ANALYSIS OF TENURE CHOICE AND HOUSING EXPENDITURE PATTERNS

by

Chung L. Huang and Robert Raunikar

Department of Agricultural Economics
Georgia Experiment Station, University of Georgia

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Since the first Homestead Act in 1880, many government policies and programs have encouraged single family home establishment and helped provide housing for lower income families. Tax advantages at the Federal and local government levels, public housing, Federal Home Administration mortgage loan program, and housing subsidies and transfer payments provided incentives and helped individuals and families purchase a housing.

Home ownership has long been considered as an American dream and pursued as a family goal. Housing ownership is often regarded as a symbol of social status and achievement, and a highly desirable physical and social environment for families. The American tradition and desire for home ownership are well recognized and documented (Tremblay and Dillman). Hinkle and Combs find that the strength of desire to own a home, among 152 recent home buyers surveyed in a mid-west community, averaged 8.9 on a scale ranging from 1 to 10, with 10 being the strongest. Older and higher income home buyers were more likely to indicate social status as a primary reason for their decisions to purchase a home; whereas, larger families tend to make the purchase decision to increase space for inside and outside family activities.

When considering a home purchase, the effect on the family budget represents a long-term financial and resource commitment. To aid policy and decision-makers understand consumer demand for housing and home purchasing behavior, studies focusing on the nature of housing demand and on identifying primary determinants of home ownership have been reported in the literature. Most studies estimate demand for housing or expenditure equations by ordinary least squares techniques (Carliner; de Leeuw; Straszheim). In this approach, it is customary to analyze the demand for owner-occupied housing and the demand for rental housing separately. Alternatively, the entire sample may be

sed to estimate a single equation with some dummy variables included to account for differing housing tenure. Other studies have examined only the choice aspect of whether to buy or rent a home. Typically, a probit or logit model is used to estimate the probability that a family will own its home or will choose among different types of residential housing (Li; Quigley).

These approaches neglect the joint determination of housing expenditure and tenure choice in demand for housing. While some individuals or families may choose to own houses, and others choose to rent, it is imperative for this choice to be included in the estimated models. The objective of this study is to estimate and analyze housing expenditure patterns within a framework that allows for the joint determination of housing tenure choice and the level of housing expenditures simultaneously. Estimation of the empirical model is based on data from the most recent Consumer Expenditure Survey conducted by the Bureau of Labor Statistics (BLS) to provide new estimates of the housing demand parameters. Most importantly, the study emphasizes the analysis of self-selection effects presented in the estimated model.

A Simultaneous Framework for Tenure Status and Housing Expenditures

Models involving selectivity problems have received considerable attention in recent econometric literature. Originally developed by Heckman in his study of labor supply, empirical applications of selectivity models abound in various aspects of social and economic research problems. Examples include sex and race discrimination (Reimers), union/non-union wage differential (Lee), education and earnings (Kenny et. al.), brand name selection and orange juice consumption (Lee et. al.), food stamp program participation and food expenditures (Smallwood and Blaylock), and at home and away from home food expenditure patterns (Lee and Brown), among others.

In a study of housing demand, Lee and Trost developed a simultaneous

model approach to study the joint determination of self-selection process of tenure status and the level of family spending on housing based on household panel data. Income, family size, and household head age and race are generally found to be the important and significant factors that influence choice of tenure status and level of housing expenditure. Families tended to spend more on housing closer to the city and as city size increases.

More recently, Gillingham and Hagemann adopted a similar model for their analyses of housing services demand based on the 1972-73 BLS Consumer Expenditure Survey. Gillingham and Hagemann also found that simultaneity between housing tenure choice and the demand for housing services is statistically significant. More importantly, the study shows that the structure of both tenure choice and housing services demand varies substantially across household type and, hence, the estimated elasticities in both overall level and conditional demand components.

Following the Lee and Trost model, the model for analysis is specified as

1) $$Y_j = X_j\beta + U_j, \text{ and}$$

2) $$I_j^* = Z_j\tau + e_j, \qquad j=1, 2, \ldots, N,$$

where Y represents the housing expenditures, I^* is an unobservable index determining tenure choice, and X and Z are the sets of independent variables. Implicit in the model is the assumption of two distinct regimes that represent consumer's demand for housing, i.e., owned and rented accommodations, which are conditional on I^*. More explicitly, it is assumed that

$$I_j = 1, \text{ iff } I_j^* > 0 \implies e_j > -Z_j\tau,$$

$$= 0, \text{ iff } I_j^* \leq 0 \implies ej > Z_j\tau, \text{ and}$$

3) $$Y_{oj} = X_{oj}\beta_o + U_{oj}, \quad \text{if } I_j = 1,$$

4) $$Y_{rj} = X_{rj}\beta_r + U_{rj}, \quad \text{if } I_j = 0.$$

Y_o and Y_r are the observed housing expenditures and X_o and X_r are the sets of independent variables for owners and renters, respectively. Assuming e_j is normally distributed with mean zero and variance one, the conditional expected housing expenditures for owned and rented housing are such that

(5) $$E(Y_{oj} \mid I = 1) = X_{oj}\beta_o - \sigma_{oe}W_{oj}, \text{ and}$$

(6) $$E(Y_{rj} \mid I = 0) = X_{rj}\beta_r + \sigma_{re}W_{rj},$$

where σ_{oe} and σ_{re} are the covariance of the error terms between (2) and (3), and (2) and (4), respectively. $W_{oj} = \phi(Z_j\tau)/\Phi(Z_j\tau)$ and $W_{rj} = \phi(Z_j\tau)/[1 - \Phi(Z_j\tau)]$; and $\phi(.)$ and $\Phi(.)$ are the standard normal density and distribution functions, respectively. For estimation purpose, equations (5) and (6) can be rewritten as

(7) $$Y_{oj} = X_{oj}\beta_o - \sigma_{oe}W_{oj} + \mu_{oj}, \text{ and}$$

(8) $$Y_{rj} = X_{rj}\beta_r + \sigma_{re}W_{rj} + \mu_{oj}.$$

Thus, equations (2), (7) and (8) constitute the model for analyzing household expenditure patterns. Statistical methods for joint estimation of these equations are discussed elsewhere (Lee and Trost; Maddala). The two-stage estimation procedure involves the probit estimation of equation (2) followed by weighted least squares estimation of equations (7) and (8).

Data Description and the Statistical Model

This study is based on the BLS 1984-85 Consumer Expenditure Interview survey data. The BLS survey is conducted on a continuous basis consisting of a panel of about 5,000 households. Survey data for the first quarter of 1985, the most recent survey results released by the BLS, are selected for this analysis. The BLS survey contains a sample that representing student, rural and urban households in the United States. The urban households are classified by the Northeast, North Central, South and West census regions.

In this study, the student portion, households with incomplete income

reporting, and households with top coded income or age of the reference person are deleted. Furthermore, sample observations for study include only owner-occupant (with or without mortgage) and renter-occupant households. Of the 5,236 households surveyed in the first quarter of 1985, 4,520 households were retained for this analysis. The housing cost variable includes utility payments, value of additions and repairs done by the family, mortgage and property taxes for home owners and rental payments for home renters. Total annual income after tax from all sources was used to measure household disposable income.

As shown in Table 1, home owners generally have higher income and housing expenditure than renters. Home owners also consist of larger family size and the head of the household on average is considerably older than in the renter-occupant household. Furthermore, a greater majority of owners are white and married households as compared to renters. In addition to the conventionally used household socioeconomic characteristics, a number of variables describing the housing units' characteristics are included in the analysis.

For statistical estimations, equation (2) was specified to include household income, number of earners in the household, age of head, household size, race, household types, educational attainment and occupation of the head, and a set of dummy variables representing interactions between the regional location of the household and degrees of urbanization. Furthermore, household income was expressed in a logarithmic scale, and squared terms for age and family size are included to capture potential nonlinear effects of these variables.

The housing expenditure equation for home owners was specified to include similar basic household socioeconomic characteristics used for the selection equation and a set of specific characteristics for the housing units.

Table 1. Sample Means and Standard Deviations of Owner and Renter Households by Selected Characteristics, United States

Variable	Home owner		Home renter	
	Mean	Standard deviation	Mean	Standard deviation
Housing expenditure ($/qtr.)	1,930.90	1,635.36	1,299.63	908.56
Household income ($/yr.)	25,035.91	18,326.78	14,670.16	11,940.89
No of earners (persons)	1.53	1.12	1.16	0.83
Age of head (yr.)	51.37	16.30	39.81	18.30
Household size (person)	2.89	1.48	2.23	1.54
Nonwhite household (%)	11.50	31.91	18.81	39.09
Married household (%)	70.45	45.63	34.52	47.56
Single household (%)	20.30	40.24	53.62	49.88
Education of head (%):				
High school graduate	49.86	50.01	53.74	49.87
College graduate	23.51	42.41	18.30	38.68
Occupation of head (%):				
Farming	0.65	8.02	1.61	12.59
Service	5.00	21.79	11.05	31.36
Other	65.46	47.56	60.76	48.84
Region (%):				
Northeast	19.30	39.47	17.95	38.39
North Central	24.44	42.98	20.08	40.07
West	20.09	40.08	27.85	44.84
Urbanization (%):				
Population size > 4 million (UBN1)	12.76	33.37	14.73	35.45
1.25 mil. ≤ Pop. size < 4 mil. (UBN2)	31.70	46.54	36.02	48.02
Population size < 1.25 million (UBN3)	42.49	49.44	42.46	49.44
Rural	13.05	33.69	6.79	25.16
Owner without mortgage (%)	38.00	48.55	--	--
Housing characteristics (%):				
Public housing	0.40	6.28	4.78	21.33
Single family structure	85.30	35.42	27.73	44.78
Multi-unit structure	5.72	23.22	2.13	14.44
Age of building < 5 years	5.82	23.42	5.01	21.82
5 years ≤ Age of building ≤ 10 years	10.86	31.11	5.35	22.51
10 years < Age of building ≤ 20 years	19.45	39.59	12.89	33.52
Swimming pool/tennis court	7.40	26.19	14.96	35.68
Major fuel use - gas	55.07	49.75	46.09	49.86
Major fuel use - electricity	23.33	42.30	27.79	44.81
No. of rooms excluding bath (no.)	6.18	1.75	4.29	1.63
No. of observations	2782		1738	

Source: BLS, 1984-85 Consumer Expenditure Interview Survey.

Specifically, household income was represented by four income levels to test if income effects differ at various income levels. Individual region and urbanization dummy variables were used instead of the interaction terms. Furthermore, the housing characteristics were specified to include number of rooms in the unit and a set of dummy variables. The dummy variables represent housing owned without mortgage, public housing, type of structures, age classifications of the building, swimming pool or tennis court, and major source of fuels used for air conditioning, heating, hot water and cooking. For home renters, the housing expenditure equation was similarly specified except for the variable representing mortgage status.

Results and Discussion

Probit estimates of the tenure status selection equation are presented in Table 2. With few exceptions, most estimated coefficients are statistically significantly different from zero at less than the .01 significance level. Households with higher income, more earners, older head and larger size are more likely to own than rent a home. Married households and heads with high school or college education are more likely to own a home as compared to other types of household and heads with less education. Nonwhite households are less likely to own a home than white households. Household heads whose occupation are classified as professional or managerial are most likely to own a home than heads in other occupations. Furthermore, households located in rural areas are most likely to own a home than any households in urban areas and larger population centers. The overall significance of the estimated equation is indicated by the likelihood ratio test and a pseudo-R^2 measure for goodness of fit. To evaluate the marginal effect of an independent variable on housing tenure status, the estimated marginal probability associated with the significant variables are presented in Table 2.

Table 2. Maximum Likelihood Estimates for Housing Tenure Status Choice Equation

Variable	Estimated coefficient	Standard error	Marginal probability[a]
Constant	-5.115		
Log-household income	.139**	.022	.003[b]
No. of earners	.167**	.033	.066
Age of head	.113**	.008	.016[c]
Age of head squared	-.765E-3**	.803E-4	--
Household size	.355**	.089	.059[c]
Household size squared	-.039**	.896E-2	--
Nonwhite household	-.295**	.064	-.117
Married household	.445**	.073	.176
Single household	-.077	.099	
Education of head:			
High school	.294**	.057	.116
College	.436**	.075	.173
Occupation of head:			
Farming	-.574*	.227	-.227
Service	-.293**	.096	-.116
Other	-.035	.057	
Region and urbanization:			
Northeast x UBN1	-.679**	.109	-.268
Northeast x UBN2	-.329*	.152	-.130
Northeast x UBN3	-.339**	.101	-.134
North Central x UBN1	-.301**	.104	-.119
North Central x UBN2	-.309**	.099	-.122
North Central x UBN3	-.228	.133	
South x UBN1	-.606**	.096	-.240
South x UBN2	-.417**	.091	-.165
West x UBN1	-.696**	.138	-.275
West x UBN2	-.550**	.102	-.217
West x UBN3	-.505**	.098	-.200
-2xLog-likelihood ratio	1657.6		
Chi-squared (26,.01)	45.642		
Pseudo-R^2	.417		

a. Marginal probability is defined as $\hat{\tau}\,\hat{\phi}$, where $\hat{\tau}$ is the estimated probit coefficient and $\hat{\phi}$ is the standard normal density function evaluated at the sample means of the independent variables.
b. Marginal probability is evaluated for a $1,000-increase in annual after tax household income.
c. Includes the effect of square term in the computation of marginal probability.
* Indicates the computed t-ratio is at least at the 0.05 significance level.
** Inidcates the computed t-ratio is at less than the 0.01 significance level.

Results of estimating housing expenditure equations (7) and (8) for owner-and renter-occupant households are reported in Table 3. Most variables included in the equations have the expected signs and are statistically significant in explaining variations in housing expenditures among sample households. Income was not very important in explaining housing expenditure variations among home owners whose annual after tax income is below $40,000, however, the income variable becomes quite significant for home renter with annual income equal to or greater than $20,000. The estimated coefficients indicate that the effect of income on housing expenditures is progressively greater as household income increases.

Age of household heads was shown to have a negative effect on housing expenditures for both home owners and renters. This is expected since older households usually have smaller mortgage payments and smaller family size, generally requiring less housing. While family size has a highly significant impact in determining the probability of owning or renting a home, the variable has no significant effect in the owner equation and is only significant at about the .10 significance level in the renter equation. Nonwhite households were estimated to spend less on housing accommodations than white households. Lee and Trost suggest that black or nonwhite households may be constrained to low-quality neighborhoods and, hence, have a stronger preference for other goods. While significant regional differences in housing expenditures existed among home renters, only home owners in the West region spent a greater amount on housing accommodations than those residing in the South. Households also tend to spend more on housing as size of the urban population increases. Among the housing characteristics, housing expenditures are generally higher for newer buildings than older buildings and lower for multi-unit structures than for other types of building structures.

Table 3. Weighted Least Squares Estimates of Housing Expenditures Equation for Home Owner and Renter by Selected Characteristics, United States.

Variable	Home owner		Home renter	
	Estimated coefficient	Standard error	Estimated coefficient	Standard error
Constant	843.941		394.780	
Log-household income < $10,000	58.195	43.08	15.499	29.33
$10,000 ≤ Log-household income < $20,000	36.992	38.08	37.425	26.35
$20,000 ≤ Log-household income < $40,000	59.633	35.93	72.573**	25.13
Log-household income ≥ $40,000	123.635**	34.52	129.509**	25.28
Age of head	-10.476**	3.18	-7.245**	1.943
Household size	-60.940	82.02	71.512	44.27
Household size squared	3.824	9.53	-2.734	5.121
Nonwhite household	-168.996*	87.89	-13.018	52.23
Married household	27.367	81.98	-92.796	57.41
Region:				
Northeast	-7.445	90.24	-130.469*	63.63
North Central	8.102	82.20	-155.930**	57.04
West	365.908**	83.48	142.014**	51.76
Urbanization:				
UBN1	371.506**	83.48	157.753**	42.16
UBN2	362.192**	88.56	330.376**	59.39
Rural	-107.238	101.20	-332.469**	82.94
Owner without mortgage	-445.743**	69.75		
Public housing	-26.546	412.90	-381.762**	90.25
Single family structure	-181.992	98.21	109.910*	48.90
Multi-unit structure	-616.405**	146.50	-53.912	130.50
Age of building ≤ 5 years	986.156**	120.30	359.658**	86.55
5 years ≤ age of building ≤ 10 years	451.369**	92.39	286.035**	79.17
10 years < age of building ≤ 20 years	224.203**	71.21	108.816*	55.29
Swimming pool/tennis court	279.578**	101.90	176.218**	58.25
Major fuel use - gas	-77.050	70.12	-15.065	45.37
Major fuel use - electricity	-33.259	84.54	-69.144	53.68
No. of rooms excluding bath	200.040**	16.72	46.828**	13.21
W_o	270.375	164.70		
W_r			537.308**	87.20
$\bar{R}^2$	.313		.395	
F-statistic	47.967		44.632	

Note: The reported adjusted R-square, $\bar{R}^2$, and F-statistic are based on the ordinary least squares results.

* Indicates the computed t-ratio is at least at the 0.05 significance level.

** Indicates the computed t-ratio is at less than the 0.01 significance level.

The estimated coefficients for selectivity bias variables, W_o and W_r, suggest evidence of self-selectivity bias for owners and renters equations. These coefficients are positive and statistically significant, indicating a positive correlation between disturbances of the selection equation and disturbance terms of both expenditure equations. The statistical significance implies the existence of simultaneity between choice of tenure status and level of spending on housing. Therefore, the selectivity model which accounts for this nature of simultaneity is appropriate for this study. Exclusion of these variables would result in biased coefficient estimates for the housing equations even though evidence of selectivity bias may be relatively weak statistically for one of the equations.

While there is no a priori expectation for the signs of the estimated selectivity bias coefficients, σ_{oe} and σ_{re}, Maddala suggests that σ_{re} is expected to be greater than σ_{oe} in actual practice. This appears to be true for the present study. Given that both σ_{oe} and σ_{re} are positive, these results suggest that estimated housing expenditures are downward biased for those who choose to own and upward biased for those who choose to rent if self-selectivity is not accounted for in the estimation procedure. Hence, this implies that home owners, on average, would spend less on housing had they chosen to rent, and home renters would spend more on housing had they chosen to own their homes. Using these results, the expected housing expenditures for home owners would be $1,684.65 per quarter as compared with $1,930.90 (Table 1) had they chosen to rent, and expected housing expenditures for home renters is estimated to be $1,692.21 per quarter as compared with $1,299.63 had they chosen to own their homes instead of renting.

Conclusions

Among the major findings, this study confirms the results of earlier

studies that the demand for housing should take into account joint determination of tenure status and level of spending. The empirical results indicate that the existence of simultaneity problem is statistically significant based on the observed sample data.

Important socioeconomic characteristics affecting housing tenure were identified; namely, income, age of head, family size, marital status, and educational level, among others. Income had a more important effect on housing expenditures of renters than for owners at a lower household income levels. Race of the household head had a significant effect on variations in housing expenditures for owners but not for renters, suggesting that race may be a more important factor in owner-occupant than in renter-occupant housing.

Once tenure status is selected, family size had no significant impacts on housing expenditures. Similarly, married couples were most likely to own their own homes than were other household types; however, married households did not spend more or less than other types of households on either owned or rented accommodations.

The discussion and analysis of selectivity effects revealed that although correction for self-selectivity bias is imperative for obtaining unbiased coefficient estimates, meaningful interpretation of estimated selectivity effects is of equal importance in assessing empirical results. This aspect of model evaluations has largely been neglected and ignored in the literature.

The analysis reveals deficiencies in previous studies which are primarily concerned with the correction and testing for occurrence of selectivity bias in the estimated models. The advantages of employing selectivity models are otherwise not fully realized if the model is simply tested for existence of selection bias without revealing and exploring implications of implicit selection effects.

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