Differences in the Demand for Housing by Owners and Investors

By

Hak Choi

Department of Decision Sciences

and Managerial Economics

The Chinese University of Hong Kong

Shatin, Hong Kong

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Correspondence:

Dr. Hak Choi, Department of Decision Sciences and Managerial Economics, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong, S.A.R.

Tel.: (852) 26097898; Fax: (852) 26036840; Email: hakchoi@cuhk.edu.hk

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ABSTRACT

This paper will distinguish between owner demand for housing, and that of investors. Such differentiation in demand should be viewed as an integral part of the decision to buy. A durable goods approach to homeowner demand for housing is developed, and then the traditional investment consideration is modified. An estimation using the durable goods approach reveals that demand for housing by owners is positively affected by rent, real income, and general price level; and negatively affected by the housing price and interest rate. The modified investment equation produces better estimation with correct parameters. Property price is positively related to owner demand for housing units, and negatively related to tenant demand.

1. INTRODUCTION

This paper will distinguish between owner demand for housing, and that of investors. Most previous studies using real estate models, notably Wheaton and Di Pasquale (1992), treat all owning decisions as investment decisions. In such models, all occupants are considered as tenants, even though some are actually owners. On the other hand, tenure choice studies treat households as either tenants or owners, and ignore the role of investors. Furthermore, tenure choice studies usually adopt probability models (Probit or Logit) to determine whether a household decides to rent or own (see, for example, Chou and Shih, 1995; Diamond, 1980; Linneman and Megbolugbe, 1993). This treatment is a statistical convenience, but lacks an economic foundation. Lee and Trost (1978) offer a more sensible model of tenure choice, which uses sound economic reasoning, but their concept of tenure rests on a tax consideration alone.

The present approach, in contrast, will separately consider demand by owners and investors. The former group will be analyzed with a durable goods method, while the latter will be assessed with a modified assets pricing formula. Homeowners purchase houses for their own use, while investors let the property. However, a complete model for the housing market should contain both forms of demand, and the considerations of

homeowners and investors are related. Homeowners will take into account investment factors such as interest rates, while investors will consider whether more people are likely to switch from renting to owning. Thus, it is important to consider both groups of people simultaneously.

First, a durable goods approach to homeowner demand for housing will be developed. Then, the traditional investment consideration will be modified to make it more suitable to the real estate market.

The Durable Goods Approach

We can assume the following utility function for a potential owner-purchaser of property (Deaton and Muellbauer, 1980):

$$U \ ? \ U(q_1,q_2,.q_t..,q_L,H_1,H_2,.H_t..,H_L,A_L/P_L) \qquad (1)$$

The household's utility is determined by the availability of housing stock and the quantity of other goods at every period for t = 1, 2, …, L, and the availability of the

assets for bequest purposes, A_L/P_L. The budget constraint for each period is:

$$A_t ? (1 ? i_t)A_{t?1} ? y_t ? (R_t ? M_t)H_{t?1} ? p_t q_t ? dV_t S_t \quad (2)$$

A_t is the assets value at period *t*, y_t is the real income, and $(R_t ? M_t)H_{t?1}$ is the net income from the housing units, with R_r the imputed rental payment and M_t the interest portion of the mortgage payment. The total income may then be used to purchase another housing unit, S_t, which has a value of V_t, or other goods, $p_t q_t$. The purchase of a new housing unit requires only a fraction, *d*, of the total price, because of an eventual mortgage arrangement. However, a mortgage arrangement is not compulsory. Imputed rental payment should be used, as the owner-occupier pays no rent.

This budget constraint, using backward substitution, leads to the following result (Deaton and Muellbauer, 1980:348):

$$? ?_t p_t q_t ? ? ?_t V_t^* H_t ? ?_L A_L ? W_1 \quad (3)$$

$$W_1 ? V_1(1 ? ?)H_o ? (1 ? i_1)A_o ? ? ?_t y_t \quad (4)$$

where $?_t ? 1/? ^{t}_{s?2}(1?i_s)$ is the discount factor, and

$$V_t^* ? dV_t ? \frac{1}{1?i_{t?1}}[R_{t?1} ? M_{t?1} ? d(1??)V_{t?1}] \quad (5)$$

is the user cost of the property. V_t^* is only a fraction of the actual housing price, due to the eventual mortgage arrangement. Furthermore, if the rental income derived from a property is higher than the mortgage payment, or if there is a capital gain (represented by a higher value of $V_{t?1}$ than V_t), then the user's cost of housing will be smaller.

To derive the demand function, we can maximize the utility function subject to the budget constraint. Therefore, we have the following Lagrangean equation:

$$\begin{aligned} L ? U(q_1, q_2, .q_t .., q_L, H_1, H_2, .H_t .., H_L, A_L / P_L) ? ?\{? \; ?_t p_t q_t ? ? \; ?_t V_t^* S_t \\ ? ?_L A_L ? [V_1(1??)S_0 ? (1?i_1)A_0 ? ? \; ?_t y_t]\} \end{aligned} \quad (6)$$

The consumer's choice can be a contemporaneous one between housing and non-housing products, or an inter-temporal one between housing now or housing later. For analytical convenience, the former choice is used now, and the inter-temporal choice can be tackled by interest consideration. The first-order conditions of

contemporaneous choice at time *t* are:

$$\frac{?L}{?q_t} ? \frac{?U}{?q_t} ? ??_t p_t \tag{7}$$

$$\frac{?L}{?S_t} ? \frac{?U}{?S_t} ? ??_t V_t^* \tag{8}$$

Set these conditions to zero and eliminate ?, and the following ratio is produced:

$$MRS ? \frac{p_t}{V_t^*} \tag{9}$$

Substituting equation (5) of V_t^* into equation (9), we have the following inverse demand function:

$$V_t ? \frac{1}{d} \left[\frac{p_t}{MRS_t} ? \frac{1}{1 ? i_{t?1}} [R_{t?1} ? M_{t?1} ? d(1 ? ?)V_{t?1}] \right] \tag{10}$$

Thus property price, as perceived by the owner-purchaser, is a function of the general price level, interest rate, imputed rent, mortgage payment, down payment ratio, depreciation, and future property price. A technical term in the consideration is *MRS*: the marginal rate of substitution. This ratio is proportional to H_t / q_t. For example, for

the Cobb-Douglas utility function, $MRS_t ? \frac{?}{?}\frac{H_t}{q_t}$. Thus, in the case of housing stock and higher property prices are negatively related.

Equation (10) thus provides the inverted demand function, and in general form:

$$V_t ? H_o^{?1}(P_y, Y, H_o, i_{t?1}, V_{t?1}, R_{t?1}, M) \quad (11)$$

From here a normal demand function can be derived:

$$H_o ? H_o(P_y, Y, V_t, N_o, i_{t?1}, V_{t?1}, R_{t?1}, M) \quad (12)$$

where H_o is the housing units demand by owners.

An Algebraic Example

Assume a contemporaneous Cobb-Douglas function for equation (1):

$$U ? q_t^{?} H_t^{?} \quad (13)$$

Although the utility function can be expressed in a single period, the same life-long budget constraint still applies:

$$\sum_t p_t q_t \le \sum_t V_t^* S_t + \sum_L A_L + V_1(1-\delta)S_0 + (1+i_1)A_0 - \sum_t y_t \qquad (14)$$

Maximizing (13) subject to (14) leads to:

$$\frac{\partial L}{\partial q_t} = \alpha q_t^{\alpha-1} H_t^{\beta} = \lambda p_t \qquad (15)$$

$$\frac{\partial L}{\partial S_t} = \beta q_t^{\alpha} H_t^{\beta-1} = \lambda V_t^* \qquad (16)$$

On eliminating λ we have:

$$\frac{\beta}{\alpha}\frac{H_t}{q_t} = \frac{p_t}{V_t^*} \qquad (17)$$

Using equation (5) for V*, we have

$$H_t = \frac{\partial}{\partial} \frac{p_t q_t}{\partial dV_t = \frac{1}{1 + i_{t-1}} [R_{t-1} + M_{t-1} + d(1 +)V_{t-1}]} \qquad (18)$$

Thus, housing demand by owners is a positive function of the price level of other goods, expected rental income, and expected appreciation; and a negative function of property price, interest rate and mortgage payment. Real income as represented by the quantity of other goods, q_t, also has a positive effect should on owner demand.

The Investment Approach

Most of the finance and real estate literature considers the purchase of property as purely an investment decision, with the following present value formula:

$$V = \frac{R}{i} \qquad (19)$$

This formula assumes constant annual rental value in real terms. One may expand the formula to include every future rental value, but this will not change its fundamental structure.

This investment equation reflects the average value of an investment. The actual investment price may deviate from it, and sometimes it is difficult to predict the actual price from this formula. As an investment formula we need to include, at least, the expectation element.

Many people modify this present value formula one way or the other: see, e.g. Gillingham (1983:255), or Poterba (1984:732). It shall be modified here in the following way. When demand by owners increases, property price should go up, and thus owner demand for housing units will be perceived by investors as the signal of price appreciation. On the other hand, if demand for housing units by tenants increases, then investors will perceive this as signal of price depreciation. Thus we have the following modified assets pricing formula for investor demand:

$$V ? \frac{R}{i} ? hH_o ? kH_r \qquad (20)$$

Now we have two equations for describing housing demand and property prices, equations (18) and (20), representing the demand by owners and by investors respectively.

Statistical Estimation

The Owner Demand Equation

We can use double log for the estimation of owner demand. The dependent variable is housing stock occupied by owners. Property prices (PR) and GDP (GDPR) are in real terms. GDPDEF is the GDP deflator for general price level. PRATE is the prime lending rate. The expected appreciation (or depreciation) and mortgage payment factors are not considered in this estimation. The former will be tackled in the estimation of the investment equation, while the latter should be incorporated in the interest rate variable. A time series of 16 years in quarterly format will be considered, and the data are classified into 5 size classes, so we actually have panel data. The total number of observations is 320. To account for size and seasonal factors, corresponding dummy variables are used. The following table is the double-log estimation of equation (18).

<Insert Table 1 here>

All the variables carry the expected sign. Property price has the negative effect on

housing demand, and so does interest rate. Rental value and GDP and its deflator have positive signs by estimation. Housing demand by owners is understandably very inelastic in relation to most variables, including prices. The coefficients attached to these variables, however, are very significant. The explanatory power is extremely well reflected in both R-squared and adjusted R-squared. No attempt has made to correct the autocorrelation as reflected by the D-W statistics, because this model is not dynamic.

The Traditional Investment Decision Equation

Before we estimate the modified assets pricing formula, consider the estimation of the traditional investment formula of equation (19):

<Insert Table 2 here>

This estimation is, of course, less attractive than the previous one. The fact that property prices do fluctuate a lot cannot be explained solely by rent and interest rate levels. However, we do have the proper sign on all related parameters. Property price is positively related to rental value and negatively related to interest rate, and is very

elastic to rental change. We can drop the seasonal factors because of insignificant estimation.

The Modified Investment Decision Equation

The following is the estimation for the modified investment demand of equation (20).

<Insert Table 3 here>

This equation contains more variables than that which is traditionally used, and naturally produces a better estimation. Apart from the result that most of the coefficients carry the proper sign and the elasticity is high, property price is positively related to housing unit demanded from owners, and negatively related to demand from tenants in two out of the five size classes. These two interesting classes are those of the smallest and the largest size. The coefficients attached are mostly significant and elastic. Thus, the hypothesized investment formula of equation 20 is not completely implausible.

In summary, equation (20) produces a better estimation than equation (19). Thus, the modified investment equation is better, or at least the proposition is not totally implausible.

Conclusion

This paper develops a durable goods approach to explaining the demand for housing by homeowners, and a modified understanding of the investment decision.

The durable goods estimation reveals that demand for housing by owners is positively affected by rent, real income, and the general price level; and negatively affected by the housing price and interest rate. Although these factors have low elasticity, the estimated coefficients are all very significant. The modified investment equation produces better estimation with correct parameters. Property price is positively related to housing unit demanded from owners, and negatively related to tenant demand in two out of the five size classes.

The demand for housing by owners, and the investment consideration, should be

viewed as integral parts of homeowner purchase decisions. A more complete model would also incorporate supply interaction, and this can be the subject of further research.

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Table 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.54	0.74	10.25	0.00
LOG(PR)	-0.18	0.02	-10.59	0.00
LOG(RR)	0.15	0.03	4.73	0.00
LOG(GDPR)	0.43	0.06	7.19	0.00
LOG(GDPDEF)	0.73	0.05	14.05	0.00
LOG(PRATE)	-0.06	0.01	-4.72	0.00
DUMS2	0.06	0.01	6.36	0.00
DUMS3	-1.44	0.01	-139.46	0.00
DUMS4	-2.07	0.01	-176.76	0.00
DUMS5	-2.72	0.01	-227.90	0.00
DUMQ2	-0.01	0.01	-2.01	0.04
DUMQ3	-0.04	0.01	-5.29	0.00
DUMQ4	-0.04	0.01	-5.16	0.00

R-squared	1.00
Adjusted R-squared	1.00
Durbin-Watson stat	0.12

Note: the model is stored as price5 in the workfile called prent.

Table 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.20	0.42	-7.54	0.00
LOG(RR)	2.37	0.08	29.22	0.00
LOG(PRATE)	-0.45	0.05	-8.74	0.00
DUMS2	-0.35	0.04	-8.11	0.00
DUMS3	-0.46	0.05	-10.01	0.00
DUMS4	-0.60	0.05	-12.34	0.00
DUMS5	-0.59	0.05	-11.65	0.00

R-squared	0.77
Adjusted R-squared	0.77
Durbin-Watson stat	0.37

Note: the model is stored as tinvest7 in the workfile called prent.

Table 3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.81	9.67	1.01	0.31
LOG(RR)	1.43	0.09	15.80	0.00
LOG(PRATE)	-0.18	0.05	-3.62	0.00
LOG(HO)	1.29	0.31	4.16	0.00
LOG(HR)	-1.85	1.08	-1.71	0.09
DUMS2	-46.50	11.44	-4.06	0.00
DUMS3	-49.39	11.49	-4.30	0.00
DUMS4	-41.94	12.52	-3.35	0.00
DUMS5	63.71	18.30	3.48	0.00
LOG(HO)*DUMS2	-1.94	0.41	-4.74	0.00
LOG(HO)*DUMS3	-2.25	0.41	-5.53	0.00
LOG(HO)*DUMS4	-1.74	0.43	-4.09	0.00
LOG(HO)*DUMS5	1.01	0.43	2.34	0.02
LOG(HR)*DUMS2	5.68	1.32	4.29	0.00
LOG(HR)*DUMS3	6.70	1.37	4.90	0.00
LOG(HR)*DUMS4	5.70	1.52	3.75	0.00
LOG(HR)*DUMS5	-7.96	2.24	-3.56	0.00

R-squared	0.89
Adjusted R-squared	0.87
Durbin-Watson stat	0.34

Note: the model is stored as invest4 in the workfile called prent.

Footnotes

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