	.958	.429
q2 · d3	−2.925	1.289	−1.823	.716	−.066	.448
q2 · d4			.943	.924	.699	.616
q2 · d42	−.077	1.293				

Table 2.15 (continued)

	Model					
	Rent Small		Rent Medium		Rent Large	
Variable:	Coeff.	SE	Coeff.	SE	Coeff.	SE
q2 · d51			−.496	1.809	−.758	1.450
q2 · d52	−20.830	12.359				
q2 · d61			.643	11.694	8.441	5.165
q3 · d1	−2.119	1.394	−.705	.874	.521	.337
q3 · d2	−.307	.549	−.730	.418	−.022	.157
q3 · d3	−.646	.753	.061	.341	.157	.173
q3 · d4			−1.520	.592	−.377	.259
q3 · d42	−2.073	.952				
q3 · d51			−.750	1.121	.610	.547
q3 · d52	5.802	4.730				
q3 · d61			−3.980	9.639	−3.956	2.783
q4 · d1	1.822	.591	2.633	584	3.764	.578
q4 · d2	2.049	.226	2.648	.241	4.294	.260
q4 · d3	1.989	.150	2.763	.195	3.900	.238
q4 · d4	2.114	.158	3.423	.270	3.934	.327
q4 · d5	2.196	.226				
q4 · d6	2.144	.409				
q4 · d7	3.958	1.978				
q4 · d51			3.546	.441	5.037	.746
q4 · d61			.735	1.274	3.599	3.806
Sample *N*	2,451		2,411		4,255	
Log lik.	−1,726.5		−1,676.5		−3,397.1	

	Model					
	Own Small		Own Medium		Own Large	
Variable:	Coeff.	SE	Coeff.	SE	Coeff.	SE
q1 · d1	1.026	.817	.615	1.416	2.716	1.483
q1 · d2	1.335	.328	3.526	1.233		
q1 · d3	1.335	.314	1.374	.511		
q1 · d4	.973	.345				
q1 · d42			.292	.562		
q1 · d51	1.994	0.495				
q1 · d52			4.769	3.930		
q1 · d61	−1.052	1.161				
q1 · d23					1.246	.433
q1 · d33					8.432	5.263
q2 · d1	−2.261	3.120	.461	2.921	.829	3.228
q2 · d2	1.767	.872	6.103	2.484		
q2 · d3	2.154	.751	1.412	1.089		
q2 · d4	1.222	.831				
q2 · d42			1.709	1.021		
q2 · d51	2.244	1.205				

(continued)

Table 2.15 (continued)

	Model					
	Own Small		Own Medium		Own Large	
Variable:	.Coeff.	SE	Coeff.	SE	Coeff.	SE
q2 · d52			10.607	7.793		
q2 · d61	.131	3.224				
q2 · d23					.918	.879
q2 · d33					17.383	10.495
q3 · d1	.895	1.177	.432	.525	1.841	.560
q3 · d2	−.346	.323	.469	.248	1.008	.136
q3 · d3	−.208	.245	.480	.235	1.066	.107
q3 · d4	.047	.267			1.052	.147
q3 · d42			.355	.202		
q3 · d51	.122	.367			1.207	.239
q3 · d52			−1.354	1.013		
q3 · d61	−1.660	1.446			1.218	.662
q4 · d1	.099	1.707	−2.428	2.743	5.289	2.859
q4 · d2	1.029	.669	7.371	2.422		
q4 · d3	2.069	.607	2.652	.956		
q4 · d4	1.396	.654				
q4 · d42			2.445	.932		
q4 · d51	2.877	.983				
q4 · d52			8.910	7.567		
q4 · d61	−4.220	2.603				
q4 · d23					2.842	.836
q4 · d33					19.937	10.456
q4 · dur	2.772	.176	2.623	.166	2.680	.123
Sample N	3,489		5,462		12,783	
Log lik.	−799.62		−650.64		−1,041.5	

are also applied to calculate the probability of nonsurvival in a period *before* the multiple hazard model for mobility is applied. Figure 2.5 shows the survival probabilities for a husband-wife household and for a single woman household, conditioned on the individuals being alive at age 60 in 1974.

2.3.3 Assets and Income Expectations

Expectations of future income not only enter household expected wealth, which directly influences life-cycle planning, but also determine expected income tax offsets to housing costs. We model income expectations as a function of current income, wealth, and demographic characteristics. We assume that there is no information available to the household that is unavailable to the econometrician, that there were no macro shocks through the period of the PSID panel that make the life-cycle income patterns observed therein unrepresentative, and that income expectations are stationary once trends are accounted for. Then the ex post distribution of incomes in a future

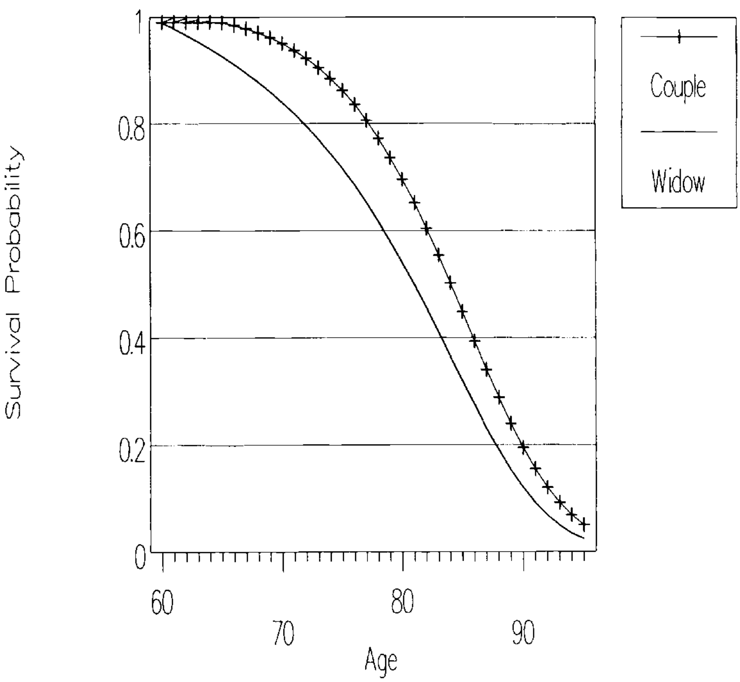

Fig. 2.5 Survival probabilities (households aged 60 in 1974)

period, for the subpopulation with the same history as the household in question, coincides with the ex ante expectation of this household. We can then estimate the ex post distribution and use it in the user cost calculation. However, these assumptions may not be a good approximation of reality. We note that assuming the absence of macro shocks is unpalatable here, as there is certainly correlation of the housing markets seen by geographically proximate households, and ex post house price data from areas such as the Los Angeles SMSA will certainly embody the realizations of market-wide shocks not perfectly anticipated by consumers.

The *taxable* income profiles starting from year t with a head of age A_t are assumed to have the form

$$(21) \qquad y_{t+s} = y_t \exp\left(\sum_{j \in J} \theta_j [d_j(A_{t+s}) - d_j(A_t)]\right),$$

where $s = 1, 2, \ldots$ denotes future years, the θ_j are coefficients, and the d_j are linear spline functions of age,

$$(22) \qquad d(a) = \begin{cases} 1 - c_1(c_0 - a) \text{ if } c_1\,(c_0 - a) < 1 \text{ and } a \leq c_0\,, \\ 1 - c_2(a - c_0) \text{ if } c_2\,(a - c_0) < 1 \text{ and } a > c_0\,, \\ 0 \text{ otherwise,} \end{cases}$$

with c_0, c_1, and c_2 specified nonnegative constants. In order to estimate this model using the eleven-year window from 1974 through 1984 in which the PSID has comparable income data, we make the crude approximation that households treat their demographic state as time invariant. For example, a household consisting of a couple with head aged 60 is postulated to assume that changes in its income profile between ages 80 and 90 will resemble the changes over a decade of *couples* that start with head aged 80. In fact, there is a substantial probability that this head will die before age 80 and the household's income profile in this future decade will more closely resemble that of widows that start at age 80. This is not very satisfactory, and a better solution would be to turn to data on full life cycles in which future income profiles could be constructed conditioned on demographic status at comparable ages.

The form of the income profile could have been elaborated to account for additional effects, some of which may be important. A term allowing a chronological trend in real income levels or a function of actual variations in aggregate real income per household in the historical period (replaced in income projections by long-run macroeconomic forecasts) could be added. Base income y_t could be replaced by an exponential distributed lag on current and past income levels; this might more closely approximate the "nontransitory income" that the household uses as a base for income forecasts. We have not made these extensions.

The system above is log linear in parameters and is estimated using PSID total household money income data that are available from 1975 through 1984. (Only labor income data are available back to 1968.) These data are stacked by household and by year within household. Then the profile is estimated in log form using all available pairs of years t and $t + s$, conditioned on all income variables appearing in the regression being positive. The cases of zero income almost all correspond to nonsurvival, and for these the regression conditioning corresponds to the conditional forecast needed. The few cases where surviving households have zero labor and pension income are adapted to the functional form by assigning a minimum income of one dollar.

The formulation above of the life-cycle income profile and estimation method differs from the more common autoregressive forecasting model in that we use a direct s-period ahead forecast rather than an s-step ahead iterative forecast. The reason we do this is that we anticipate the existence of persistent individual effects, which can be approximated in an autoregressive model only with a lengthy lag. The trade-off is that we have rather tightly parameterized the tail of the life-cycle income profile. A second variation on conventional analysis is that we combine labor and pension income and do not condition on retirement. Thus, our model gives unconditional income profiles that incorporate sample information on retirement patterns and their interdependence on earnings and pension profiles. This approach circumvents the necessity of specifying a correct structural model of the retirement process and is robust to the nature of this structure. One drawback is that we will not be able to do policy analysis of housing behavior response to structural changes in retirement programs or forecast housing demand in a future where structural changes in retirement programs have occurred. Since our analysis is conditioned only on household survival, not on individual members, it incorporates the expected effect on income of nonsurvival of head or spouse. This avoids structural modeling of, say, income conditioned on the event of future widowhood.

Table 2.16 gives the coefficients of the fitted taxable income forecasting models for twenty demographic categories. Figure 2.6 gives the income profile

Table 2.16 Explanatory Variables Used in the Income Projection Model

Spline Function of Age	Center	Left Limit	Right Limit
L40	25	None	40
L45	30	None	45
L50	35	None	50
L55	40	None	55
L60	45	None	60
R60	75	60	None
R65	80	65	None
R70	85	70	None
R75	90	75	None
R80	95	80	None

Classification of Households and Income Forecasting Models

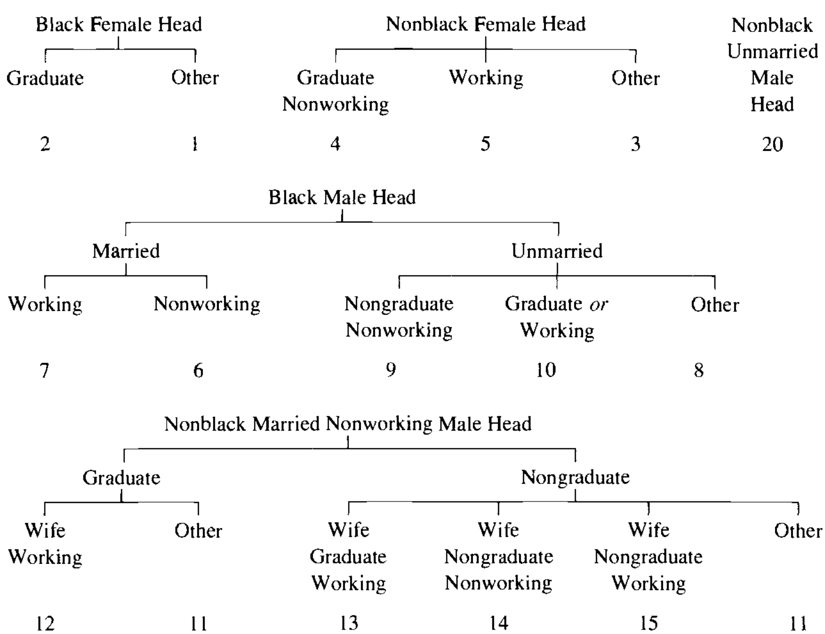

Table 2.16 (continued)

Nonblack Married Working Male Head					
Both Graduate		One Graduate		Neither Graduate	
Wife Nonworking	Other	Wife Working Graduate *or* Nongraduate	Other	Wife Nonworking	Wife Working
16	11	17	11	18	19

	Estimated Models						
	1	2	3	4	5	6	7
Constant	.073	.003	.057	.010	.047	−.023	−.078
	(.032)	(.026)	(.020)	(.032)	(.029)	(.019)	(.047)
L40	−2.421	−2.472	−4.540	−1.753	−10.245	3.368	2.665
	(1.516)	(.674)	(1.445)	(2.033)	(3.968)	(.926)	(2.168)
L45	.248	1.712	−1.484	−1.001	−1.781	.130	−1.886
	(.723)	(.406)	(.538)	(.713)	(1.229)	(.327)	(1.170)
L50	.928	−.616	−.115	−.263	.679	.200	−1.437
	(.304)	(.209)	(.278)	(.316)	(.642)	(.163)	(.651)
L55	−1.486	−.366	−.936	−.724	−1.126	−.612	.678
	(.265)	(.225)	(.234)	(.282)	(.500)	(.157)	(.465)
L60	1.072	.312	.741	.494	.045	1.036	−.057
	(.198)	(.178)	(.155)	(.207)	(.309)	(.114)	(.289)
R60	−2.391	.587	−2.403	−2.803	−.306	−3.167	−.306
	(.229)	(.233)	(.133)	(.216)	(.241)	(.140)	(.418)
R65	.917	.096	.910	.049	.403	−.220	−.309
	(.460)	(.595)	(.181)	(.335)	(.308)	(.284)	(.552)
R70	−.854	−.050	.259	−1.160	−.630	−.652	−.446
	(.700)	(.886)	(.208)	(.507)	(.258)	(.730)	(.632)
R75	.784	−20.506	−.904	2.201	.285		−.717
	(1.195)	(6.667)	(.193)	(1.349)	(.350)		(.948)
R80	−5.151			−7.809	−.406		
	(3.901)			(6.531)	(.357)		
Sample *N*	3,199	2,141	11,523	3,796	5,929	7,632	1,571
R^2	.072	.024	.059	.166	.010	.136	.026
	8	9	10	11	12	13	14
Constant	.076	.003	.140	−.019	−.066	−.044	−.025
	(.046)	(.052)	(.085)	(.009)	(.017)	(.036)	(.032)
L40	−3.633		−.632	1.913	−.724		
	(5.602)		(7.731)	(.615)	(1.277)		
L45	−.922	−1.316	−.548	1.006	1.192	−1.197	3.125
	(.899)	(.954)	(1.963)	(.205)	(.314)	(.765)	(.793)
L50	.444	.654	−.314	−.523	−.884	−.626	.572
	(.498)	(.518)	(1.161)	(.087)	(.141)	(.316)	(.296)

Table 2.16 (continued)

	Estimated Models						
	8	9	10	11	12	13	14
L55	−.607	−.373	−.786	−.120	−.183	1.374	−.056
	(.404)	(.411)	(1.025)	(.081)	(.140)	(.282)	(.258)
L60	.870	.384	1.500	.534	.502	−.666	.164
	(.285)	(.302)	(.666)	(.059)	(.103)	(.206)	(.190)
R60	−3.625	−4.530	−2.967	−2.482	−3.594	−2.934	−1.300
	(.319)	(.386)	(.549)	(.066)	(.124)	(.259)	(.233)
R65	.400	1.491	2.297	.220	−.551	−1.567	−1.188
	(.684)	(.935)	(1.153)	(.103)	(.234)	(.488)	(.466)
R70	2.787	−5.788	.614	2.126	3.467	4.310	−2.309
	(.917)	(2.317)	(1.261)	(.129)	(.355)	(1.100)	(2.022)
R75	−2.234		−2.586	−2.219	−4.780	−4.765	−8.610
	(1.444)		(1.646)	(.134)	(.589)	(99.999)	(2.486)
R80	−9.166		−6.976			−8.000	
	(2.363)		(2.676)			(99.999)	
Sample *N*	1,304	869	435	37,020	9,555	1,920	2,135
R^2	.169	.256	.136	.075	.196	.171	.095

	15	16	17	18	19	20
Constant	−.058	−.048	.010	−.024	−.051	.030
	(.030)	(.046)	(.047)	(.078)	(.052)	(.036)
L40	4.093					
	(1.000)					
L45	.639	3.071	−1.119			−.388
	(.557)	(1.439)	(1.626)			(.872)
L50	−.455	−.882	−.723	−1.777	−3.181	−1.177
	(.262)	(.735)	(.742)	(1.468)	(2.393)	(.384)
L55	.439	−1.557	.067	−1.972	7.313	.378
	(.250)	(.542)	(.659)	(.751)	(1.307)	(.389)
L60	.164	1.585	−.013	2.074	−3.756	.410
	(.184)	(.341)	(.512)	(.541)	(.500)	(.282)
R60	−3.624	−2.817	−1.467	−.601	.399	−1.418
	(.218)	(.361)	(.490)	(.802)	(.486)	(.289)
R65	.761	3.519	.259	−6.070	−1.008	−1.248
	(.382)	(.467)	(.581)	(.957)	(.617)	(.377)
R70	1.324	−1.026	1.046	4.616	.217	2.363
	(.714)	(.518)	(.404)	(1.038)	(.445)	(.429)
R75	−5.077	−6.157	−1.746	−1.993	.192	−1.932
	(1.576)	(1.478)	(.721)	(1.672)	(.668)	(.371)
R80	−.507		−3.179	−.950	−.501	
	(3.209)		(2.876)	(1.602)	(.743)	
Sample *N*	3,417	932	1,566	758	1,871	2,617
R^2	.155	.109	.031	.218	.047	.049

Note: Standard errors are in parentheses.

[a]Workng means employed in the last four years. Graduate means graduated from high school.

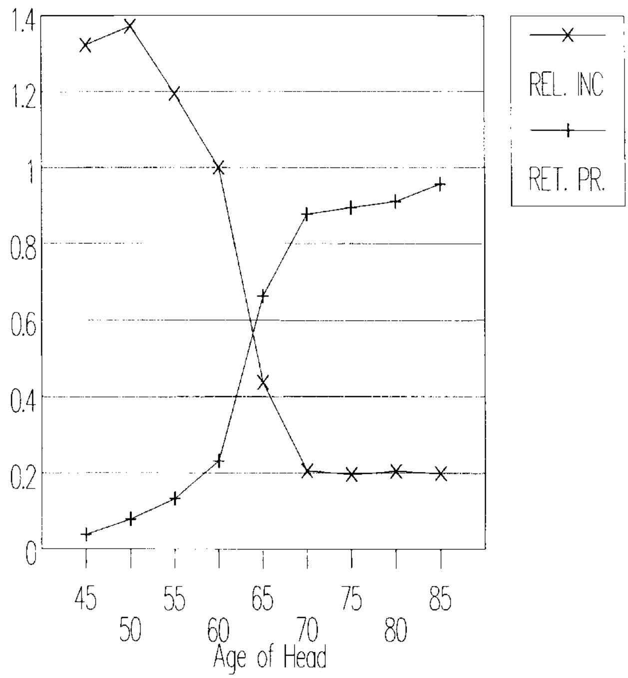

Fig. 2.6 Couple's expected income (relative income and retirement probability)

produced by the model, along with retirement probability for the head obtained from a logistic regression on the same spline functions of age, for a married household (model 11). There is a sharp drop in *taxable income* between 60 and 70 years of age. Figure 2.7 gives a comparable profile for a working widow (model 5).

2.4 The Elderly in the Panel Study of Income Dynamics

2.4.1 Some Features of the Sample

Table 2.17 gives some of the characteristics of the analysis sample and, for comparison, some population statistics on the elderly. The PSID has a slightly higher proportion of nonwhites and is slightly weighted to the older elderly but otherwise appears to resemble the general population of persons aged 65 and over. The PSID shows mean net worths in 1984 for the 65–74 age group that are lower than those found in the Federal Reserve Survey of Consumer Finances for 1983; however, the PSID net worths for the 75 and over group are higher. The latter comparison is surprising in view of the original PSID oversampling of poverty households. Table 2.18 shows the distribution of income by source.

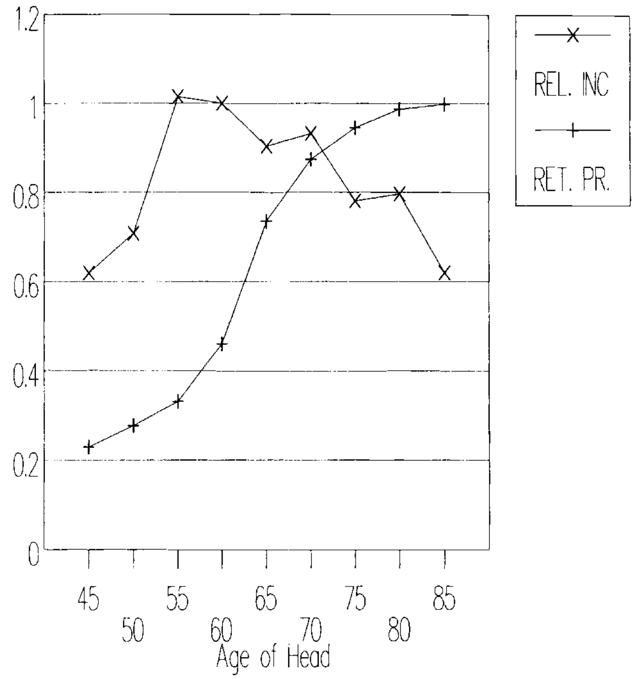

Fig. 2.7 Widow's expected income (relative income and retirement probability)

The PSID shows substantially more social security income and less asset income than the Current Population Reports, due in part to the weighting to older households. Table 2.19 gives net worth and the distribution of assets. For the PSID, these are calculated for the part of the sample (84.2 percent) that has positive assets. Table 2.20 relates 1984 asset income reported in the PSID to reported asset holdings; the coefficients can be interpreted as the gross rates of returns on these assets, not accounting for unrealized net capital gains or reinvestment. In this year, the real rate of return at the prime rate was 6.3 percent. Thus, the PSID households are either underreporting asset income, overreporting assets, reinvesting a substantial portion of asset earnings, or achieving returns well below the market.

2.4.2 User Costs

The method of calculating user costs described in section 2.3 is carried out for each household in our PSID sample, in each year from 1975 through 1984, except for years with missing data. Table 2.21 gives the average user cost of housing by age group for the sample population and for owners and renters separately. There are several factors that are expected to introduce a linkage between age and user cost. First, older households have less time to amortize

Table 2.17 **Characteristics of the Elderly Population, Age 65 and Over**

Individuals age 65+ (PSID N = 1,054):		
75+ (%)	36.7[f]	38.2[a]
White (%)	81.3[f]	90.2[a]
Female (%)	59.8[f]	58.7[a]
Married, spouse present (%)	59.9[f]	53.5[a]
Widowed or divorced (%)	38.1[f]	39.6[a]
Households age 65+ (PSID N = 823):		
75+ (%)	47.0[f]	41.1[b]
Homeowners (%)	65.9[f]	75.0[c]
Owners mortgage free (%)	80.4[f]	83.0[c]
Median house value, owners, 1983 ($)	48,600[f]	48,800[b]
Income on shelter/utilities (%):		
65–74	. . .	36.6[d]
75+	. . .	35.5[d]
Monthly household income ($):		
65–74	1,362[f]	1,164[e]
75+	1,189[f]	828[e]
Net worth total ($):		
65–74	78,598[f]	63,597[e]
75+	81,639[f]	55,178[e]
Net worth *excluding* home equity ($):		
65–74	47,546[f]	19,979[b]
75+	28,374[f]	17,025[b]

[a]1986 proportions, from Current Population Survey, 1987.

[b]1983 means, from "Financial Characteristics of the Housing Inventory," Current Housing Reports Series H-150-83, 1983.

[c]1983 means, from Current Population Reports Series P-60, no. 152, 1986.

[d]1984 means, from "Consumer Expenditure Survey: Interview Survey, 1984," Bulletin no. 2267, 1986.

[e]1984 medians, from "Household Wealth and Asset Ownership, 1984," Current Population Reports, P-70, no. 7, 1986. A median family income of $1,518 per month for household age 65 and over, excluding unattached individuals, is reported for 1984 in Current Population Reports, Series P-60. The Survey of Consumer Finances, Federal Reserve, reports for 1983 the following net worths:

Age	Mean	Median
65–74	125,184	50,181
75+	72,985	35,939

[f]PSID 1984 sample tabulation.

the initial costs of purchasing a dwelling so that the relative cost of owning to renting should rise with age, as should the relative cost of moving versus staying. Second, older households have lower taxable income and hence benefit less from income tax offsets to ownership. Third, the present expected value of capital gains from owned housing was large in the period 1975–84, providing an offset to user costs that we assume is attenuated over the remaining life of younger households.[9] Fourth, variations in the geographic distribution of households by age, with the elderly concentrating in lower-cost housing areas, could confound sample age differences in user costs. The panel for all households in table 2.21 shows that user costs do not rise uniformly with age but instead fall for the old. This pattern is repeated when households are classified separately by owners and renters.

In the PSID sample, the relative cost of owning to renting rises until age 65 and after that is nearly constant, as figure 2.8 shows. This graph was obtained by regressing the user cost ratio for four-room dwellings on age, using a quadratic spline. Examination of the survival probabilities shows that, at any age up to 80, expected remaining life is sufficiently long that the effect of

Table 2.18 **Sources of Income, Households Age 65 and Over in 1984**

Social security	60.7[a]	31.6[b]
Asset income	15.2	23.7
Pensions	12.6	15.3
Earnings	8.2	28.6
Other	2.6	.8

[a]N = 806 households with complete data.

[b]U.S. Census, Current Population Reports, Series P-60, 1984.

Table 2.19 **Assets of Household Age 65 and Over in 1984**

Net Worth:		
Percent Distribution (%):		
Home equity	50.3[a]	38.6[b]
Other real estate	7.4	11.2
Cash	33.2	30.3
Stocks	4.1	8.6
Business	3.1	4.5
Other	1.9	6.8
Debt as a % of net worth	1.9	. . .

[a]N = 693 with complete data.

[b]1984 data, "Household Wealth and Asset Ownership," Current Population Reports, Series P-70, U.S. Bureau of the Census.

Table 2.20 **Asset Income Regressed on Asset Holdings, 1984**

Independent Variable	Estimate	Standard Error
Cash	.0504	.0029
Bonds	.0257	.0005
Business nonlabor income	.0259	.0037
Real property	.0251	.0021
Stocks	.0458	.0025
Observations (N)	823	
R^2	.840	

Table 2.21 **Average Annualized User Costs (thousands of 1982$)**

	Rent			Own			
Age	Small	Medium	Large	Small	Medium	Large	Stay
All households:							
35–49	3.733	3.839	4.033	4.780	5.400	6.301	4.111
50–64	3.569	3.703	3.955	5.252	5.926	6.975	4.244
65–79	2.684	2.849	3.100	4.329	5.438	6.392	3.054
80+	2.350	2.524	2.839	4.158	5.213	6.091	2.416
Current owners:							
35–49	5.614	5.746	5.999	6.792	7.672	8.969	6.551
50–64	4.862	5.015	5.309	6.318	7.131	8.452	6.387
65–79	3.475	3.650	3.930	4.778	5.819	6.924	4.765
80+	2.292	2.438	2.709	3.195	3.938	4.626	2.585
Current renters:							
35–49	3.041	3.138	3.309	4.039	4.564	5.320	3.213
50–64	2.803	2.926	3.152	4.620	5.212	6.100	2.974
65–79	2.491	2.653	2.910	4.219	5.345	6.262	2.637
80+	2.356	2.533	2.852	4.254	5.340	6.236	2.399

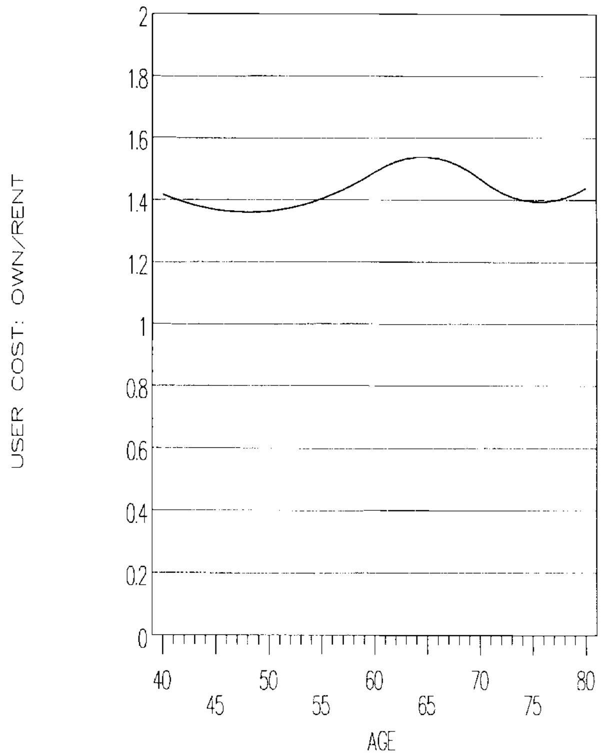

Fig. 2.8 **Relative user cost**

nonsurvival on present value calculations is small. This may explain the failure of the relative cost to show a strong trend with age.

The relation between user cost of housing and total household income (earned and transfer) is shown in figure 2.9. For comparison, housing cost (including shelter cost and expenditures for fuel, utilities, and public services) from the 1984 Consumer Expenditure Survey (CES) is included. Income drops sharply with age past 60. (This is a cross-sectional comparison, so age differences also contain cohort effects.) The housing cost share from the CES is nearly constant until age 65 and then rises steadily with age. The PSID housing cost share in income, using our construction of annualized user cost, is generally higher than the CES measure, rises more quickly in the 55–65 age range, and is relatively constant past age 70. The PSID share is calculated using the annualized user cost for the alternative of staying in the current dwelling and hence reflects the actual mix of owners and renters in the population. A quadratic spline is used to estimate share as a function of age.

2.4.3 Housing Behavior

The behavioral response of households to housing market conditions should reflect the dual role of owner-occupied housing as a source of shelter services and as an investment in the household's portfolio. Expectations of future price increases will be viewed by the household as increasing out-of-pocket costs but

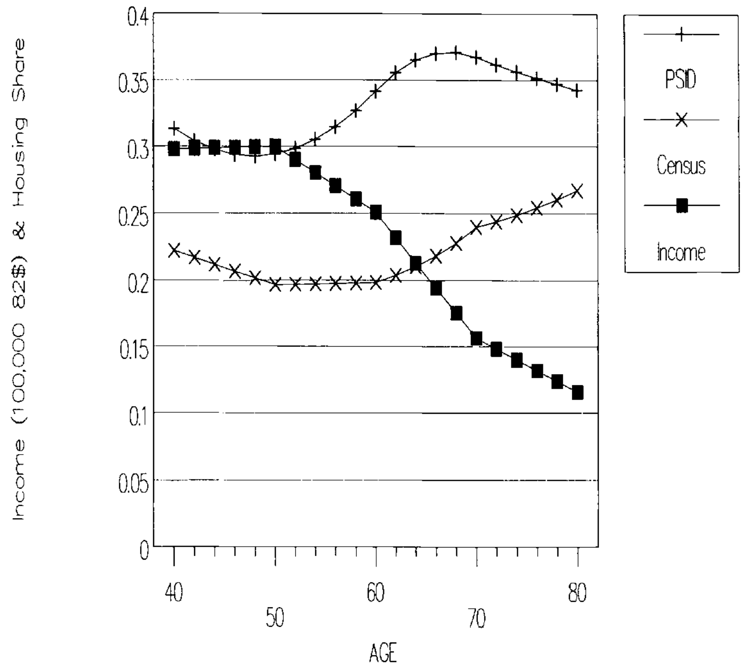

Fig. 2.9 Pretax income and shelter share

as also as increasing the return on the asset via capital gains. Once the expected investment returns are netted out, via the user cost calculations, there should be a relatively unambivalent behavioral response: lower mobility when the user costs associated with moving are relatively high and shifts toward renting when the user costs associated with owning are relatively high.[10]

While it is highly plausible that user costs will influence housing choice behavior at the margin, it is also clear that the circumstances in which prices have an opportunity to operate in housing decisions are limited. Mobility is low, empirically, and in many cases is dictated by noneconomic circumstances. Table 2.22 lists the frequencies with which the PSID sample lists various reasons for moving. Of actual movers, 74 percent give a primary purpose other than a change in dwelling size, which is the most likely to be influenced by costs. While price should be a factor in moves made for other primary reasons, such as involuntary moves (e.g., moves because of demolition of building, condominium conversion, or employment transfers), it may not be strongly correlated with the occurrence of these moves. For these reasons, one might not find statistically significant user cost effects in a relatively small sample. Tables 2.23–2.25 gives seven-alternative multinomial choice models, with the alternatives "stay" or move to one of the six tenure/size combinations (own/rent and small/medium/large), for current previous owners and for

Table 2.22 PSID Sample Reasons for Moving, 1975–84

	N	%
Why the household will or might move:		
Move due to job	207	6.17
Relocate nearer to work	68	2.03
Move to larger dwelling	504	15.02
Move to smaller dwelling	586	17.47
Move from rent to own	400	11.92
Move to better neighborhood	352	10.49
Forced to move involuntarily	493	14.69
Mixed reason	745	22.21
Subtotal	3,355	100.00
No move planned	17,471	83.89[a]
Why the household did move:		
Move due to job	96	5.37
Relocate nearer to work	34	1.90
Move to larger dwelling	278	15.56
Move to smaller dwelling	188	10.52
Move from rent to own	235	13.15
Move to better neighborhood	129	7.22
Forced to move involuntarily	508	28.43
Mixed reason	319	17.85
Subtotal	1,787	100.00
No move planned	19,011	89.14[a]

[a]Percentage of total.

Table 2.23 Multinomial Logit Models of Mobility and Tenure/Size Choice

		Alternative						
Variables	Mnemonic	Rent Small	Rent Medium	Rent Large	Own Small	Own Medium	Own Large	Stay
User cost	ucost	X	X	X	X	X	X	X
Stay dummy	dstay	0	0	0	0	0	0	1
Owner dummy	down	0	0	0	1	1	1	0
Small size dummy	dsmall	1	0	0	1	0	0	0
Large size dummy	dlarge	0	0	1	0	0	1	0
Stay dummy · income	ystay	0	0	0	0	0	0	Y
Owner dummy · income	yown	0	0	0	Y	Y	Y	0
Small size dummy · income	ysmall	Y	0	0	Y	0	0	0
Large size dummy · income	ylarge	0	0	Y	0	0	Y	0

Table 2.24 Choice Model for Previous Owner

A.

Value	Label	Count	%
0	Rent small	14	.61
1	Rent medium	11	.48
2	Rent large	18	.79
3	Own small	9	.39
4	Own medium	12	.52
5	Own large	38	1.66
6	Stay	2,190	95.55

B.

Independent Variable	Estimated Coefficient	Standard Error	Estimated Coefficient	Standard Error
ucost	1.69576e-05	2.82166e-06		
ln(ucost)			1.17957	.27408
dstay	4.93273	.32904	4.87769	.33209
down	−.55890	.31431	−.59912	.32216
dsmall	.56310	.42271	.57259	.42171
dlarge	.68214	.26913	.74638	.26266
ystay	1.06427e-05	9.56519e-06	1.34464e-05	9.75145e-06
yown	1.41865e-05	9.50871e-06	1.72864e-05	9.72394e-06
ysmall	−1.93585e-05	1.42695e-05	−1.98148e-05	1.42886e-05
ylarge	−8.54206e-07	2.55076e-06	−8.68247e-08	2.16556e-06
Sample *N*	2,292		2,292	
Log lik.	−565.47		−575.14	

Table 2.25 **Choice Model for Previous Renter**

A.

Value	Label	Count	%
0	Rent small	282	5.45
1	Rent medium	177	3.42
2	Rent large	327	6.31
3	Own small	36	.70
4	Own medium	50	.97
5	Own large	74	1.43
6	Stay	4,233	81.73

B.

Independent Variable	Estimated Coefficient	Standard Error	Estimated Coefficient	Standard Error
ucost	1.90477e-06	1.68221e-06		
ln(ucost)			−.44357	.23104
dstay	2.97519	9.42026e-02	2.97544	9.41622e-02
down	−2.49811	.13480	−2.22623	.16958
dsmall	.49256	.11626	.46266	.11692
dlarge	.44611	.10615	.48836	.10781
ystay	1.30355e-05	5.94221e-06	1.36404e-05	5.94588e-06
yown	5.98801e-05	5.87533e-06	5.81235e-05	5.94104e-06
ysmall	−1.41928e-05	7.26346e-06	−1.43114e-05	7.24157e-06
ylarge	8.88810e-06	5.28270e-06	9.30676e-06	5.26707e-06
Sample N	5,179		5,179	
Log lik.	−3,824.1		−3,822.8	

previous renters. In the model for owners, the effect of user cost is positive, suggesting that investment incentives may outweigh consumer substitution effects in "hot" markets. In the model for renters, we find a weak price elasticity of the expected sign and responsiveness to income in choice of dwelling size.

2.5 Conclusions

The primary conclusion of this paper is that carefully constructed user costs for housing, which adjust for income tax offsets and capital gains, show *declining* annualized costs past age 60. While the income of the elderly declines even more rapidly so that the housing share of consumption expenditures rises with age for the elderly, the increase is not sharp, and the housing share appears to level off for the very elderly.

We find that user costs increase sharply with dwelling size. This reflects in part sharp differences in our hedonic price indices for dwellings of different sizes, which may be due in part to quality differences that are correlated with size and that are not captured by the measured features of dwellings. It also reflects the effects of the multiple hazard models (table 2.15) for tenure/size transitions: occupants of large owner-occupied dwellings are more likely to stay in the current dwelling, at high out-of-pocket costs, and are more likely to move to a large dwelling if they move than are occupants of small rental dwellings. We find that the annualized user cost of owner housing generally exceeds that of renting for middle-aged and elderly households. The persistence of ownership in the face of this differential suggests the presence of substantial quality differences in owned and rental housing.

We find little evidence in the relatively small PSID data set that, at the margin, households are modifying choices to avoid relatively high-priced housing. This may be the result of analyzing a relatively small group of movers, many of whom had stated primary motives for moving that were noneconomic. A second possibility is that "supply side" investment incentive effects, with housing prices acting as a proxy for expected capital gains, overwhelm "demand side" consumer response. A third possibility is that the subjective evaluation of the economic costs of choices by households may fail to match the relatively complex model we have used of formation of expectations. On the one hand, the household is likely to have access to more information on its prospective income than is available to us and may have more information on local housing markets. On the other, the household may fail to weigh consistently the contribution of tax offsets and capital gains to user costs or to weigh bequests of real property as we have done in deriving our user cost formula. The analysis of wealth effects on housing choices of the elderly by Feinstein and McFadden (1989) and a macroeconomic paper on housing price expectations and bequest motives by Mankiw and Weil (1988) suggest that households may in fact be more myopic than our user calculations assume.

Notes

1. In the PSID, individuals are identified as *sample* members if they were present in a household at the start of the panel in 1968 or are descendants of sample members. Otherwise, they are *nonsample*. Only sample members are followed through household composition changes. For example, if a sample member marries at a later date, the spouse is not a sample member and is not followed if the sample member dies or they are separated. In this study, we define a PSID household by the following steps. First, we define a *provisional* household for *each* sample member. Then we merge every pair of provisional households such that, when the two sample individuals are both alive, they do not live apart, except temporarily. (A separation for school, institutionalization, or military service or a marital separation that ends in reconciliation is defined to be temporary.) Thus, two sample members that divorce are counted as two households and treated as separate observations, even though part of their history is common. Similarly, a child who leaves home and establishes a separate residence is counted as a different

household than the parent, even if in old age the parent moves in with the child. Nonsample spouses of nonsurviving sample members are treated as a continuation of the household, with missing data. Judgment is used to resolve complex cases; usually, such cases are excluded from the analysis. We include in our analysis sample households where head and spouse are both under 35 in 1968 but where there is another household member over 35. However, the housing choices and user costs we consider are in general not the appropriate ones for a nonhead nonspouse. We exclude from the analysis sample households that attrit before 1984 for reasons *other* than death; approximately three hundred households fall in this category, most of whom attrit within the first few years of the panel.

2. Chunrong Ai and Henry Pollakowski are responsible for the results in secs. 2.2.1–2.2.3 below. The price index construction was supported in part by the Office of Policy Development and Research, U.S. Department of Housing and Urban Development (see Pollakowski 1987; and Pollakowski and Börsch-Supan 1988). We thank Paul Burke, Axel Börsch-Supan, and Thomas Thibodeau for helpful suggestions.

3. For a description of the AHS, see Hadden, Joseph, and Leger (1984).

4. Use of these median values of attributes should be interpreted as follows: for owner-occupied housing, the median dwelling has one and a half baths with a probability of .174, two baths with a probability of .218, more than two baths with a probability of .116, and less than one and a half baths (the base case) with a probability of .508.

5. These are loan origination fees and mortgage points and do not include title insurance, mortgage insurance, and transfer fees.

6. We also investigated the possibility of using data from the PSID to construct regional estimates of mortgage term and the ratio of initial mortgage to purchase price. For the PSID subsample of home purchasers in a year who take mortgages, we use the responses on market value of home, mortgage outstanding, and mortgage payments to construct the needed variables. From the standard amortization formula, mortgage length L satisfies

$$L = -r^{-1}\log(1 - rP_0/m),$$

where P_0 is the initial mortgage outstanding, m is the annual mortgage payment, and r is the state average mortgage rate. (In principle, one could use data on mortgage outstanding in successive years for nonmovers to calculate the interest rate on the individual mortgage. However, the PSID responses are not reliable enough to do this accurately.) In 1973–75 and 1982, the required data were not collected by the PSID. For these years, for 1968 and earlier, and for 1985 and later, L and the ratio of P_0 to house price were calculated by interpolation and extrapolation. In general, the results of this analysis were similar on average to the national statistics and sufficiently noisy so that regional differences could not be distinguished. Therefore, we used the national averages.

7. The mortgage/price ratio distribution is in fact bimodal, with some fraction of households taking no mortgage and the remainder fairly heavily concentrated in the range .6–.9. We have used the average of this distribution, excluding households with zero mortgages, as an approximation to the maximum mortgage available. We have *not* adjusted this statistic for its likely downward bias.

8. For most households, the patterns are right censored before death. Thus, table 2.13 understates to some degree the frequency of multiple moves. Also, only changes in tenure and/or size are counted as "moves."

9. We assume that regional housing prices grow in real terms at a rate that declines linearly from the actual 1984 rate to zero in 1994.

10. Since detailed housing commodities, such as "small rental units," may be inferior goods, classical consumer theory leaves some ambiguity about the sign of response to price.

References

Blackley, D. M., J. R. Follain, and H. Lee. 1986. An evaluation of hedonic price indexes for 34 large SMSA's. *American Real Estate and Urban Economics Association Journal* 14 (Summer):179–205.

Börsch-Supan, A., L. Kotlikoff, and J. Morris. 1988. The dynamics of living arrangements of the elderly. NBER working paper. Cambridge, Mass.: National Bureau of Economic Research.

Bryan, T. B., and P. F. Colwell. 1982. Housing price indexes. In *Research in real estate*, vol. 2, ed. C. F. Sirmans. New York: JAI.

Feinstein, J., and D. McFadden. 1989. The dynamics of housing demand by the elderly: Wealth, cash flow, and demographic effects. In *The economics of aging*, ed. David Wise. Chicago: University of Chicago Press.

Ferri, M. G. 1977. An application of hedonic indexing methods to monthly changes in housing prices: 1965–1975. *American Real Estate and Urban Economics Association Journal* 5 (Winter):455–62.

Follain, J., and J. Ozanne, with V. Alburger. 1979. Place to place indexes of the price of housing. *Urban Institute Paper on Housing*. Washington, D.C.: Urban Institute, December.

Gillingham, R. 1975. Place-to-place rent comparisons. *Annals of Economic and Social Measurement* 4:153–74.

Goodman, A. C. 1978. Hedonic prices, price indices and housing markets. *Journal of Urban Economics* 5 (October):471–84.

Goodman, A. C., and M. Kawai. 1984. Replicative evidence on rental and owner demand for housing. *Southern Economic Journal* 50 (April):1036–57.

Hadden, L., C. Joseph, and M. Leger. 1984. *Codebook for the annual housing survey data base*. Cambridge, Mass.: Abt Associates (prepared under contract H5529 with the U.S. Department of Housing and Urban Development).

Hendershott, Patric, and Joel Slemrod. 1983. Taxes and the user cost of capital for owner-occupied housing. *AREUEA Journal* 10(4):375–93.

Malpezzi, S. L., L. Ozanne, and T. Thibodeau. 1980. Characteristic prices of housing and fifty-nine metropolitan areas. Contract report 1367-1. Washington, D.C.: Urban Institute.

Mankiw G., and R. Weil. 1988. The baby boom, the baby bust, and the housing market. NBER Working Paper no. 2794. Cambridge, Mass.: National Bureau of Economic Research.

Mark, H., and M. A. Goldberg. 1984. Alternative housing price indices: An evaluation. *American Real Estate and Urban Economics Association Journal* 12 (Spring):30–49.

Ozanne, L., and T. Thibodeau. 1983. Explaining metropolitan housing price differences. *Journal of Urban Economics* 13 (January):51–66.

Palmer, B. 1987. Moving and the elderly: Using a stochastic, yet finite planning horizon. Working paper. Cambridge: Massachusetts Institute of Technology.

Palmquist, R. 1980. Alternative techniques for developing real estate price indexes. *Review of Economics and Statistics* 62 (August):442–48.

Pollakowski, H. O. 1982. *Urban housing markets and residential location*. Lexington, Mass.: Lexington.
Pollakowski, H. 1987. Owner-occupied housing price change in the U.S., 1974–1983: A disaggregated approach. Working paper. Cambridge, Mass.: Joint Center for Housing Studies of the Massachusetts Institute of Technology and Harvard University.
Pollakowski, H. O., and A. Börsch-Supan. 1988. Hedonic price indexes for the United States, 1974 to 1983. Working paper. Cambridge, Mass.: Joint Center for Housing Studies of the Massachusetts Institute of Technology and Harvard University.
Schnare, A., and R. Struyk. 1976. Segmentation and urban housing markets. *Journal of Urban Economics* 3 (April):146–66.
Struyk, R. 1977. The housing expense burden of households headed by the elderly. *Gerontologist* 17.
Venti, S., and D. Wise. 1984. Moving and housing expenditure: Transactions costs and disequilibrium. *Journal of Public Economics* 23:207–43.
______ . 1989. Aging, moving, and housing wealth. In *The economics of aging*, ed. David Wise. Chicago: University of Chicago Press.
Weisbrod, G., J. Berkovec, J. Ginn, S. Lerman, H. Pollakowski, and P. Reid. 1982. Residential mobility and housing choices of older Americans. Final report. Cambridge, Mass.: Cambridge Systematics.

Comment Michael D. Hurd

On average, housing equity is the most important component of the bequeathable wealth of the elderly: about 50 percent in the 1984 Panel Study of Income Dynamics, about 57 percent among families in the twentieth to eightieth wealth percentile in the 1984 Survey of Income and Program Participation, and 44 percent in the 1979 Retirement History Survey. Yet our knowledge of the determinants of housing choice is rather limited. For example, we do not know the role of housing choice in life-cycle consumption. Do the elderly desire to decumulate housing wealth as they age, or do they tend to hold housing for purposes of a bequest? Do large transaction costs (both financial and psychic) prevent the elderly from moving? If they do, programs to facilitate downsizing should produce gains, both at the individual level and at the aggregate level, as the existing housing stock is used more efficiently. How large would the gains be? What should be the structure of reverse annuity mortgage programs, and how much benefit could be expected from them? These examples are just a few of many that show the importance of understanding the determinants of housing choice.

The study of housing choice is difficult, however, for at least two different kinds of reasons. The first is that making the best choice is a difficult problem for an individual; housing is lumpy, and its consumption cannot be adjusted smoothly; housing quality varies greatly, and it is not always apparent. A house

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has both a consumption and an investment component, which means that the decision must consider future economic conditions. Housing decisions must be made in the face of considerable uncertainty about the course of inflation rates, income, health, mortality, rates of return, and income tax rates. For example, if there are fixed costs associated with moving, the decision of a couple to move today will be influenced by the probability that one spouse will die, leaving the other with too much housing. The greater the fixed costs of reversing the move following the death of a spouse, the more the couple will tend not to move. If future inflation destroys the value of nonhousing assets, the couple would want eventually to convert equity to consumption, but anticipated capital gains will be an important factor in the timing of the conversion. A homeowner who moves will probably incur psychic costs associated with neighborhood, climate, family, and the particular house, and he or she probably will find it difficult to factor the psychic costs in with the monetary costs.

The second reason that housing choice is difficult to study is that the researcher has much less information than the individual who makes the choice. Typically, researchers have no information on expectations or tastes or on the full range of choices that were considered but rejected. They may observe with error variables such as health status and the quality of housing. Although they may have quite good information on some financial variables such as Social Security income and bequeathable wealth, other financial variables such as quality-corrected housing prices, neighborhood characteristics, and tax status are bound to be observed with error.

A complete understanding of the determinants of housing choice would involve the solution of the individual's stochastic dynamic program with appropriate adjustments for the difference between what the individual takes to be known and what the researcher takes to be known. Because there are many kinds of uncertainty and several discrete choices over many time periods, this is an exceptionally difficult problem to solve empirically. The nonconvexities require the evaluation of the utility associated with all possible future housing choices (renting and owning housing of various sizes and qualities) in every future time period for all possible outcomes of future uncertainties. The solution would determine the choice of housing today, and it would balance the utility from occupying the housing over the next time period with the requirement that the individual be well positioned to take advantage of new information that is revealed during the time period. Were such a solution obtained, it could be used to answer questions such as how the probability of downsizing today depends on mortality rates and how the choice of renting versus owning depends on uncertainty about income. However, such a complete solution is probably beyond reach as it makes unrealistic demands on modeling, computation, and data.

A different approach, which is taken here by Ai, Feinstein, McFadden, and Pollakowski, is to find the costs associated with choosing various types of housing and to see if the costs are an important determinant of the actual choices made. The costs are, of course, the user costs of the paper, but they are much broader than what we would usually think of as costs.

User cost is found from four components: the cost of occupying a particular housing unit, the cost of changing housing, the probability of occupying a housing unit, and the probability of changing housing. To take a simple example, suppose a couple contemplates moving from a small house to a large house. They will pay costs associated with the transition and out-of-pocket costs while occupying the new house (which may be offset by capital gains and tax advantages). Following the move, however, one of the spouses may die, causing the survivor to move back to a small house, and the transition costs will have been lost. The couple should take this possibility into account when considering the first move.

A way for them to do this is to associate with the first move the discounted probability-weighted cost of the second move. In this example, the calculation of the user cost of the first move is relatively simple because it depends on the out-of-pocket costs of occupying the house, which can be estimated in a straightforward if cumbersome way from outside information; transition costs, which can also be estimated from outside information; and the probability of the second move, which depends on mortality tables. In application, however, the calculation of user cost is much more complicated because not all survivors will choose to move back to a small house: for example, well-to-do widow(er)s may decide to remain in the large house, or some survivors will remain simply because they prefer large houses. The actual probabilities of future transitions will depend on tastes, income, expectations, health, and so forth. To predict what the probabilities are, in order to calculate the user cost, requires the full-scale solution of the stochastic dynamic utility maximizing problem discussed above. If the estimation of user cost were to be implemented in this way, it would offer no simplification over stochastic dynamic programming.

The simplification comes from estimating the transition probabilities of a particular household from the observed transitions of similar households rather than from the solution to the utility maximizing problem. To see why this might be reasonable, consider a population in steady state in which everyone reaching, say, age 65 is identical. As people age and stochastic events unfold, they will make housing choices. By observing the states (housing types) occupied by older people and the transitions they make, a 65-year-old can estimate the probabilities that he will reach each of the states and make each of the transitions. He can then use the estimated probabilities to calculate the user cost associated with a choice to be made at age 65. In panel data, a researcher can duplicate this calculation to arrive at a similar estimate of the probabilities and of user cost.

The calculation does, however, require a number of assumptions. First, if the economic environment is changing, the distribution of older people across housing types will not be a good guide to the future of a 65-year-old because the probabilities of the various paths leading to those states will be different for her than they were for the older people. Second, if people are not identical, the researcher must know how to classify them in the same way the individual classifies herself. For example, suppose an individual knows that she will have high income, and suppose further that high-income people move more often than low-income people. If the researcher has no information on income expectations, user cost cannot vary from individual to individual as income varies, yet the high-income individual will calculate a high user cost (because of the high frequency of moves) and choose housing accordingly. Thus, the data will show no variation in estimated user cost yet variation in housing choice, implying incorrectly that user cost has no effect on choice. Third, this method, in common with many others, relies heavily on constructed variables rather than on actual variables. In complicated models like housing choice, we do not know what effects this will have, so to use this method we must assume that they are small.

These assumptions, and others I have not mentioned, are unlikely to be met strictly in practice. I should emphasize, however, that I think that the user-cost method is a good way to reduce an unmanageable problem to a manageable one. The examples are meant to provide a note of caution.

Most of the results in the paper are the calculations of various parts of the user cost. This is superb work: the attention to detail, the inclusiveness of the components, and the explanation of the methods deserve high praise. These results should prove useful to others in many applications. A good example is the hedonic housing price index for twenty-two locations over nine years, which is an important variable in many kinds of empirical studies.

An important finding is that user cost as a fraction of income peaks at about age 67 and then declines (fig. 2.9), whereas the share of income devoted to housing (from the census) continues to increase with age. The difference comes from the tax and mobility adjustments. The importance of the finding is that most people believe that the elderly devote an increasingly large amount to housing as they age, and people interpret this as evidence against life-cycle behavior. The user cost results show that this view may not be correct. I believe, however, that any interpretation in support of life-cycle behavior should be only tentative because the variation of user cost with age is a cross-sectional result, which can be quite different from a panel result. Furthermore, the decline with age is partly due to the Ricardian equivalence assumption: according to that assumption, except for transaction costs, the value of a house as a bequest is fully as great as its value to the elderly person in consumption. The opposite kind of assumption is that a bequest had no value to the elderly person. Then user cost would tend to rise with age (and increasing mortality rates) because each time period the probability would increase that the house would become worthless. In view of the fact that there is practically no evidence for Ricardian equivalence, the calculation under the alternative assumption (no value from a bequest) should also be made. An extension would be to calculate user cost under Ricardian equivalence for those elderly with children and under the alternative for those elderly without children. Such a variable may provide greater explanatory power in the housing choice equation.

User costs depend heavily on the treatment of capital gains. In view of the fact that housing prices rose rapidly during the sample period, the assumption of perfect foresight in housing prices probably has an important effect on user cost. As a description ex post of what the cost of holding housing was, this is not objectionable, but, as a variable to be used ex ante to explain housing decisions, I believe that the assumption is not justified. A valuable addition to the paper would be to detail the difference that the expectations assumption makes, especially in the housing choice estimation.

Table 2.21 shows that user cost varies with housing size; this is to be expected because the price of a house (or the rent) is imputed from the hedonic equation, which shows increasing price with size. The exhibit also shows substantial variation with age, indicating a good deal of variation by personal characteristics. I believe it would be helpful to detail the source of variation at the individual level: how much is due to taxes, how much to expected transitions, and how much to mortality rates and other factors.

The second kind of result is the effect of user cost on housing choice. Preliminary findings are reported in the final two tables of the paper; more detailed results will be the subject of a future paper. Because they are tentative, my comments on them will be suggestions, not criticisms: as I mentioned above, the method is an interesting and useful alternative to the solution of the stochastic dynamic problem.

The variation in user cost of the different types of housing has two sources. First, the hedonic equations assign a price to each kind of housing that is common to all individuals. Because the housing choice equations (tables 2.23–2.25) have dummy variables for housing types (stay, own, large, and small), the variation in user cost that comes from the hedonic equations will be approximately picked up by the dummy variables in the housing choice equations. Second, each individual has an individual-specific adjustment to the price of each kind of housing that comes from his particular tax and mobility characteristics. That is, a particular house will cost different individuals different amounts to occupy. I imagine that this variation is the main determinant of the estimated effect of user cost. A simple example will show how this could lead to a positive association between housing choice and high user cost.

Suppose there are two types of people, low user cost (20 percent of the population) and high user cost (80 percent of the population), and that their costs and housing choices are given in table 2C.1. Thus, the low-cost types all choose their lowest-cost type of housing, which is type A; the high-cost types also choose their lowest-cost type of housing, which is type B. On average, 20 percent of the population chose housing with an average cost of \$90, and 80 percent of the population chose housing with an average cost of

Table 2C.1 **Housing Type**

	A		B	
Person Type	User Cost ($)	% Choosing	User Cost ($)	% Choosing
1 (20 percent)	90	100	100	0
2 (80 percent)	150	0	110	100
Average	90	20	100	80

$100. Estimation that uses the costs of the housing actually chosen will find a positive relation between user cost and choice, whereas estimation that also uses the costs of the housing not chosen will find the true negative relation.

The results in tables 2.23–2.25 do show a positive relation between user cost and choice, which is not what would be expected. The estimation uses only information on the choice taken; in some cases, as the example above shows, this could lead to such a result. I believe that a better specification would describe the costs of all the choices available to the individual, whether taken or not.

I also imagine that "need" should be taken into account. User cost is not a price; it is an estimated fully inclusive expenditure, and people with greater needs will spend more. This could have an effect because both need and user cost are systematically related to age. Similar reasoning suggests that income should have an interaction with income.

Notwithstanding my reservations about the preliminary results, I believe that the approach shows considerable promise, and I look forward to the next paper in the series.