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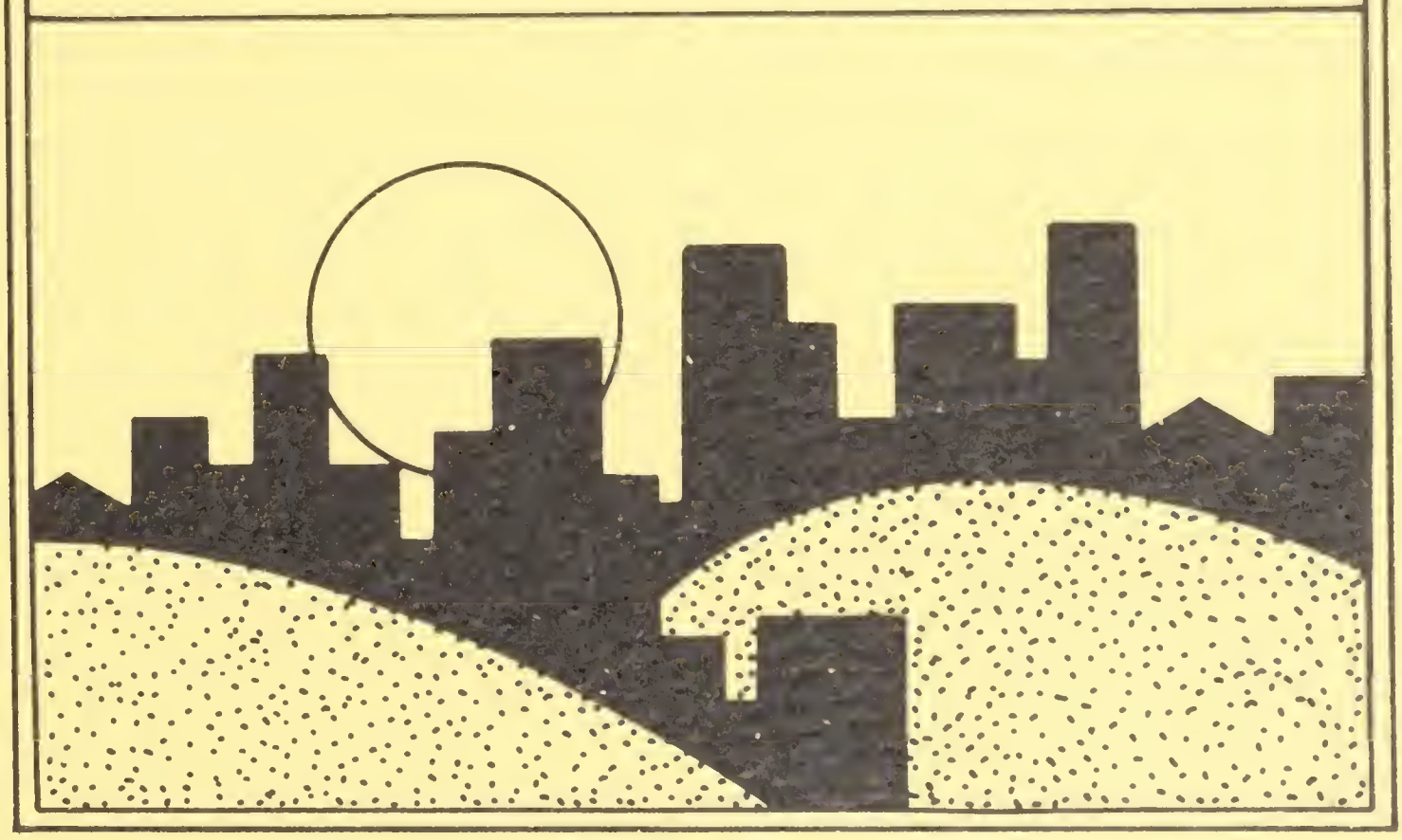

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Abstract

This paper reports the results of an econometric analysis of the choice between home owning and renting in Australia. Particular attention is given to assessing the significance of the user cost of owner-occupied housing for tenure decisions. Using cross-sectional data from a 1991 housing survey of Sydney and Melbourne, this study shows that including user costs in the tenure choice model results in a substantial improvement in goodness-of-fit. The paper concludes with suggestions for possible applications of the model.

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A Model of Housing Tenure Choice in Australia

Steven C. Bourassa

Introduction

This paper reports the results of an econometric analysis of housing tenure choice in Australia. The paper has several aims: (a) to determine the relative importance of the various economic and demographic determinants of the probability of homeownership in Australia; (b) to provide evidence relevant to the question whether Goodman (1988) incorrectly omits from his tenure choice model a measure of the user cost of owner-occupied housing; and (c) to serve as a basis for further studies of housing tenure choice and demand in Australia as well as possible comparative studies of ownership rates in Australia, the United States, and elsewhere.

Estimating the probability of ownership

Modeling the tenure choice decision

Theory suggests that a household's tenure choice decision is a function of household income, the relative costs of owning and renting, and demographic variables such as age and household size. The tenure choice decision is therefore modeled as a function of economic and demographic variables:

$$\text{Prob(own)} = f(y_j, o_{jm}/r_m, \mathbf{d}_j) \qquad (1)$$

where y_j is household j's income, o_{jm} is the household's periodic cost of owning a dwelling in housing market m, r_m is the periodic cost of renting a dwelling in that market, and $\mathbf{d}_j$ is a vector of demographic characteristics of the household. Household income may be divided into permanent and transitory components, y_{jp} and y_{jt}, because these are likely to have different effects on the tenure decision. The annual cost of owning a dwelling, o_{jm}, is the household's user cost, u_j, multiplied by the market price, p_m. The user cost takes into account the effects of taxes, interest rates, inflation,

depreciation, and maintenance expenses on the cost of owner-occupied housing.

Goodman (1988) specifies a somewhat different tenure choice model:

$$\text{Prob(own)} = g(y_j, p_m/r_m, p_j/r_j, \mathbf{d}_j) \qquad (2)$$

where p_j and r_j are the value and rent of the individual dwelling occupied by each household. The model omits the household's user cost, but includes a variable, p_j/r_j, that purports to measure expectations about capital gains, which are one component of the user cost. Goodman argues that, given the market price/rent ratio, a high individual price/rent ratio suggests high capital gains expectations. He further argues that this measure should be positively related to the probability of ownership. His empirical results seem to support this hypothesis, as do the more recent results obtained by Wachter and Megbolugbe (1992). The individual price/rent ratio is endogenous, however, and should not be included in the model. Given a decision to own, households will likely choose houses that are expected to offer high capital gains over those expected to yield low gains, but it is incorrect to model the tenure choice decision as a function of a characteristic of the individual dwelling that is subsequently purchased or rented.

The present paper compares the explanatory power of tenure choice models that both exclude and include measures of user costs. The models are estimated with cross-sectional data from the 1991 Housing and Locational Choice Survey (HALCS).[1] Sample means for the variables employed in this study are reported in Table 1.[2] Because survey data are available only for Sydney and Melbourne, the results of this study are not necessarily

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[1] A logit analysis of choice of dwelling type using the HALCS data is reported in Industry Commission (1993), Appendix B.

[2] Although there were 8,530 observations in the HALCS sample, only 7,544 cases had sufficiently complete responses to be usable in the present study.

Table 1. Sample means: owners, renters, and pooled sample

	Owners	Renters	Pooled sample
n	5396	2148	7544
%	71.5	28.5	100.0
Income variables			
Household income	35199	25919	32557
Permanent income	31550	27000	30255
Transitory income	3649	-1081	2302
Price variables			
Market price/rent ratio (a)	17.96	18.11	18.00
Relative cost ratio	1.948	2.299	2.048
Demographic variables			
Head's age	51.6	38.5	47.9
Marital status:			
Married	0.747	0.470	0.668
Never married	0.067	0.303	0.134
Divorced/separated	0.069	0.154	0.093
Widowed	0.117	0.073	0.105
Female head	0.238	0.350	0.270
Household size	2.93	2.67	2.86
Number of dependent children	0.82	0.73	0.79
Security of tenure (b)	0.466	0.098	0.361
Country or region of birth:			
Australia	0.641	0.579	0.623
New Zealand	0.012	0.043	0.021
United Kingdom/Ireland	0.089	0.088	0.089
Southern Europe (c)	0.091	0.021	0.071
Other Europe	0.078	0.052	0.070
South East Asia	0.022	0.071	0.036
Far East Asia	0.009	0.024	0.013
Indian Sub-Continent	0.011	0.018	0.013
Middle East	0.026	0.038	0.030
Other countries (d)	0.021	0.066	0.034

Notes:

(a) Price/rent ratios are based on annual rents.

(b) 1 if household identified security/insecurity of tenure as primary advantage/disadvantage of current tenure status; 0 otherwise.

(c) Includes Italy, Greece, and Yugoslavia.

(d) All countries not included in the other categories.

representative of the total Australian population.[3] However, approximately 39 per cent of the total population lived in the two metropolitan areas at the 1991 census. The ownership rate in the sample, 71.5 per cent, is higher than the 67.3 per cent national figure found in the 1991 census.[4] On the other hand, average household income as reported in the HALCS data is much lower than that reported in the 1990 ABS survey.[5] These observations suggest that particular care should be taken in interpreting the sample statistics.

A series of models were estimated:

$$\text{Model 1: } \text{Prob(own)} = \Gamma_1(y_j, p_m/r_m, \mathbf{d}_j) \quad (3)$$

$$\text{Model 2: } \text{Prob(own)} = \Gamma_2(y_{pj}, y_{tj}, p_m/r_m, \mathbf{d}_j) \quad (4)$$

$$\text{Model 3: } \text{Prob(own)} = \Gamma_3(y_{pj}, y_{tj}, o_{jm}/r_m, \mathbf{d}_j) \quad (5)$$

Model 2 simply tests the proposition that separate measures of permanent and transitory income explain more than the total household income variable in Model 1.[6] Model 3 multiplies the market price/rent ratio by the household's user cost for owner-occupied housing. In each model, the vector of demographic variables includes the household head's age, marital status, sex, and country or region of birth, household size, and level of concern, as expressed in the survey, about security of tenure. Marital status is captured by three dummy variables: never married, divorced or separated, and widow or widower; the default variable is married. In view of the high rates of immigration into Australia, country or region of birth is specified in some

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[3]The Australian Bureau of Statistics conducted surveys in Adelaide and Canberra, but is not planning to release the data.

[4]The rental sector in Australia is primarily private, with only about 6 percent of all dwellings owned publicly.

[5]It is not surprising that income was systematically under-reported in the HALCS, because only one question was asked about income. In contrast, the ABS survey asked numerous detailed questions.

[6]Incomes were adjusted to reflect the relative cost of living in Sydney and Melbourne (virtually all of the difference is due to the relative cost of housing).

detail, using 10 dummy variables (the default is Australia). All of the estimation results are shown in Table 2, which reports the marginal probabilities ($\partial P/\partial x$, where P is the probability of ownership and x refers to the explanatory variables) rather than the logit coefficients.

Permanent and transitory income

Goodman (1988) observes that it is likely that the permanent and transitory components of household income affect housing decisions, including tenure choice decisions, in different ways. Total household income may reflect temporary shocks (both positive and negative) that do not have as great an effect on tenure choice as expected permanent income.[7] Thus, the marginal probability associated with permanent income should be greater than that for transitory income. In Goodman's model, estimates of permanent income are obtained from separate owners' and renters' income regressions. Separating owners and renters in this way might introduce selection bias from current tenure status back to the income estimation: owners may work more because they decided to be owners. In other words, separate income regressions probably make the permanent and transitory income estimates endogenous. For this reason, owners and renters are pooled in the regression results presented in Table 3. The permanent income equation incorporates various aspects of human capital and demographic factors that would be expected to explain permanent income.[8] The equation was estimated using a transformed

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[7]In a dynamic model, positive transitory income would be likely to help households to overcome downpayment constraints (Dynarski and Sheffrin 1985).

[8]Ideally, one would want to estimate permanent income from panel data rather than a single year's income (*e.g.*, as in Henderson and Ioannides [1987]), but the HALCS data do not allow for this. Zorn's (1988) method could possibly be applied, although it is not clear that the result would be worth the additional effort, particularly in the absence of information about assets. It should also be noted that respondents were reponsible for nominating the household head, and approximately 10 percent of married couples chose the wife. The

Table 2. Tenure choice logit results (a)

	Model 1	Model 2	Model 3
Unrestricted log likelihood (ln L)	-3016	-3003	-2225
Restricted log likelihood (ln Lr)	-4507	-4507	-4507
Chi-square (-2[ln L - ln Lr])	2981	3006	4564
Significance level	0.00000	0.00000	0.00000
Prediction error rate (b)	0.181	0.180	0.124
Constant	-0.35002	-0.47866	1.3264
	-2.376	*-2.951*	*5.309*
Income variables			
Household income	4.8146E-06		
	6.100		
Permanent income		7.0696E-06	-2.5735E-06
		4.924	*-1.303*
Transitory income		3.9976E-06	5.5745E-06
		4.501	*4.643*
Price and user cost variables			
Market price/rent ratio	-0.0090875	-0.0078549	
	-1.306	*-1.124*	
Relative cost ratio			-0.67033
			-7.786
Demographic variables			
Head's age	0.010217	0.010901	0.0065679
	8.990	*9.155*	*4.231*
Marital status: (c)			
Never married	-0.12941	-92447	-0.29512
	-2.893	*-1.898*	*-4.044*
Divorced/separated	-0.12801	-0.094153	-0.29096
	-2.587	*-1.801*	*-3.604*
Widowed	-0.082143	-0.046077	-0.19436
	-1.359	*-0.733*	*-2.071*
Female head	-0.011389	-0.0045452	0.012405
	-0.325	*-0.129*	*0.250*
Household size	0.0068723	0.0021915	0.0024126
	0.370	*0.118*	*0.091*
Number of dependent children	0.026156	0.028481	0.29352
	1.196	*1.303*	*0.964*
Concern for security of tenure	0.29823	0.30017	0.23922
	8.055	*8.104*	*4.785*
Country or region of birth: (d)			
New Zealand	-0.17924	-0.18078	-0.13964
	-2.152	*-2.165*	*-1.223*
United Kingdom/Ireland	-0.074905	-0.076975	-0.075125
	-1.637	*-1.681*	*-1.217*
Southern Europe	0.15934	0.18332	0.093464
	2.213	*2.520*	*0.937*
Other Europe	0.0010127	0.017464	-0.0052516
	0.019	*0.321*	*-0.069*
South East Asia	-0.13402	-0.12089	-0.10283
	-2.114	*-1.895*	*-1.208*

characteristics of the self-nominated head were used for the income regression.

Table 2. Tenure choice logit results (continued)

	Model 1	Model 2	Model 3
Country or region of birth (continued):			
Far East Asia	-0.14102	-0.13554	-0.10142
	-1.331	*-1.280*	*-0.684*
Indian Sub-Continent	-0.11047	-0.10042	-0.11997
	-1.067	*-0.967*	*-0.860*
Middle East	-0.055256	-0.034888	-0.016210
	-0.777	*-0.487*	*-0.158*
Other countries	-0.22589	-0.21196	-0.17067
	-3.369	*-3.143*	*-1.847*

Notes:

(a) Dependent variable in each model is the probability of ownership; the table gives the marginal probabilities, $\partial P/\partial x$, where P refers to the probability of ownership; t-statistics are in italics.

(b) Error rate refers to the proportion of households assigned to the incorrect tenure (based on application of the 0.5 rule to fitted values).

(c) The default variable is married (including de facto).

(d) The default variable is Australia.

dependent variable, with a Box-Cox parameter of $\lambda = 0.5$ (a square root transformation), as recommended by Goodman.[9] The explanatory power of this equation compares favorably to previous results. Most of the variables are statistically significant and all have the expected signs.

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[9]For a dependent variable, $y > 0$, Box and Cox (1964) proposed the following transformation: $z(\lambda) = (y^{\lambda} - 1)/\lambda$ if $\lambda \neq 0$ or $\log y$ if $\lambda = 0$. This transformation is attractive because it allows one to systematically test a continuous range of possible transformations, from linear through square root to logarithmic. The Box-Cox parameter used by Goodman was found to give the best fit for Australia.

Table 3. Permanent income regression (a)

R-squared	0.4923	
Adjusted R-squared	0.4912	
n	7593	
λ	0.5	
Independent variables	Coefficient	*t-statistic*
Constant	109.381	*19.657*
Education of household head (b)		
Some secondary	8.868	*2.064*
Completed secondary	36.565	*7.091*
Trade certificate or diploma	43.981	*10.346*
Bachelor's degree	103.732	*20.926*
Post-graduate qualification	130.219	*13.908*
Age of household head (c)		
15 to 24	18.191	*2.674*
25 to 29	65.641	*11.302*
30 to 34	81.485	*14.818*
35 to 44	92.174	*18.340*
45 to 54	82.671	*15.857*
55 to 64	39.742	*7.663*
65 to 74	3.703	*0.718*
Country of birth of head (d)		
Australia/New Zealand	39.658	*14.969*
United Kingdom/Ireland	41.527	*9.502*
Other variables		
Married head	87.899	*29.780*
Male head	19.699	*6.480*
Working spouse	68.983	*27.108*

Notes:
(a) Dependent variable is a Box-Cox transformation of annual household income (see text).
(b) Default variable is no secondary education.
(c) Default variable is age 75 and over.
(d) Default variable is all other countries.

The predicted values from the permanent income equation were re-transformed and then used as estimates of permanent income in the tenure choice equation. Transitory income was defined as the difference between actual household income and permanent income. This residual difference has a

positive mean due to the non-linear transformation of the dependent variable. Replacing actual household income with these two components of income yields the tenure choice results shown under Model 2 in Table 2. As the table shows, the marginal probability associated with permanent income is greater than that of household income. As expected, transitory income has a positive effect on the probability of ownership, but a smaller marginal probability than permanent income.

Relative costs of owning and renting

The market price/rent ratios for Sydney and Melbourne are taken from Bourassa and Hendershott (1993). The price/rent ratios in the two cities were 19.9 and 16.1, respectively, reflecting the relatively steeper increase in real house prices in Sydney in the late 1980s. Of course, prices and rents are not directly comparable, as the price of a house does not reflect the true cost to the occupier. In particular, the price of houses does not take into account the effects of taxation and inflation. User costs do measure these factors and therefore they provide a means for translating house prices into periodic costs that can be compared directly with rents.

The neglect of user costs in a model of tenure choice in the United States is particularly perplexing, as housing analysts there have for some time emphasized the importance of the tax advantages of ownership in the tenure choice decision (Laidler 1969). Moreover, numerous US studies of tenure choice pre-dating Goodman's 1988 paper include measures of user costs (Hendershott and Shilling 1982; Henderson and Ioannides 1987; Rosen 1979; Rosen and Rosen 1980; Rosen, Rosen and Holtz-Eakin 1984). Tax effects are also important in Australia for a number of reasons. A progressive tax schedule means that higher income households receive greater advantages from the non-taxation of imputed rent from owner-occupied houses. Also, because mortgage interest is not deductible, user costs vary with the household's loan-

to-value ratio (Bourassa and Hendershott 1992). Finally, because personal income tax returns are filed by individuals only, while houses are typically owned by couples, the composition of a household and the distribution of income within that household can have a significant impact on the user cost it faces.

The calculation of user costs in this paper is based largely on the method outlined by Haurin, Hendershott, and Kim (forthcoming), with appropriate modifications for the Australian context. Tenure choice user costs in Australia are defined as:

$$u_{jm} = (1 - \tau_{jm})(1 - v_j)i + v_j i - \pi + \delta + \rho_m, \qquad (7)$$

where: u_{jm} is the user cost faced by household j in locality (or market) m; τ_{jm} is the household's "permanent" tenure choice tax rate; v_j is a loan-to-value ratio; i is the pre-tax financing rate; π is the expected rate of house price inflation; δ is the rate of depreciation and maintenance costs; and ρ_m is the property tax rate.[10] The loan-to-value ratio is the present value of the household's expected annual loan-to-value ratios over the estimated remaining holding period. Because HALCS does not include information on the size of purchasing households' mortgages, it was necessary to predict loan-to-value ratios for both owners and renters using an equation estimated from another data set (the 1990 Survey of Income and Housing Costs and Amenities). Details of this estimation and the calculation of present-value-equivalent loan-to-value ratios are reported in the Appendix.

Following Hendershott and Slemrod (1983), the appropriate tax rate for a tenure choice user cost is not the marginal rate faced by the household, but rather the average rate at which tax deductible housing costs are expected to be

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[10]Note that property taxes—like mortgage interest payments—are not deductible in Australia.

deductible (imputed rent from owner-occupied housing is in effect "deductible" because it is not taxed):

$$\tau_{jm} = (T_{Rjm} - T_{Ojm})/\{p_{jm}[(1 - v_j)i]\}. \quad (8)$$

This tax rate is an expected or "permanent" rate because it is based on permanent income, rather than actual income, and on the household's present-value-equivalent loan-to-value ratio, rather than its current ratio. Here, T_{Rjm} is the income tax household j residing in market m would pay if it rented, and T_{Ojm} is the income tax it would pay if it owned a dwelling of value p_{jm}. For households headed by single persons, T_{Rjm} and T_{Ojm} are based on the income tax and Medicare (national health insurance) levy that would be paid by the household head only.[11] For married or de facto couple households, the relevant amounts are the sums of the taxes that would be paid by the head and spouse, and adjustments to income to convert owners' incomes to renters' incomes and vice versa are split evenly between the spouses.[12] For renting households, T_{Rjm} is simply the sum of the income tax and Medicare levy the household would pay given estimated permanent income and number of dependents, and T_{Ojm} is calculated by subtracting $p_{jm}(1 - v_j)i$ from income. The latter is an estimate of the amount by which taxable income would be reduced owing to the non-taxable equity invested in the house rather than taxable assets. For owning households, the calculation of T_{Rjm} requires that $p_{jm}(1 - v_{cj})i$ be added to permanent income, where v_{cj} refers to the estimated

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[11]The income data in the HALCS are not precise enough to permit the calculation of rebates (tax credits); nor is it possible to accurately estimate the amount of deductions taken by each household.

[12]For the case of married couples, it is not obvious how transitory (and permanent) income should be allocated to the head and spouse. One option would be to assume that all or most of the couple's transitory income is earned by the female member, while another option would be to allocate transitory income to the head and spouse in proportion to actual income. A compromise between these extremes was adopted: half of transitory income was allocated to each member of the couple.

current loan-to-value ratio. Then T_{Ojm} is based on income as a renter less $p_{jm}(1 - v_j)i$, where v_j is defined as before (*i.e.*, the present-value-equivalent loan-to-value ratio). The dwelling value, p_{jm}, is a predicted value which depends on the household's income and city of residence, but not on current tenure status or the value of the dwelling currently occupied (details of the estimation are in the Appendix).

Incorporating the user cost in the relative costs variable (defined as $u_{jm}p_m/r_m$) gives the results shown under Model 3 in Table 2. The marginal probability of the relative cost variable has the expected sign and is significant. The Chi-square statistic is substantially greater than that for Model 2, and the prediction error rate has dropped substantially. Notably, the marginal probability associated with permanent income is now negative, but not significant. In the absence of a user cost variable, one would expect permanent income to be positively related to the probability of ownership due to the fact that user costs and loan-to-value ratios decline with income. However, given the user cost variable, which is based on permanent income, there is no longer a theoretical basis for expecting a positive relationship between permanent income and owning. Thus the negative relationship identified here is not anomalous, and reflects the residual effect of permanent income once user costs are accounted for. It is likely that the residual effect of income reflects the tendency of higher income households to live in inner locations dominated by rental housing. Transitory income continues to be positively and significantly related to ownership, as expected.

Demographic variables

Although the primary focus of this paper is on the economic factors affecting housing tenure choices, the demographic variables merit some discussion. The vector of demographic variables is specified more fully than in previous

studies. Goodman (1988), for example, includes only household size and the race, age, marital status, and sex of the household head. Except for race, which is not identified in the HALCS data set, the present study includes these variables plus: the number of dependent children in the household (defined according to 1991 income taxation rules); a dummy for those households identifying security as the primary advantage/disadvantage of their current tenure; and a set of dummy variables for country or region of birth of the household head. Also, marital status is specified by three dummy variables rather than just one.

The results show that specifying marital status with one married/single dummy variable ignores important differences among the subcategories of single persons, particularly the differences between widows/widowers and other singles. Although all categories of single-person households are significantly less likely to own than married couples, the marginal probability associated with widowed persons is small relative to those for the other two groups. In other words, the tenure choices of widowed persons are more like those of married couples. This is not surprising in view of the fact that widows and widowers often continue to occupy a house that was purchased when their spouses were alive.

Numerous studies, including Burgess and Skeltys (1992) and Troy(1991), have identified desire for security of tenure as a motivation for homeownership. As Table 1 shows, 47 per cent of owners in the sample identified security of tenure as the primary advantage of homeownership, while only 10 per cent of renters identified insecurity of tenure as the primary disadvantage of renting. Thus it is not surprising that concern for security of tenure is a positive and significant factor in tenure choice.

Aside from the marital status dummies and concern for security of tenure, age is the only significant demographic variable. As expected, the marginal probability associated with age is positive. The marginal probabilities for household size, number of dependent children, and the dummy for female heads are all positive, but not significant. It is notable, however, that number of children has a greater effect on the probability of ownership than does household size.

Conclusions

This paper has developed and applied a model of housing tenure choice in Australia. The model improves upon Goodman's tenure choice model by incorporating the household's tenure choice user cost as part of the variable measuring the relative cost of owning and renting. This modification results in a substantial improvement in goodness-of-fit and a corresponding reduction in the prediction error rate. The importance of the tenure choice user cost in the Australian model clearly indicates that future work employing US data (or data from other countries) should also test for the significance of user costs. Variations in tax rules across countries and over time suggest that user costs may be significant only in some places and at some times. Thus the finding that user costs were significant determinants of the probability of ownership in Australia in 1991 does not necessarily imply that they would have been significant in the US in that year. In fact, it is quite possible that they would be less important due to the small range of owner-occupier user costs in the US following the 1986 Tax Reform Act (Bourassa and Hendershott 1992). Nevertheless, the relevance of user costs to tenure choice is an empirical issue that should not be decided *a priori*.

Another implication of this research is that policy makers concerned with homeownership rates in Australia should pay attention to user costs. Changes

in factors affecting user costs—particularly changes in the real interest rate and income tax schedules—are likely to have significant effects on households' tenure choice decisions. For example, the reduction in marginal tax rates that has been proposed by the Australian government would result in higher user costs and, possibly, lower homeownership rates. On the other hand, reductions in the real interest rate from its current high level would have the opposite effect.

Appendix: Estimating Loan-to-Value Ratios and House Prices

Loan-to-value ratios were predicted for households in the HALCS data set (both owners and renters) using results derived from the 1990 Income and Housing Costs and Amenities Survey. For owning/purchasing households in Sydney and Melbourne, the current loan-to-value ratio, v_c, was regressed on the log of household income and dummy variables for all of the age groups defined in the 1990 Survey, with the exception of ages 60 and older (this older age group served as the default variable). The results were (with t-statistics in parentheses):

$$v_c = \underset{(-1.658)}{-0.053} + \underset{(1.930)}{0.0063} \ln y + \underset{(15.497)}{0.482}\, AGE_{15\text{-}24} + \underset{(25.827)}{0.346}\, AGE_{25\text{-}29} + \underset{(24.129)}{0.276}\, AGE_{30\text{-}34}$$
$$+ \underset{(19.924)}{0.207}\, AGE_{35\text{-}39} + \underset{(11.316)}{0.117}\, AGE_{40\text{-}44} + \underset{(6.730)}{0.078}\, AGE_{45\text{-}49} + \underset{(3.594)}{0.043}\, AGE_{50\text{-}54}$$
$$+ \underset{(1.781)}{0.022}\, AGE_{55\text{-}59} \qquad (9)$$

Survival analysis was used to estimate holding periods for these age groups. The HALCS data identify households planning to move within 12 months and include duration of stay (years) at the current dwelling. The survival analysis was conducted by adding 0.5 to the duration of stay and identifying the stayers' durations as censored. This yielded an estimate of the total holding period for each household. Subtracting duration of stay from the total estimated holding period produced an estimate of the remaining holding period (i.e. the holding period from the date of the survey). These values were averaged for each age group with non-zero loan-to-value ratios. Average duration of stay was subtracted from 20 (the typical loan term) to obtain an estimate of the remaining term of the mortgage loan for each age group.

The present value of expected loan-to-value ratios over the remaining holding period was calculated by solving

$$\sum_{t=1}^{n} \frac{(1 - v^*)ip_t}{(1 + i)^t} = \sum_{t=1}^{n} \frac{(1 - v_t)ip_t}{(1 + i)^t} \qquad (10)$$

for v^*. Here p_t is an index of expected house prices over the remaining holding period n, and v_t is the projected declining loan-to-value ratio, given the age group averages of the current ratios predicted from equation (9) and the estimated remaining term of the mortgage loan. The resulting present

value equivalent loan-to-value ratios were regressed on the current ratios for each age group to obtain the following:

$$v^* = \underset{(-4.063)}{-0.036} + \underset{(27.628)}{1.017}\ v_c \qquad (11)$$

This equation was used to estimate v_j for each household given v_c.

House prices were estimated from the HALCS data set by regressing the log of house values (in \$1000s) provided by owning respondents on the log of household income and a dummy variable for Sydney:

$$\ln (p_{jm}/1000) = 4.012 + 0.098 \ln y + 0.305 \text{ SYDNEY}. \qquad (12)$$

House values for both owners and renters were predicted using this equation. This rather simple method of estimating house value has the virtue of avoiding any downward bias in the house values estimated for current renters. For current renters, such bias would result in underestimation of the tax advantages of owning, and overestimation of user costs and the relative costs of owning and renting.

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