Replicative Evidence on the Demand for Owner-Occupied and Rental Housing*

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I. Introduction

Some important results in urban economic theory and policy analysis rest upon housing demand, and its associated price and income elasticities. The extent to which the affluent choose to live away from the city's center (thus increasing their commuting time) depends on the relative income elasticities of housing demand and valuation of leisure. In a more policy-oriented framework, the relative efficacies of income as opposed to housing price subsidies for low income households depend on the relative values of income and price elasticities.

Several good surveys of housing demand literature including Mayo [11] and Quigley [15], agree that both relevant elasticities are substantially less than unity. Best estimates of income elasticities are in the 0.3 to 0.5 range for renters, and in the 0.5 to 0.7 range for owners. Best estimates of price elasticities are in the −0.6 to −0.7 range for both renters and owners.[1]

Almost all studies of housing demand unavoidably concentrate on a specific metropolitan area at a specific point in time due to difficulty in collecting and standardizing data. As a result, many estimates of "the" elasticity of demand are very narrowly based, and replication either across cities or over time within the same cities is difficult if not impossible. It may also be difficult to separate effects such as local shortages from more global effects such as general business cycles, credit availability, or anticipated inflation.[2]

This paper attempts to remedy at least part of this problem by estimating housing demand for both owner-occupied and rental units over nineteen metropolitan areas, using recent Annual Housing Survey (AHS) data. This data set is comparable over dissimilar areas, and facilitates testing of hypotheses concerning the absolute magnitudes and the

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1. This synopsis comes from Mayo [11].

2. It is likely that local housing market conditions may limit the extent to which households can switch to other dwelling units. Rent control legislation, for example, may lock households into low priced units, limiting both price and income elasticities.

(implicit) constancy of elasticities. It also allows good comparisons between owner and renter demand elasticities, alleviating some of the problems that may occur when an elasticitity from one tenure class is applied to another.

The findings reported here are perhaps not surprising, yet are robust to replication over the 19 areas. Permanent income elasticities are substantially higher than current income elasticities, usually by magnitudes of 50 percent or more. Transitory incomes have significantly positive impacts on both owner-occupied and renter housing demand. Income elasticities are higher for owner units, although much of the difference is, in fact, attributable to the higher owner incomes used to evaluate them. Renter price elasticities appear to be higher than owner price elasticities, but the differences between the two become insignificant when adjusted for the differential income levels of owners and renters.

Section II presents some of the foundations of housing demand analysis, applicable both to owner-occupied and rental housing. Computation of appropriate permanent income, housing price and housing quantity variables is explained. In Section III, demand estimation results are reported and analyzed both for separate metropolitan areas, and for pooled samples across the 19 areas. Following the summary, the final section suggests the necessity of making both tenure choice and tenure length endogenous to the housing demand model.

II. Theoretical Foundations

Over a decade of analyzing disaggregated housing data has led to a fairly detailed set of theoretical and practical methods for estimating housing demand. deLeeuw [2] presents a reconciliation of several types of estimation methods, and Polinsky [13] discusses many theoretical problems concerning income and price variables.

We postulate the housing-demand equation to be estimated as

$$Q_i = \alpha + \beta Y_i + \gamma P_i + \sum_j \delta_j Z_{ji} + U_i \quad i = 1, \ldots, n , \tag{1}$$

where Q_i refers to the housing quantity, Y_i to income (current, permanent and/or transitory), P_i to housing price, and Z_{ji} to other economic and/or sociodemographic variables; α, β, γ and δ_{ji} represent parameters to be estimated; and i is the cross-sectional individual. The relationship is estimated in linear form.

Housing Price and Quantity

Among consumer goods, demand equation (1) is unusual because neither the dependent nor the explanatory variables of choice are generally very well defined. For a rental bundle, the monthly payment is, of course, the product of price and quantity. For an owner-occupied bundle, housing market value can also be considered the product of price and a level of housing stock. If a housing price index is formed either through estimation of a cost function, calculation of a construction price index, or computation of a hedonic price measure, the quantity of housing can be determined in index terms. For rental housing, the resulting index should reflect the service flow. For owner-occupied housing the customary assumption is that the flow is a constant fraction of the calculated housing stock.

This paper attempts to estimate housing price and quantity by way of hedonic regression techniques. Suppose the housing value (in the case of owner-occupied units) or rent (for rental housing units) S is expressed as

$$S_i = g(\mathbf{C}_i, \mathbf{T}_i), \tag{2}$$

where **C** is a vector of physical and neighborhood characteristics, and **T** is a vector of resident characteristics. We agree with Rosen [17] that a well-specified hedonic price equation should omit most household characteristics relating to household demand. On the other hand, certain racial, ethnic or length-of-residency characteristics should be included in order to measure any discriminatory discounts or premia properly.[3] The price of housing, P_i, is determined by a "standardized unit" according to the area's hedonic regression, that is,

$$P_i = g(\mathbf{C}_i^*, \mathbf{T}_i),$$

where $\mathbf{C}^*$ is a vector of standardized physical and neighborhood characteristics. The quantity of housing Q_i, then, is obtained by dividing S_i by P_i, i.e., $Q_i = S_i / P_i$.

Permanent and Transitory Income

Most analysts have come to agree that permanent, rather than current, income is the appropriate measure for Y_i, given the long-term nature of housing purchase. Using the identity that current income equals the sum of its permanent and transitory components (Y_i^P and Y_i^T respectively),

$$Y_i \equiv Y_i^P + Y_i^T. \tag{3}$$

Goodman and Kawai [7] show that the ordinary least squares regression of housing quantity on current income gives inconsistent estimates of the permanent income coefficient, β_P, (and that the bias is asymptotically determined by the variation in transitory income relative to that in actual income), such that:

$$\beta_T < \operatorname{plim} \hat{\beta} < \beta_P.$$

That is, the estimated current-income coefficient $\hat{\beta}$ lies between the true transitory income coefficient β_T and the permanent income coefficient β_P. Although β_T is often assumed to be zero, this is a testable hypothesis. Fenton [4], Goodman and Kawai [7] and Mayo [10] all find significant propensities to purchase out of transitory income.

The search for proper methods to estimate permanent income has proceeded in several directions in the literature. Grouping of observations by socio-demographic characteristics has been proposed on the premise that the transitory components "wash out." Income lagged (or led) one or more periods, or a multiyear average of actual income is also often used as a proxy for permanent income. Finally, since current income is expressed as a function of the determinants of permanent income (reflecting human capital H, which

3. Although length-of-tenure discounts are well-documented, it is not at all clear that longer-term tenants can have any quantity of housing service they want at the lower price. Tenants with the longest tenure may have price-quantity points that are far from their demand curves. In preliminary work, we tried to test for this by including a variable that represented the price discount, that is, the difference between current housing price and the price if the unit were being newly purchased. Coefficients were significant in only three of nineteen cases, and in no case led to substantive differences in estimation of price or income coefficients in the housing demand regression.

depends on age (AGE), education (EDUC), and employment status (JOB) as well as nonhuman capital components N) plus a random transitory component, one can rewrite current income (3) in terms of the human and nonhuman capital components:[4]

$$Y_i = \phi H(AGE_i, EDUC_i, JOB_i) + \psi N_i + Y_i^T. \quad (4)$$

Hence the strategy is to derive an estimable regression equation from (4) and to interpret the systematic part of the regression as permanent income Y_i^P and the residual as transitory income Y_i^T. We adopt this strategy in constructing permanent/transitory income.[5]

Remarks

There are several reasons why renters and owners cannot easily be combined to estimate housing demand. First, whereas the purchase of rental housing (aside from any expectation that renting in a specific building may give the tenant first choice in the event of condominium conversion) involves an essentially pure flow of housing services, home ownership involves both a consumption and an investment component. These two components are tied together in the same purchase, and their separation into alternative portions is difficult. Second, there are substantial tax benefits (in the United States) to home ownership that are not accorded to rental housing. As a result, renters and owners with the same income and living in the same community may pay different prices per unit of housing service [12; 16; 19]. The existing tax structure may stimulate owner-occupied housing consumption, investment or both.

Third, there are large transactions costs in purchasing an owner-occupied unit that do not accrue to a renter. These including closing costs, escrow accounts and the like. Shelton [18] demonstrates that short expected lengths of tenure make renting more attractive, while longer lengths make owning more attractive. In his example, the break-even point is an expected tenure length of 3.5 years. Although in the 1970s expected capital gains may have shortened the amount of time needed to amortize the closing costs, they still amount to 5 percent or more of the final purchase value, leading to a wedge in the cost of owning rather than renting.[6]

Finally, the last argument against pooling observations over rents and owners is the "life-cycle" nature of the housing decision. It is quite plausible that a young couple, for example, may consciously refrain from purchasing additional rental housing early in their marriage, on the presumption that they are saving to buy owner-occupied units later in the marriage. This is likely to lead to low estimates of renter income elasticities, and high estimates of owner income elasticities.

This discussion suggests that the savings-investment motive as well as the life-cycle nature of housing decisions lead to lower renter income elasticities than those estimated for owners. On the other hand, the high owner transactions costs for moving suggest

4. All variables are defined in Table III.

5. Goodman and Kawai [7] consider the possibility that relevant explanatory variables such as occupation or quality of education are omitted from (4). Suppose, for example, the true model is $Y = \phi_1 A + \phi_2 E + U$, $Q = \beta_P Y^P + \beta_T Y^T + \gamma P + V$. Y^P is represented by the systematic component $\phi_1 A + \phi_2 E$, and Y^T by U. Also suppose that instead of $\phi_1 A + \phi_2 E$, only $\phi_1 A$ is used as Y^P in estimating Q. If A, E, P, U, and V are orthogonal, then it can be demonstrated that plim $\hat{\beta}_P = \beta_P$, and plim $\hat{\beta}_T = \beta_T$; thus the estimators are consistent. However, to the extent that E is correlated with A, omitted variables biases may occur.

6. Dougherty and Van Order [3] show the relationship between expected capital gains and the "user cost" of housing.

Table I. Owners v. Renters: Means and Standard Deviations of Representative Variables

	Owners	Renters
ROOMS	6.11	4.03
	(1.62)	(1.45)
Y	20.355	11.043
	(12.226)	(5.016)
AGE	49.4	39.7
	(16.2)	(18.1)
PER	3.21	2.30
	(1.61)	(1.45)
EDUC	12.65	12.42
	(3.19)	(3.27)
MALE	.883	.617
	(.373)	(.486)
BLACK	.071	.172
	(.257)	(.377)
n	11,089	8,608

a. See Table III for variable definitions.
b. n = Number of observations.
c. Numbers in parentheses are the standard deviations.

that renters are likely to be more responsive to price changes than are owners. These hypotheses are tested for the 19 separate metropolitan areas, as well as in pooled estimation procedures.[7]

Thus, the following two-step estimation procedure is used for owners and renters:

1. Estimate hedonic price functions for each metropolitan area to compute housing price and quantity.

2. Estimate income regressions for each metropolitan area to construct permanent and transitory income.

3. In the second stage of this two-step procedure, estimate housing demand, using the constructed variables for permanent and transitory incomes and for housing price.

4. Where necessary for variation, particularly with respect to housing price, pool data across the nineteen metropolitan areas and reestimate housing demand regressions.

7. As has been discussed in the text, the federal income tax treatment of home-ownership has an important effect on tenure choice and housing consumption among home-owners. Polinsky [13], for example presents the standard urban monocentric model, in which richer households live on cheaper land (hence, cheaper housing), further from the city's center. With a progressive income tax, after-tax prices and incomes may not be proportional to pre-tax values, so richer households may face still lower prices for comparable housing than do poorer households. If this is the case, our estimates of owner price elasticities are likely to be biased upward in absolute value, and income elasticities biased downward. Rosen [16] has shown how to estimate tenure choice and expenditures jointly, and our work in progress is aimed at replicating his findings over our sample of AHS cities.

III. Empirical Estimation

Data

The data used for estimation were drawn from the SMSA sample of the AHS for 1977. The sample is divided into 15 "small" areas (Albany, Anaheim, Dallas, Fort Worth, Madison, Memphis, Minneapolis, Newark, Orlando, Phoenix, Pittsburgh, Salt Lake City, Spokane, Tacoma and Wichita) with 5,000 observations each, and 4 "large" areas (Boston, Detroit, Los Angeles, and Washington, D.C.) with 15,000 observations each. A 30 percent sample was drawn from renter housing and a 25 percent sample from owner-occupied housing for small areas. These percentages were reduced by two-thirds for the large areas.

Table I presents comparative descriptive statistics (means and standard deviations in parentheses) for the entire sample of 19 metropolitan areas on owners as opposed to renters. Owner units are usually over two rooms per household larger than are renter units. Owners have roughly twice the income of renters, and are approximately ten years older. Owner households, on average, have roughly 3.2 members, compared to 2.3 members for renters. With the exception of Madison and Pittsburgh, owners are generally more educated.

Computation of Housing Price and Quantity

Table II summarizes hedonic price regressions used to construct price indices for owner-occupied and rental housing. Specification of the hedonic price regressions follows the set of variables described by Follain and Malpezzi [5], although their work was limited to linear and log-linear functional forms. These regressions are estimated using the generalized functional form discussed by Box and Cox [1] and used by Goodman [6], Halverson and Pollakowski [8], Linneman [9] and others:

$$(S_i^\lambda - 1)/\lambda = v_0 + \sum_j v_j \mathbf{C}_{ji} + \sum_k \nu_k \mathbf{T}_{ki} + V_i, \tag{5}$$

in which S is the bundle value, **C** is a vector of physical or neighborhood characteristics of a housing bundle and **T** is a vector of resident characteristics reflecting discrimination premia that may be paid by Blacks or Spanish surnamed individuals, for example. The best estimate for λ is determined by a search through alternative values of λ.[8]

Examination of λ across the the 19 metropolitan areas generally dictates rejection of linearity (λ equal to 1) or log-linearity (λ equal to 0). For owner-occupied housing, 12 of the 19 metropolitan areas show λ equal to .3 or .4 and three are larger than .5; only Salt Lake City satisfies the log-linearity conditions and only Washington, D.C. is linear. For rental housing, 11 of the 19 estimates are greater than .5; only Los Angeles is log-linear and Tacoma is linear.

A caution is necessary in interpreting some of the price equations for owner-occupied units. The maximum likelihood estimate for Anaheim of λ equal to 2.1 is highly unusual in our experience, where dependent variable transformations using the Box-Cox formulation almost always maximize between 0 and 1. This is probably due to the fact that almost 50

8. Detailed regression results of hedonic price equations (as well as income and housing demand equations to be discussed later) for individual cities are not reported here, but are available upon request from the authors.

Table II. Best Functional Forms for Hedonic Regressions

City	Owners		Renters	
	λ	$\bar{R}^2$	λ	$\bar{R}^2$
Albany	.3	.5626	.6	.6020
Anaheim	2.1	.5167	.2	.6396
Boston	.4	.6582	.6	.5651
Dallas	.2	.6944	.6	.5878
Detroit	.4	.6807	.7	.6612
Fort Worth	.3	.6678	.7	.6593
Los Angeles	.7	.5319	.0	.5713
Madison	.4	.6160	.4	.5060
Memphis	.4	.6456	.7	.7411
Minneapolis	.3	.5918	.8	.5194
Newark	.4	.6436	.8	.5770
Orlando	.4	.5501	.7	.5993
Phoenix	.2	.6056	.4	.6050
Pittsburgh	.4	.5222	.4	.5235
Salt Lake City	.1	.4909	.4	.4409
Spokane	.3	.6206	.5	.6145
Tacoma	.2	.5693	.9	.4972
Washington	1.0	.6045	.6	.6499
Wichita	.4	.5738	.2	.6537

a. $\bar{R}^2$ is the coefficient of multiple correlation adjusted for the degrees of freedom.

percent of the observations for Anaheim were in the upper open-ended category for house value. (The highest category for house value was \$75,000+, which was coded at \$87,500.) As a result, there may be some very serious heteroskedasticity in the structure of the sample, and the resulting parameter estimate should be viewed skeptically.[9]

To some extent, comparative estimates of λ may provide a description of the malleability of the housing stock in the various metropolitan areas. Rosen [17] shows how constant returns to scale *and* the ability to repackage units would lead to linear hedonic price functions (i.e., λ equal to 1.0). Landlords selling housing services might have considerably more incentive to alter the units and/or repackage them according to market conditions than might owner-occupiers. To the extent that renter hedonic price equations show larger λ than owner equations (in 13 of 19 cities), this might provide a weak verification of Rosen's theoretical point.

Table III shows the significance of variables used in the hedonic price regressions. So-called "quantity" variables (such as *ROOMS* and *BATH*) are very significant in all metropolitan areas for both owner-occupied and rental housing. Significant monthly inflation occurs in 14 of the nineteen areas for owner units, contrasting with only 6 out of 19 for rental housing. The variables are similar to those chosen by Follain and Malpezzi [5], and their performances are roughly comparable. Structure descriptors do fairly well; however, neighborhood descriptors, for which the AHS is notoriously weak, do not do as well.

9. This does not generally appear to be a serious problem as for fifteen of the nineteen areas, where less than 10 percent of the observations are in the open-ended category (Anaheim, Los Angeles, Washington, and Newark are the exceptions).

Table III. Significant Impacts of Variables in Hedonic Price Regressions

	Owners		Renters	
	Positive	Negative	Positive	Negative
RMONTH	14	—	6	—
BUILT	—	15	1	13
LNTAX	—	16	—	—
CELLAR	6	1	8	—
EXTRA	1	4	17	—
PAYHT	4	—	10	—
ROOMS	19	—	17	—
CFUELE	15	—	12	—
BATH	19	—	16	—
LAV	14	—	12	—
HFUEL	1	3	5	—
HEQP	3	6	3	—
BADHEAT	—	7	—	7
HADDL	—	2	2	—
NUNMD	—	8	1	2
AIRSYS	13	—	17	—
IFBLOW	6	—	4	—
CRACKS	1	6	—	2
PLASTER	—	3	—	2
RATS	1	2	—	3
PRIVNR	—	5	—	1
HOWHR	—	14	3	1
HALLS	1	1	—	2
BRKDOWNS	—	1	2	3
HOWNR	—	18	—	11
AIRNR	2	2	1	—
CRIME	—	—	3	2
STRNR	—	1	—	1
TRAFR	4	1	—	—
SCH	1	—	—	1
SHP	—	6	5	3
BLACK	—	9	—	11
SPAN	1	4	—	5
MOVED	1	7	—	18
ZCROWD	—	4	4	—
GARAGE	13	—	—	—
BEDRMS	4	3	8	—
STHEAT	1	1	—	—
NUMU	—	—	2	1
SF	—	—	4	1
FLOORS	—	—	4	3
ELEVI	—	—	2	2

Table III. (continued)

LIST OF VARIABLES:

Hedonic Price Variables

AIRNR	Airplane noise; 0 - not bothersome, . . ., 3 - makes one want to move
AIRSYS	"1" if central air conditioning; "0" otherwise
BADHEAT	"1" if unvented heaters; "0" otherwise
BATHR	Number of bathrooms
BEDRMS	Number of bedrooms
BRKDOWNS	Plumbing breakdowns in last 90 days (0 - 3)
BUILT	Age of structure
CELLAR	"1" if basement in building; "0" otherwise
CFUELE	"1" if electric cooking; "0" otherwise
CRACKS	"1" if open cracks in wall or ceiling; "0" otherwise
CRIME	Crime; 0 - not bothersome, . . ., 3 - makes one want to move
ELEVI	"1" if passenger elevator; "0" otherwise
EXTRA	Number of nonoil or nongas utilities paid for (0 - 5)
FLOORS	Number of stories, excluding basement
HADDL	"1" if additional heating equipment used last winter; "0" otherwise
HALLS	Repairs needed in common areas in last 90 days (0 - 3)
HEQP	"1" if central furnace; "0" otherwise
HFUEL	"1" if electric heating; "0" otherwise
HOWHR	Opinion of rental unit; 1 - excellent, . . ., 4 - poor
HOWNR	Opinion of street; 1 - excellent, . . ., 4 - poor
IFBLOW	"1" if fuses or breakers blown in last 90 days; "0" otherwise
LAV	"1" if 1½ baths; "0" otherwise
MOVED	Length of tenure at location
NUMU	"1" if 5 or more units in building; "0" otherwise
NUNMD	"1" if 2 or more rooms without hot air ducts; "0" otherwise
PAYHT	"1" if renter or owner pays for oil or gas; "0" otherwise
PLASTER	"1" if over 1 sq. ft. broken plaster; "0" otherwise
PRIVNR	"1" if necessary to go through bedroom to reach others; "0" otherwise
BLACK	"1" if black; "0" otherwise
RATS	"1" if signs of rats or mice last 90 days; "0" otherwise
RMONTH	Month of year; 1 - April, 1977, . . ., 12 - March, 1978
ROOMS	Number of rooms
SCH	School adequacy; 0 - adequate, . . ., 2 - makes one want to move
SF	"1" if single unit detached; "0" otherwise
SHP	Shopping adequacy; 0 - adequate, . . ., 2 - makes one want to move
SPAN	"1" if Spanish origin; "0" otherwise
STRNR	Street noise; 0 - not bothersome, . . ., 3 - makes one want to move
TRAFR	Traffic problems; 0 - not bothersome, . . ., 3 - makes one want to move

Table III. (continued)

ZCROWD	Persons per room (× 100)
LNTAX	Natural logarithm of property tax
GARAGE	Number of garage spaces
STHEAT	"1" if steamheat; "0" otherwise
Income Regression Variables	
AGE	Age of household head
AGESQ	AGE * AGE
GRADE	Number of years of education
GRADEA	"1" if 9 - 11 years of education; "0" otherwise
GRADEB	"1" if 12 years of education; "0" otherwise
GRADEC	"1" if 13 - 15 years of education; "0" otherwise
GRADED	"1" if 16 years of education; "0" otherwise
GRADEE	"1" if over 16 years of education; "0" otherwise
PER	Household size
BLACK	"1" if black; "0" otherwise
JOB	"1" if household head employed last week; "0" otherwise
MAR	"1" if household head married; "0" otherwise
MALE	"1" if male head of household; "0" otherwise
XTEN	"1" if previously owned home; "0" otherwise
XVAL	Equity from previous home
Demand Regression Variables	
Y	Actual, observed income (in thousands) $\equiv Y^P + Y^T$
Y^P	Permanent income
Y^T	Transitory income
P	Housing price
PER	Household size
BLACK	"1" if black; "0" otherwise
MALE	"1" if male head of household; "0" otherwise

Prices and quantities of housing are then computed by using a standardized, mean index bundle following Goodman [6] and many others. Table IV reports the mean prices and quantities and their standard deviations for owner-occupied and rental units of housing. Note that owner and renter quantities are not directly comparable to each other.[10] Fort Worth has the smallest owner quantities (.860) and Detroit the largest (1.287). The costliest owner units are found in Los Angeles ($60,434) while the least expensive in Detroit ($25,416). For renter units the quantity extremes are Orlando (.825) and Boston (1.330), and price extremes are Memphis ($145) and Newark ($252). Since, as is mentioned, the highest category on the actual house value ($75,000 and up) for owner-occupied units was coded as $87,500, the mean may be biased downwards to the extent that large numbers of

10. For example, the mean owner bundle has about two more rooms than the mean renter bundle. Renter bundles with standard *owner* characteristics are typically half again as expensive. Goodman [6] demonstrates that these price differentials are not generally sensitive to specification of the bundle chosen.

Table IV. Mean Quantities and Prices by Metropolitan Area

	Owners		Renters	
City	Quantity	Price	Quantity	Price
Albany	1.056 (.447)	36,322 (1,198)	.963 (.373)	190.16 (18.31)
Anaheim	1.062 (.571)	54,962 (24,797)	1.187 (.403)	233.28 (19.96)
Boston	.966 (.358)	46,908 (5,644)	1.330 (.583)	167.05 (19.51)
Dallas	.917 (.517)	40,992 (2,953)	1.030 (.445)	191.17 (21.10)
Detroit	1.287 (.590)	25,416 (4,470)	1.006 (.360)	197.14 (17.89)
Fort Worth	.860 (.497)	38,102 (2,665)	1.149 (.471)	156.58 (17.12)
Los Angeles	.944 (.337)	60,434 (7,414)	.953 (.473)	226.80 (27.56)
Madison	1.119 (.405)	40,683 (1,802)	1.035 (.351)	195.60 (11.59)
Memphis	.969 (.499)	35,887 (1,841)	1.076 (.445)	145.40 (13.85)
Minneapolis	1.090 (.410)	43,184 (2,991)	.966 (.344)	210.29 (15.17)
Newark	1.031 (.335)	54,628 (2,358)	.912 (.319)	252.32 (27.78)
Orlando	.952 (.486)	37,831 (1,564)	.825 (.308)	233.41 (38.61)
Phoenix	1.151 (.513)	35,323 (2,258)	1.102 (.505)	189.99 (20.70)
Pittsburgh	.895 (.419)	41,365 (2,850)	1.037 (.419)	170.34 (22.52)
Salt Lake City	1.112 (.421)	42,526 (2,703)	1.138 (.505)	165.84 (5.78)
Spokane	1.054 (.483)	33,710 (1,764)	1.095 (.454)	153.09 (14.76)
Tacoma	.946 (.456)	40,032 (1,535)	1.099 (.370)	169.10 (11.36)
Washington	1.074 (.314)	56,936 (6,542)	1.036 (.441)	217.12 (24.14)
Wichita	1.021 (.507)	35,695 (1,938)	1.095 (.409)	167.20 (12.20)

a. Numbers in parentheses are standard errors.
b. Owner and renter bundles are not directly comparable (see footnote 6).

houses are in this category (Anaheim is the most notable example). For most other metropolitan areas and for rental housing units, the bias is smaller or nonexistent.

Construction of Permanent and Transitory Income

From equation (4), current (or actual) income is estimated for each of the 19 metropolitan areas using the following regession:

$$Y_i = \phi_0 + \phi_1 JOB_i + \phi_2 AGE_i + \phi_3 AGESQ_i + \varphi_4 (EDUC_i) + \sum_j \psi_j N_{ji} + W_i,$$

where JOB is the employment status (1 if employed and 0 otherwise), AGE is the age of the household head, $AGESQ$ is its squared value, $EDUC$ is the education variable, and $\mathbf{N}_j$ are other socioeconomic and nonhuman capital variables. Age is entered quadratically to capture its expected nonlinear effect on permanent income. Education is entered either linearly or in a step-wise manner. In the linear case ($GRADE$), φ_4 is a scalar term; in the step-wise case ($GRADEA-GRADEE$), where a series of dummy variables indicate educational levels, φ_4 is a vector of coefficients.[11] On the assumption that W_i is the disturbance

11. The education variable *EDUC* could be expanded to include quadratic and higher level polynomials, similarly to age. Preliminary work settled on the step-wise procedures as being preferable.

Table V. Significant Impacts of Variables in Income Regression

	Owners		Renters	
	Positive	Negative	Positive	Negative
JOB	19	—	18	—
AGE	18	—	18	—
AGESQ	—	16	—	17
BLACK	—	9	—	8
SPAN	—	4	—	2
MALE	10	—	14	—
MAR	7	—	17	—
XTEN	1	1	—	5
XVAL	4	—	8	—
PER	13	—	1	—
GRADE	10	—	5	—
GRADEA-E	9	—	14	—

a. Significant at the 5% level (2-tailed test: $t > 1.96$).

term uncorrelated with the explanatory variables, the OLS procedure provides consistent estimates. Coefficients are expected to be

$$\phi_1 > 0, \phi_2 > 0, \phi_3 < 0, \varphi_4 > 0.$$

Table V indicates that age, education, and employment, of course, have large effects on income. Interestingly enough, sex (*MALE* equal to 1 if male and 0 if female) and marital status (*MAR* equal to 1 if married and 0 otherwise) of the household head have more significant impacts among renters than they do among owners. For owners, being a male head of household has a significant (positive) impact in 10 of the 19 areas; for renters it is significant in 14 of the 19 cities. For owners, being married has a significant positive impact in 7 of the 19 cases; for renters it is significant 17 of 19 times.

Estimation of Housing Demand

Tables VIa and VIb display income and price coefficients and elasticities for owners and renters respectively. The regressions are estimated in linear form with income (either current Y or the combination of permanent Y^P and transitory Y^T), housing price (P), household size (*PER*), race of household head (*BLACK* equal to 1 if black and 0 otherwise), and sex of household head (*MALE*). Elasticities are evaluated at variable means for individual metropolitan areas.

Permanent income coefficients and elasticities are substantially higher than are current income parameters, for both owner and renter housing. (For owners, the permanent income elasticity is higher in all 19 metropolitan areas. For renters, it is higher in 18 of the 19 areas—only Madison provides an exception.) Median current income elasticities (coefficients) are .322 (.173) and .245 (.204) for owners and renters, respectively. Median permanent income elasticities (coefficients) of .571 (.300) and .402 (.365) for owners and

Table VIa. Price and Income Coefficients (Elasticities) for Owners: Separate Regressions of 19 Individual Metropolitan Areas

	Current Income			Permanent Income		
	Income Coefficient (Elasticity)	Price Coefficient (Elasticity)	$\bar{R}^2$	Income Coefficient (Elasticity)	Price Coefficient (Elasticity)	$\bar{R}^2$
Albany	.156 (.308)	+ (+)	.1772	.331 (.627)	+ (+)	.2334
Anaheim	.029** (.067**)	+ (+)	.1934	.098** (.224**)	+ (+)	.1953
Boston	.130 (.297)	+ (+)	.3100	.202 (.456)	+ (+)	.2706
Dallas	.222 (.501*)	+ (+)	.3574*	.300 (.676)	+ (+)	.3670*
Detroit	.221 (.365)	+ (+)	.3197	.312 (.512)	+ (+)	.3271
Fort Worth	.199 (.442)	+ (+)	.2861	.350 (.775*)	+ (+)	.2340
Los Angeles	.108 (.248)	+ (+)	.2245	.208 (.475)	−.001 (−.060)	.2561
Madison	.162 (.315)	+ (+)	.2517	.309 (.592)	−.001 (−.062)	.2870
Memphis	.208 (.395)	− .027 (−1.000)	.3234	.403* (.758)	−.029 (−1.100)	.3544
Minneapolis	.187 (.376)	+ (+)	.2725	.276 (.550)	+ (+)	.2859
Newark	.111 (.258)	+ (+)	.2641	.179 (.377)	+ (+)	.2829
Orlando	.173 (.320)	+ (+)	.2054	.369 (.676)	+ (+)	.2523
Phoenix	.206 (.327)	+ (+)	.2839	.324 (.507)	+ (+)	.2961
Pittsburgh	.164 (.322)	+ (+)	.2131	.297 (.583)	+ (+)	.2384
Salt Lake City	.150 (.260)	+ (+)	.1696**	.213 (.371)	−.000 (−.018)	.1741**
Spokane	.226 (.378)	+ (+)	.2999	.341 (.581)	−.000 (−.008)	.3146
Tacoma	.186 (.368)	+ (+)	.2613	.291 (.571)	+ (+)	.2828
Washington	.089 (.226)	+ (+)	.1773	.136 (.344)	+ (+)	.1861

Table VIa. (continued)

	Current Income			Permanent Income		
	Income Coefficient (Elasticity)	Price Coefficient (Elasticity)	$\bar{R}^2$	Income Coefficient (Elasticity)	Price Coefficient (Elasticity)	$\bar{R}^2$
Wichita	.252* (.466)	−.024 (−.850)	.3189	.380 (.692)	−.020 (−.706)	.3346
Median	.173 (.322)	—	.2613	.300 (.571)	—	.2828

* = Largest value of the 19 SMSAs.
** = Smallest value of the 19 SMSAs.

renters are substantially higher.[12] In terms of goodness-of-fit, regressions using permanent and transitory incomes are superior in 17 (16) of the 19 areas for owners (renters).[13]

Intrametropolitan price elasticities are generally disappointing. Many cities indicate positive price elasticities, particularly for owners, although some positive price elasticities turn negative by switching from current to permanent incomes (4 and 2 cities for owners and renters, respectively). Due to suppression regulations, the geographical and neighborhood identifiers are very weak in the AHS data.[14] It is quite difficult then, to use land price variation (and its attendant impact on housing prices) to form a good housing price series, especially within a metropolitan area.

This insufficient intrametropolitan variation suggests that a pooled sample across metropolitan areas may provide the price variation necessary to estimate proper price elasticities. The final set of demand estimation concentrates on the pooled data over the 19 areas. To control for intermetropolitan general price differentials, following Polinsky and Elwood [14], the Bureau of Labor Statistics family budget is used with its housing components deleted. Income (Y, Y^P and Y^T) and housing price (P) are deflated by these general price indices to obtain real income and relative housing price in terms of nonhousing consumption goods. Also, given the high adjustment costs that are often necessary, it might be argued that it is more appropriate to look only at recent movers since they are more likely to be close to equilibrium. Renter mobility rates are relatively high, whereas owner mobility rates are substantially lower. For the 19 metropolitan areas, between 19% (Newark) and 49% (Orlando) of all renters have moved in the preceding year. For owners, however, the percentage ratios vary from 2.8% (Albany) to 12.1% (Phoenix), and often lead to sample sizes of dubious reliability (13 observations in Newark, 14 in Albany, 16 in Boston, for example).[15]

12. The apparent inconsistency between coefficients and elasticities is due to the differences in units of measure (owner housing units are larger than renter units, as they are standardized from different bundles).

13. It is here that the truncation of the owner-occupied sample may lead to the most serious biases. Anaheim and Washington, the two areas with the largest percentages of observations in the open-ended house price category show the lowest income elasticities. Newark and Los Angeles also show relatively low income elasticities.

14. Location by county within the metropolitan area is known, and appropriate dummy variables are used to capture these effects. They may, however, be somewhat confounded by local fiscal variables, although property tax and service quality *are* taken into account.

15. Casual observation shows the highest mobility rates to be in the "sunbelt" areas, suggesting that much of the measured mobility is due to migration from elsewhere. Owner and renter mobility rates across the 19 areas display a correlation of .73.

Table VIb. Price and Income Coefficients (Elasticities) for Renters: Separate Regressions of 19 Individual Metropolitan Areas

	Current Income			Permanent Income		
	Income Coefficient (Elasticity)	Price Coefficient (Elasticity)	$\bar{R}^2$	Income Coefficient (Elasticity)	Price Coefficient (Elasticity)	$\bar{R}^2$
Albany	.222 (.245)	+ (+)	.2313	.365 (.402)	−.000 (−.008)	.2496
Anaheim	.198 (.224)	+ (+)	.2828	.210 (.235)	+ (+)	.2813
Boston	.319 (.270)	−.000 (−.002)	.2796	.539 (.456)	−.000 (−.008)	.3350
Dallas	.257 (.286)	+ (+)	.2199	.473 (.524*)	+ (+)	.2702
Detroit	.178 (.207)	+ (+)	.2869	.298 (.346)	+ (+)	.3053
Fort Worth	.259 (.253)	+ (+)	.2056	.422 (.411)	+ (+)	.2271
Los Angeles	.258 (.301*)	+ (+)	.2375	.370 (.428)	−.000 (−.157)	.2452
Madison	.145 (.148**)	−.003 (−.576)	.2552	.132** (.135**)	−.003 (−.576)	.2540
Memphis	.275 (.249)	+ (+)	.3959*	.566* (.508)	+ (+)	.4414*
Minneapolis	.162 (.182)	−.004 (−.936)	.2146	.222 (.250)	−.004 (−.936)	.2176
Newark	.137 (.178)	+ (+)	.2236	.233 (.302)	+ (+)	.2428
Orlando	.132** (.162)	−.003 (−.877)	.2594	.284 (.341)	−.002 (−.820)	.2041
Phoenix	.180 (.173)	−.001 (−.224)	.1611**	.404 (.405)	−.002 (−.379)	.2956
Pittsburgh	.319* (.299)	−.001 (−.197)	.2712	.444 (.418)	−.000 (−.161)	.2833
Salt Lake City	.181 (.176)	+ (+)	.1900	.305 (.294)	+ (+)	.1946**
Spokane	.307 (.245)	−.001 (−.154)	.2822	.342 (.272)	−.001 (−.168)	.2812
Tacoma	.191 (.176)	−.002 (−.354)	.2154	.365 (.335)	−.002 (−.354)	.2476
Washington	.204 (.270)	+ (+)	.2613	.311 (.410)	+ (+)	.2742

Table VIb. (continued)

	Current Income			Permanent Income		
	Income Coefficient (Elasticity)	Price Coefficient (Elasticity)	$\bar{R}^2$	Income Coefficient (Elasticity)	Price Coefficient (Elasticity)	$\bar{R}^2$
Wichita	.270 (.277)	+ (+)	.2347	.453 (.460)	+ (+)	.2587
Median	.204 (.245)	—	.2347	.365 (.402)	—	.2587

Note: * = Largest value of the 19 SMSAs.
** = Smallest value of the 19 SMSAs.

Tables VIIa and VIIb display pooled demand regression results for owners and renters, respectively. Separate estimates are presented for the entire tenure-specific samples (columns 1 and 2 of each table), and for samples of recent movers only (columns 3 and 4). Three major findings emerge.

1. Owner price elasticities (η_P) appear to be substantially lower (in absolute value) than are renter elasticities. Elasticities for all owners (evaluated at the means) are 33 percent smaller than for all renters; elasticities for owner-movers are 20 percent lower than for renter-movers. (As will be shown later in Table IX, these significant differences result from the higher owner and lower renter incomes used as mean values.)

2. Owner income elasticities (η_Y), evaluated at means, are substantially larger than are renter elasticities. Permanent income elasticities for all owners are 44 percent higher than for all renters; elasticities for owner-movers are 76 percent higher than for renter-movers. (Table IX again will show that adjustments of income elasticities, based on common income levels, reduce these differences.)

3. Transitory income is an important determinant of housing demand for both renters and owners, but the relative impacts differ by the immediacy of the move.

Discussing these regression results in more detail, the price elasticities are more satisfactory (significantly negative) for the pooled regressions than for the individual metropolitan-area regressions, owing to sufficient housing price variation lacking in the SMSA samples. The price elasticity for all owners is −.236 when current income is used, and −.306 when permanent income is used. For all renters, the elasticity is higher in absolute value at −.395 (with current income) and −.459 (with permanent income) respectively.

Use of permanent income also increases the income elasticity from .353 to .567 for all owners; and from .238 to .393 for all renters. Transitory income is always significantly positive. Controlling for permanent income, blacks purchase approximately 14 percent less owner-occupied housing and 11.8 percent less renter housing than do whites; male headed households purchase approximately 12.5 percent less owner-occupied housing and 13.8 percent less rental housing. Household size (*PER*) does not appear to be significant in owner-occupied housing demand, while it is important for rental housing demand.

Income and price elasticities for owner-movers are considerably higher than for all owners (Table VIIa). The permanent income elasticity is .672, and the price elasticity is −.429. The race differences persist, but they are barely significant (at the 10 percent level).

Table VIIa. Demand Regression for Owners: Pooled Sample

	All Owners		Owners-Movers	
Variable[a]	Current Income	Permanent Income	Current Income	Permanent Income
Y	.00179	—	.00190	—
	(50.97)[b]		(16.27)	
Y^P	—	.00291	—	.00341
		(42.25)		(15.22)
Y^T	—	.00142	—	.00140
		(35.46)		(10.78)
P	− .000586	− .000752	− .000787	− .001065
	(14.13)	(18.00)	(6.96)	(9.26)
PER	.0126	− .00462	.0250	.0050
	(4.84)	(1.70)	(2.67)	(.53)
BLACK	− .1866	− .1436	− .1337	− .1041
	(12.05)	(9.32)	(2.11)	(1.70)
MALE	− .0281	− .1250	− .0376	− .1281
	(2.45)	(10.07)	(.84)	(2.86)
CONSTANT	.9118	.8894	1.0077	.9447
$\bar{R}^2$	.2364	.2599	.2610	.3082
SER	.4100	.4037	.3872	.3746
η_Y	.353	.567	.379	.672
η_P	− .236	− .306	− .317	− .431
n	11,089	11,089	882	882

a. Y, Y^P, Y^T, and P are all measured relative to the price level for other goods and services.
b. Numbers in parentheses are t-statistics.

The transitory income coefficient is approximately the same for all owners and for owner-movers.

Income elasticities are about the same for all renters and for renter-movers (Table VIIb), while renter-movers' price elasticities are higher than all renters'. The propensities to spend out of transitory income are approximately 46 and 51 percent of the propensities to spend out of permanent income for all renters and for renter-movers respectively.[16]

Table VIII summarizes these income and price elasticities, and propensities to purchase from transitory and permanent incomes, in ratio form. The analysis covers entire samples of renters and owners, as well as mover subsamples. Among all occupants, the owner-renter permanent income elasticity ratio is approximately 1.44; the price elasticity is approximately .67. Among movers, the owner-renter permanent income elasticity ratio is

16. Additional pooled estimates were performed omitting Anaheim (because of its large proportion of high value houses, which are truncated) and Detroit (whose price index seemed implausibly low). The estimated elasticities in this case were not significantly different from the entire, pooled sample.

Table VIIb. Demand Regression for Renters: Pooled Sample

	All Renters		Renters-Movers	
Variable[a]	Current Income	Permanent Income	Current Income	Permanent Income
Y	.00228	—	.00245	—
	(42.21)[b]		(27.03)	
Y^P	—	.00379	—	.00381
		(36.17)		(22.04)
Y^T	—	.00174	—	.00195
		(28.10)		(18.65)
P	−.2185	−.2535	−.2625	−.3001
	(18.67)	(21.65)	(13.06)	(14.83)
PER	.0538	.0463	.0750	.0681
	(18.03)	(15.60)	(14.36)	(13.08)
$BLACK$	−.1502	−.1176	−.1599	−.1293
	(13.21)	(10.34)	(7.50)	(6.07)
$MALE$	−.0631	−.1378	−.0909	−.1559
	(6.80)	(13.66)	(5.71)	(9.05)
$CONST$	1.1655	1.1255	1.2744	1.2533
$\bar{R}^2$	.2415	.2648	.2904	.3103
SER	.3869	.3809	.3757	.3704
η_Y	.238	.393	.241	.381
η_P	−.395	−.459	−.474	−.540
n	8,608	8,608	2,845	2,845

a. Y, Y^P, Y^T, and P are all measured relative to the price level for other goods and services.
b. Numbers in parentheses are t-statistics.

about 1.76 or higher than for the sample as a whole. The price elasticity ratio rises to .80.

The ratio of propensities to purchase out of transitory and permanent incomes varies chiefly according to the immediacy of the move. This ratio equals .488 for all owners, and .459 for all renters. The similar ratio for owner-movers of .411, compares to the renter-mover ratio of .512. Perhaps due to the shorter length of tenure in a specific unit (as indicated by the much higher turnover rate), renter-movers are willing to spend larger proportions of their transitory incomes.

Re-evaluation of Elasticities with Income Differential Adjustments

With linear demand functions, it is easily demonstrated that income elasticities rise and price elasticities fall with incomes. This suggests that some portions of the higher owner income elasticities and lower owner price elasticities may be attributable to the income differentials between owners and renters. Since mean owner income is roughly twice the

Table VIII. Permanent Income and Price Elasticities: Owners/Renters

	All Purchasers		
	All Owners	All Renters	$\eta O/\eta R$
η_Y	.567	.393	1.44
η_P	− .306	− .459	.67
β_T/β_P	.488	.459	—
	Recent Movers		
	Owner-Movers	Renter-Movers	$\eta O/\eta R$
η_Y	.672	.381	1.76
η_P	− .431	− .540	.80
β_T/β_P	.411	.512	—

size of mean renter income, it is useful to recalculate income and price elasticities based on the income of the other tenure.[17]

Table IX summarizes this operation on income elasticities for all owners and renters (IXa) and for movers only (IXb), as well as on price elasticities for all owners and renters (IXc) and for movers only (IXd). Table IXa shows that adjustment of income elasticities for income differentials eliminates a substantial portion of the difference. The two are insignificantly different when evaluated using owner income, and significantly different only at the 10 percent level when evaluated at renter income. Table IXb is more replicative of other studies in that it examines only mover behavior. Even in this case, the apparent 76 percent difference in elasticities (.672/.381) is halved when tenure-specific income is adjusted.

Similar results occur for price elasticities. The apparent difference of .153 for all owners and renters is reduced by approximately 70 percent (Table IXc), when adjusted for income differentials. Renter housing demand is still significantly more price elastic than owner demand at the 10 percent level, but only barely. Income adjustments have more dramatic effects in the recent mover regressions (Table IXd). The apparently higher renter price elasticities are reversed in both cases, although neither difference is significant.

Income adjustments, then, result in all-renter and all-owner income elasticities that are of approximately the same magnitudes, and in all-renter price elasticities that are slightly higher. For recent movers, owner income elasticities remain higher, but price elasticities are insignificantly different. In both cases, values calculated with tenure-specific incomes overstate the differences between housing tenures.

17. Consider a simplified linear demand equation:

$$Q = \beta Y + \gamma P$$

The elasticity of income elasticity η_Y with respect to Y equals $(1 - \eta_Y)$. Hence, it increases for η_Y less than 1. The elasticity of price elasticity η_p with respect to Y equals $- \eta_Y$, decreasing (in absolute value) as Y increases.

Although it might seem appropriate to treat price symmetrically, this is not done because the standardized units are not comparable. Moreover, it is not necessarily straightforward to move between rent, which refers to a flow of services, and house value, which contains components that refer both to rent on the stock of housing capital and expected capital gain on the dwelling unit.

Table IX. Income Differential Adjustments of Permanent Income and Price Elasticities

	Base Mean Income	
Regression	Owner Income	Renter Income
a. Permanent Income Elasticities for All Owners and Renters		
All-Owners	.567	.416
	(.013)[a]	(.009)
All-Renters	.543	.393
	(.015)	(.010)
Difference	.024	.023
	(.020)	(.014)
b. Permanent Income Elasticities for Recent Movers Only		
Owner-Movers	.672	.547
	(.044)	(.035)
Renter-Movers	.522	.381
	(.023)	(.017)
Difference	.150	.166
	(.050)	(.039)
c. Price Elasticities for All Owners and Renters		
All-Owners	−.306	−.414
	(.017)	(.023)
All-Renters	−.345	−.459
	(.016)	(.021)
Difference	−.039	−.045
	(.023)	(.031)
d. Price Elasticities for Recent Movers Only		
Owner-Movers	−.431	−.646
	(.047)	(.069)
Renter-Movers	−.394	−.540
	(.027)	(.036)
Difference	.037	.106
	(.053)	(.079)

a. Standard errors in parentheses.

IV. Conclusions

In the introduction, we mention survey articles that report income and price elasticities for rental and owner-occupied housing demand. The estimated parameters are often from different cities and/or from different years. Our study proposes a replicative set of tests to investigate the behaviors of housing consumers in nineteen SMSAs in 1977.

We estimate permanent income elasticity by constructing permanent/transitory components of current income from a human and non-human capital model. The median "all owner" permanent income elasticity for the 19 areas is .571, with the estimates varying from .224 to .775. These generally represent increases of from 50 to 100 percent over elasticities measured with current income. The "all renter" permanent income elasticities vary from .135 to .524 with the median being .402. Both the owner and renter estimates are in the range cited by Mayo [11]. The separate estimates for each metropolitan area provide fairly robust evidence of the relative magnitudes of the income elasticities; in short, all-owner permanent income elasticities appear to be about half again as large as all renter elasticities (both unadjusted for tenure-specific income differentials). Pooling of the samples (across municipalities) yields elasticities for all-owners and all-renters of .567 and .393 respectively (once again, unadjusted). Estimation for mover samples alone increases the income elasticity for owner units by about twenty percent, but has little (insignificantly negative) impact on renter elasticity.

Price elasticity estimates are somewhat disappointing for individual areas due to the limited spatial housing-price variation within SMSAs. Pooling of observations across the nineteen metropolitan areas creates the sufficient price variation, yielding elasticities of −.303 for all owners and −.458 for all renters (unadjusted for income). For recent movers only, the estimates rise in absolute value to −.429 (owners) and 0.542 (renters) respectively. These price elasticity estimates are slightly lower than those reported by Mayo.

We also find that transitory income is significant in predicting housing demand. This is particularly true in metropolitan areas where there is a "good" fit in the income regression. Since the mean transitory income is zero, an elasticity concept is inappropriate, but examination of the ratio of β_T and β_P is instructive. For rental housing, the ratio is .459 (all renters) or .512 (renter-movers). For owner-occupied housing, the measure is .488 (all owners) or .411 (owner-movers). The replication over the 19 areas suggests that a well-specified housing demand model should include both permanent and transitory incomes.

Finally, we find that adjusting income and price elasticities for tenure-specific incomes has significant impacts on the calculated values. For the all-owner vs. all-renter comparisons of income elasticities, this adjustment essentially eliminates the differences, although they remain significant for mover households. Since truncation of the house value measurements leads to some downward biases in owner-income elasticities, it is likely that they *are*, in fact, significantly higher, but by much smaller magnitudes than have been found elsewhere. Price elasticity differences are also reduced. Renter elasticities remain slightly larger for all-owner vs. all-renter comparisons, but the difference disappears for mover comparisons.

Several aspects of this and previous analyses suggest that further housing demand study requires panel data on individual households. Over the longer term a household must plan housing consumption, length of stay at various locations (and/or housing tenures), savings for down payment, the joint consumption/investment nature of owner-occupied housing, maintenance, and liquidation of the investment at retirement or death. This obviously presents an enormous modeling effort, yet it is equally apparent that selection biases are manifest if individual parts of the system are estimated separately. With questions of income and housing-price estimation largely settled in theory and in practice by this point, it may be wise to address the dynamic problems attendant to such a "life cycle" view of housing demand. Clearly, a well-specified model of housing demand should include tenure choice, tenure change, length of residency and amount of housing purchased (not to mention maintenance and repairs). This is an exciting future task.

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