Choice of Rental Housing in a Developing Economy: The Case Study of Korea*

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This study attempts to build a Korean rental housing choice model in which households choose their dwelling units using hierarchical logit analysis. The decision is viewed as a partial sequence process, beginning with the choice of rental housing tenure and finishing with a decision on the type of occupation. The study incorporates hedonic price technique into our hierarchical logit model in order to contribute an additional step in the urban spatial structure. In addition, it estimates permanent and transitory components of income through the instrumental variables method based on human capital theory. To compare our model with other models, the multinomial logit analysis is proposed.

I. Introduction

In developing countries, rapid demographic change, as well as economic growth, leads to a concentration of urban population. During the past two decades, Korea has experienced not only a high rate of economic growth but an unprecedented rate of urban population growth. This high rate of urban population growth has increased Korea's shelter needs at an accelerating pace.

Recently, rental housing construction programs have been put forth in an attempt to provide housing services in Korea. These can be viewed as a policy shift from home-ownership promotion to rental housing promotion. For this reason, a reliable study of the rental housing market is very much needed for the sound formulation of urban housing policy.

However, despite the need for such a study, few economists have

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attempted to analyze explicitly the choice of Korean rental housing. Those studies done on the Korean housing market focused on general tenure choice analysis (the choice of whether to own or rent a dwelling unit), which cannot cover all aspects of a family's housing choice in a rental housing market.

This study attempts to build a Korean rental housing choice model using a hierarchical logit analysis. To compare our hierarchical logit model with other models, the multinomial logit model is estimated. The study also incorporates hedonic price technique into our hierarchical logit model in order to contribute an additional step in the urban spatial structure. In addition, this study estimates permanent and transitory components of income through an instrumental variable method based on human capital theory (Goodman and Kawai 1982).

The rest of the study is organized as follows. Section II provides a brief description of various types of rental arrangements in Korea. Modeling with theoretical considerations are described in Section III. Section IV reports statistical results. Finally, concluding remarks are provided in Section V.

II. The Korean Rental Housing Market

A. Chonsei

One of the most important types of rental arrangement in Korea is Chonsei. Under this arrangement, a renter collects a lump sum deposit of Chonsei (usually translated as "key money") at the beginning of occupancy. The lessée then pays no monthly rent, and the deposit is fully refunded at the end of the contract period. Recently, the Rental Lease Protective Law has required that the rental contract term cover a minimum of one year. The government exempts the lessor from rental income taxation. Therefore, the imputed rent of Chonsei is roughly equivalent to the interest on the initial deposit. Since Chonsei requires a large lump sum deposit (about 30% - 99% of the house price),[1] high-income households with access to such amounts of money usually choose this type of rental arrangement.

[1]In some industrial cities, the amount of Chonsei has been reported to be more than 100 % of house price. This suggests that households in industrial cities have high mobility and an extremely high liquidity preference. Thus, the households prefer Chonsei to home-ownership because home owners face higher transaction costs (in selling and moving) than renters.

B. Monthly Rent

The other type of arrangement is monthly rent. Monthly rent falls into two categories; monthly rent with security deposit and monthly rent without security deposit (the so-called pure monthly rent), which is similar to western types of lease agreements. In monthly rent with security deposit, the renter makes a deposit at the beginning of occupancy which is refunded when he moves out and also pays monthly rent. If a renter is unable to pay the monthly fee, the amount is automatically deducted from the deposit. Therefore, the rent paid by the renter is the imputed monthly value of the initial deposit plus the monthly payment.[2] This form does not require as large a deposit as Chonsei since households have to pay a monthly fee in addition. The contract period of this type of rental arrangement is the same as Chonsei, usually one year.

Pure monthly rent is equivalent to western contracts. Like the above rental housing arrangements, this form uses a one year contract period. However, in practice the contract period is sometimes only for one or two months. Since pure monthly rent does not require any deposit, it is generally preferable for poor households or short-term residents. Since the late 1980s, however, this form has been largely replaced by the monthly rent with security deposit payment scheme.

Before proceeding, another rental housing form should be mentioned here. Until the early 1980s, Korea had pure Declining Chonsei, which is a variant of Chonsei. With this type of lease agreement the renter makes a one-time deposit from which a certain amount is deducted every month. The actual amount of monthly rent equals the monthly deduction plus the imputed monthly value of the deposit balance. This type of rental arrangement also has been superseded by monthly rent with security deposit since the late 1980s. A survey conducted by the Korea National Housing Corporation in 1986 showed that not one respondent used this type of Declining Chonsei. Although the name Declining Chonsei is still popular in Korea, its payment scheme is similar to that of the monthly rent with security deposit.

[2]For monthly rent with security deposit, the imputed rent is equal to the monthly rent to which is added the security deposit multiplied by the monthly curb rate. According to the Bank of Korea, when this survey was conducted, the interest rate of private liability was 2 % per month.

In these rental housing arrangements, tenants can choose either a whole unit or a partial unit. In the case of whole unit rent, the renter can use all housing facilities and is responsible for payment of utility charges. In the case of a partial unit, however, renters share some housing facilities as well as some of the utility or maintenance charges.

III. Model Building: Theoretical Considerations

For the modeling of rental housing choice in Korea, it is postulated that a rental household (which may be a husband, a wife or whole family) chooses not only a type of tenure, but also the type of housing occupation (as a whole or partial unit) through a choice hierarchy. It should be noted that while tenure choice usually is defined as whether to own or rent, this study defines it as the choice of Chonsei or monthly rent. This hierarchical decision process is assumed to satisfy the principle of optimality.[3]

At the first level of the hierarchy, the household's rental tenure choice is determined by typical economic analysis of consumer behavior, i.e., the individual is assumed to maximize utility subject to a budget constraint. Utility is considered to be a function of housing services, Q, and other commodities, X:

$$U = U(X, Q). \tag{1}$$

Since we assume that prices of all other commodities are fixed, we can call this value X, which is dollars (or Won - Korean monetary unit) of expenditure on all commodities except housing services consumed. It is also assumed that $U_X, U_Q > 0$: U_{XX}, and $U_{QQ} < 0$.

The budget constraints can be expressed as follows:

1) Renter of monthly rent[4]:

$$X + M(Q) = Y_L + rA \tag{2}$$

2) Renter of Chonsei:

$$X + iC(Q) = Y_L + r[A - C(Q)] \tag{3}$$

where $M(Q)$ = the amount of monthly rent paid,

[3]"An optimal policy has the property that whatever the initial state and initial decision are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision." See Angel and Bellman (1972).

[4]For simplicity, we ignore the amount of the security deposit term.

Y_L = labor income,
r = rate of return on assets,
i = market interest rate (opportunity cost for renter),
A = assets,
$C\ (Q)$ = the amount of Chonsei.

Again, the budget constraint for Chonsei can be divided into two cases:

1) When the amount of Chonsei $C\ (Q)$ is greater than the amount of assets A held by the household (thus the total asset), the second term on the right hand side of equation (3) is negative. The household must then borrow funds in order to obtain Chonsei, thus paying a higher borrowing interest, which implies that $i < r$.

2) When the amount of Chonsei $C(Q)$ is less than or equal to the amount of assets A, the household will not need to borrow any funds, which implies that $i = r$.

It is important to note that the monthly rent paid $M\ (Q)$ and the imputed rent of Chonsei $iC\ (Q)$ can be represented as a total value of housing services consumed times its prices h.

Assume that $M\ (Q) = hQ$ and $C\ (Q) = kQ$, where h is the price per unit of housing services, k is a constant fraction of Chonsei which is a function of price per unit of housing services h, maximizing utility subject to both constraints yields:

1) Monthly rent:

$$U_X = U_Q/h \tag{4}$$

2) Chonsei:

a. when $i < r$: $U_X = U_Q/(i + r)k$, (5)

b. when $i = r$: $U_X = U_Q/(2i)k$ or $U_X = U_Q/(2r)k$. (6)

Equation (4) states that the household based on monthly rent consumes housing services and other commodities in such relative amounts that marginal utility per dollar (Won) spent is the same for all commodities. Equation (5) and (6) taken together imply that expenditures for housing services are adjusted by the household using Chonsei so that the marginal utility per dollar spent on all other commodities is equal to the marginal utility per interest and price of housing services.

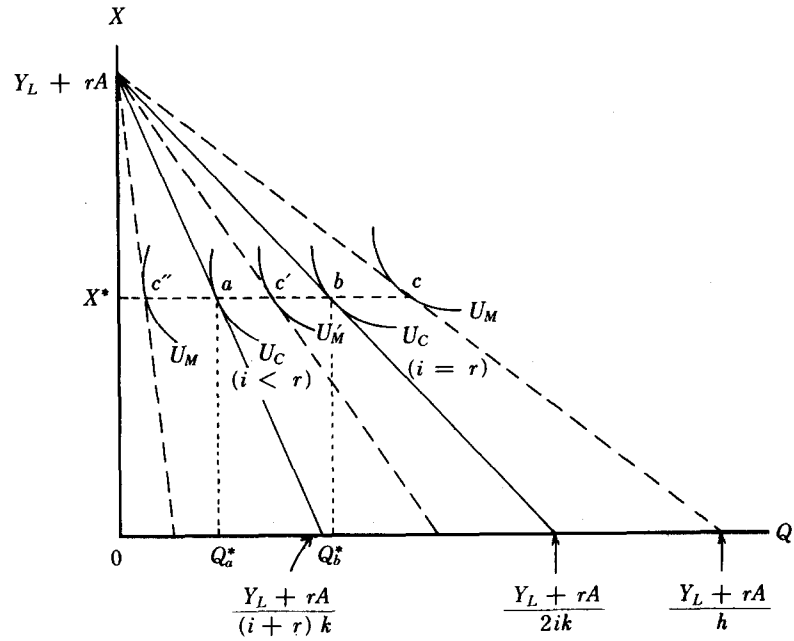

FIGURE 1
SIMPLE EQUILIBRIUM OF THE HOUSEHOLD AT THE FIRST LEVEL OF CHOICE

Figure 1 repersents these maximization problems diagrammatically with a hypothetical household choosing to consume an amount of housing services Q^* and an amount of other goods and services X^*. Each indifference curve shows the combinations of housing and other goods needed to maintain a given level of utility.

Now we assume that the household has to decide between competing tenures of rental housing. Tenure choice is influenced only through the effects of the price per unit of housing services h or market interest i, the rate of return on assets r, and the constant fraction of Chonsei k, since we are provisionally neglecting the effects of household characteristics which can make utility higher for a given level of consumption of other goods.

If the amount of Chonsei required is less than the household's assets, the household will not need to borrow any funds to obtain Chonsei. This implies that the market interest i and the rate of return on asset r are the same, and that the optimal level of housing consumption will be Q_b^* at a given level of other goods consumption X^*.

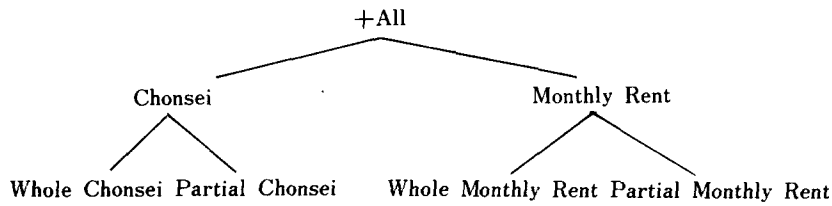

FIGURE 2
CHOICE OF RENTAL HOUSING ALTERNATIVES WITH HIERARCHICAL LOGIT MODEL STRUCTURE

If the amount of Chonsei required is greater than the household's assets, some funds would have to be borrowed to obtain Chonsei. But there are quantity restrictions in that some households cannot borrow funds at all without collateral. In this case, the household must choose monthly rent. Alternatively, a household could get a loan, but then would have to pay high interest because of imperfections in the capital market. This implies that the rate of return on assets r (where total assets is negative, hence, r is the borrowing interest rate) is greater than the market interest rate i. As a result, the consumption of housing services will be reduced to Q_a^* at a given level of other goods consumption X^*. Thus, this household might choose monthly rent which could yield a higher consumption level for a less costly rent. Finally, there are some variations in the housing quality level. Generally, Chonsei provides a better quality of housing facilities and public services than monthly rent does.

Having made a rental housing tenure choice, the household turns to the next level of the hierarchy to choose the type of housing occupation that maximizes its utility (e.g., whole or partial Chonsei, whole or partial monthly rent). Several factors determine this decision. First, a high amount of rental fee separates the type of housing occupation, i.e., partial or whole in the rental housing market. The second factor in making a decision is dictated primarily by changes in household circumstances, including life cycle characteristics.

It is important to note that the decision at the first stage is made independently between choice alternatives, while the decision at the second level is conditioned by the outcomes of first level choices. Figures 2 and 3 represent the model structures used in this research, namely, a hierarchical logit model, and the multinomial logit model, respectively, as analytical frameworks.

From the solution of a constrained utility maximization problem,

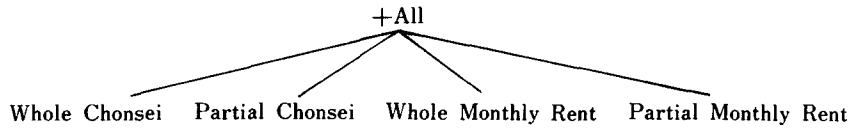

FIGURE 3
CHOICE OF RENTAL HOUSING ALTERNATIVES WITH MULTINOMIAL LOGIT MODEL STRUCTURE

this model can be applied directly to the notion of a random utility model which is termed binary logit for each stage of hierarchical choice. With this hierarchical logit choice model, we can escape the very restrictive assumption, Independence of Irrelevant Alternatives (*IIA*) which would have been associated with a multiple choice logit model.[5]

A. Hedonic Price Index and Quantity of Housing Service

In this study, there are several key variables that cannot be observed directly, such as quantity of housing services and price of housing characteristics. Only the value of rent R (the amount of monthly rent paid $M(Q)$ or the imputed rent of Chonsei $i(Q)$), which is the product of the price of housing services h and the quantity of housing services Q, is observed in the market.

The method typically used is that of hedonic price index, which weighs each characteristic by its importance in determining the unit's rental value.[6] The assumptions underlying the hedonic approach are that the rent or value of a housing unit comes directly from the quantity and types of characteristics it contains, and that the market prices of these housing characteristics can be estimated by pooling information from many dwelling units via a multivariate regression analysis between rent and dwelling characteristics.

More formally, first, we estimate the following functional form for rent;

$$lnR_t = a_0 + \sum_k d_k S_{kt} + \sum_j b_j Z_{jt} + u_t \qquad (7)$$

where S indicates household characteristics and Z refers to housing characteristics.[7]

[5]See Maddala (1983), pp. 67-72.
[6]See Rosen (1974).
[7]Rosen (1974) points out that inclusion of household characteristics, S, is usually

Next, since the variables of Z determine h in equation (7), we can estimate the hedonic price index h using

$$ln\,\hat{h}_t = \sum_j b_j Z_{jt} \tag{8}$$

where t's denote cross-sectional individual households and j's indicate housing characteristics. This index results in a dollar (Won) amount of housing, and may be interpreted as housing services.

The important point is that this price index can vary by location, over time, across cities, or by a tenant's specific characteristics. Therefore, we have to subdivide the housing market as much as possible in order to reduce the error of the predicted value of h.

Finally, the amount of rent that each household spends on rental housing in each of the prospective cities is divided by the price per unit of housing services. The real quantity of housing services Q then is determined by dividing R by h; i.e., $\hat{Q} = R/\hat{h}$ where $\hat{}$ represents an estimated value of each variable.

B. Computation of Permanent and Transitory Income

In a developing economy which has an imperfect housing capital market, we postulate that both permanent and transitory components of actual income have substantially positive, separate effects on rental housing choice. As the deposit of Chonsei is extremely large relative to household income, most households may be dependent upon financial liquidity because of the difficulty of borrowing which arises from institutional restraints. Thus the transitory component of actual income may influence rental housing choice.

Goodman and Kawai (1982) have developed a simple estimation procedure based on human capital theory. This procedure provides consistent and efficient estimators. According to Goodman and Kawai's notation, measured income of a household Y_M is expressed as a function of the determinants of permanent income Y_P plus a random transitory component Y_T. The determinants of permanent income reflect human capital H — which depends on level of education E, age A, number of family members F, and employment status

thought to be inappropriate in hedonic estimation. Here, however, Goodman and Kawai (1984) suggest that inclusion of S permits computation of premium or discounts specific to the renter for standardized bundles and allows unbiased estimates of housing structure and neighborhood hedonic prices. We use a semilog form in which the dependent variable is the natural logarithm of rent because it has several advantages, i.e., somewhat better representation of multiplicative relationships, better explanatory power, and better correction of heteroskedasticity. For detailed discussion of this, see Merrill (1980).

P—as well as nonhuman components N. Then we can write measured income Y_M as

$$Y_M = \phi H(E, A, F, P) + \Psi N + Y_T. \quad (9)$$

Finally, the following regression equation is estimated in order to construct the permanent and transitory components of measured income:

$$Y_{Mt} = b_0 + b_1 E_t + b_2 P_t + b_3 A_t + b_4 A_t^2 + b_5 F_t + \sum_{j=1} \Psi_j N_{jt} + V_t. \quad (10)$$

A_t^2 is included to capture nonlinear effects of the variables on permanent income, N_{jt} refers to control variables—as nonhuman wealth, and V_t is the disturbance term. V_t is assumed to be uncorrelated to explanatory variables, so that the OLS estimates are consistent and efficient. The signs of coefficients are expected to be $b_1 \geq 0$, $b_2 \geq 0$, $b_3 \geq 0$, $b_4 \leq 0$, $b_5 \geq 0$, $\Psi_j > 0$, where negative signs represent the diminishing return to A.

The measured income Y_M can be used as a proxy for permanent Y_p, and the predicted value of the disturbance of V_t can be interpreted as the estimate for transitory income. That is,

$$\hat{V}_t = Y_M - \hat{Y}_P = Y_M - \hat{\phi} H - \hat{\Psi} N = \hat{Y}_T. \quad (11)$$

IV. Empirical Results

A. Hedonic Price Index

The data on which our empirical research is based are from the Survey of Rent and Conditions for Multi-Households, conducted in 1986 by the Korea National Housing Corporation (*KNHC*) (unpublished). A total of 3,064 samples were taken by both cluster and stage sampling methods from 24 cities.[8]

Table 1 shows the results of the estimation of rent equation (7) for each of four areas. The purpose of this estimation is not to explain rent determination but the formation of hedonic price index (*HPI*) (for a definition of each variable, see Appendix).

As expected in the previous section, the OLS estimation of $ln\ R$

[8]Metropolitan (6) = Seoul, Pusan, Taegu, Inchon, Taejon, Kwangju; Satellite (6) = Suwon, Songnam, Uijongbu, Anyang, Puchon, Kwangmyung; Medium and Small (6) = Chunchon, Wonju, Kangnung, Chonju, Chungju, Chonan; Industrial (6) = Banwol, Kumi, Pohang, Ulsan, Iri, Masan.

TABLE 1
ESTIMATION OF RENT EQUATION FOR *HPI*

Variable	Metropolitan	Satellite	Medium & Small	Industrial
constant	0.66354**	0.87337**	0.80183*	0.38020**
	(2.761)	(2.799)	(2.331)	(2.722)
PERES 1	0.05853	0.15598**	0.14315**	0.09407*
	(1.412)	(3.869)	(3.370)	(2.198)
PERES 2	0.03629	0.11944*	0.08820+	0.06271
	(0.810)	(2.076)	(0.440)	(1.173)
NFM	−0.00168	0.07030*	0.00526	0.01675
	(−0.158)	(2.076)	(0.440)	(1.173)
AGEH	0.00528**	0.00198	0.00053	0.00447+
	(2.718)	(0.933)	(0.249)	(1.702)
EDU 1	−0.76132	−0.17264**	−0.08455+	−0.14664**
	(−1.577)	(−3.239)	(−1.708)	(−2.742)
EDU 2	0.01825	−0.10735*	−0.01236	−0.01547
	(0.495)	(−2.557)	(−0.300)	(−0.380)
EMP	0.04977	0.01842	0.13834*	0.21334**
	(0.759)	(0.255)	(2.090)	(2.681)
INCOME	0.00523**	0.00245+	0.00583**	0.00332**
	(3.799)	(1.832)	(3.066)	(2.442)
TOILS	0.35018**	0.16612*	0.05118+	0.25766**
	(2.999)	(2.564)	(1.687)	(2.826)
FTOIL	0.04329	0.15643*	0.30755*	0.21472**
	(1.301)	(2.480)	(2.586)	(3.570)
FKITC	0.22435*	0.05519	0.04126	0.10379+
	(2.553)	(1.194)	(0.822)	(1.905)
FMAG	0.08448*	0.02028	0.04048	0.01054
	(2.162)	(0.496)	(0.953)	(0.396)
FENT	0.02936	0.05631	−0.02979	0.11909**
	(0.824)	(1.550)	(−0.888)	(3.262)
WATR	0.20130**	0.14357**	0.14082*	0.13351*
	(3.912)	(3.745)	(2.110)	(2.059)
HEAT	0.04495	0.02215	0.04337	0.06441*
	(1.450)	(0.685)	(1.388)	(1.979)
SPACE	0.02874**	0.03001**	0.04007**	0.03415**
	(4.300)	(4.753)	(4.353)	(4.415)
N	1025	678	687	674
R^2	0.51	0.59	0.60	0.58
SSR	221.39	99.26	102.98	107.96

Note: 1. **: 99 % significant
2. *: 95 % significant
3. +: 90 % significant
4. ( ): t statistic
5. N: sample size
6. *SSR*: Sum of Squared Residuals

equations shows different results for each city. Variables of human capital which reflect ability to pay rent were expected to have a positive effect on rent, and among those, households head's age (*AGE*), income (*INCOME*), and employment status (*EMP*) show strong positive effects.

The number of family members (*NFM*) has the expected positive coefficient, even though it is negative for metropolitan cities and insignificant. The positive sign for the number of family members can be explained as follows: From the demander's point of view, willingness to pay higher rent increases when the number of family members increases. From the supplier's point of view, the greater the number of family members, the more the value of housing depreciates. Therefore, landlords will demand higher rent, which is expected to have a positive sign.

Level of education variables, *EDU*1 and *EDU*2, have the expected negative coefficients, since *EDU*3 which is an object of comparison is an omitted variable. But *EDU*2 in metropolitan cities has a positive sign which is statistically insignificant. This implies that in metropolitan cities, there is no difference in rent payments between tenants with a high school education and tenants with a college education.

For the period of residence variables *PERES*, it is interesting to note that residence periods of less than two years have shown strong positive effects on rent, when compared to residence periods of more than two years.[9] As mentioned previously, rents decrease with the length of residence, reflecting that long-term tenants receive considerable discounts on their rents relative to short-term tenants. Lease provisions or long-term residence may tend to slow the adjustment of rents to inflation or other changing market conditions. Long-term tenant and landlord relationships may also bring nonmonetary benefits to the landlord or may actually lower the cost of providing housing services. Over a long rental period, landlords are likely to gain real cost savings from the absence of brokerage expense and possibly, lower maintenance expenditures. On the other hand, tenants with especially favorable rental fee may be expected to remain in their units longer.

All housing characteristic variables are expected to have positive coefficients. The major concern in specifying an appropriate set of housing characteristic variables is the reduction of severe collinear-

[9] *PERES* 3 is an omitted variable.

TABLE 2
ESTIMATION OF CURRENT INCOME

Variable	Metropolitan	Satellite	Medium & Small	Industrial
constant	8.57213	9.6047	−1.8547	−2.0294*
	(1.304)	(1.333)	(−0.255)	(−2.205)
NFM	1.51295*	1.6657*	0.4880	1.11473**
	(2.040)	(2.063)	(1.490)	(2.730)
AGE 1	0.58945+	0.24635	0.95417*	1.60248**
	(1.736)	(0.657)	(2.534)	(3.209)
AGE 2	−0.00404	0.00013	−0.00812+	−0.01507*
	(−1.019)	(0.029)	(−1.827)	(2.448)
EDU 1	−18.7865**	−16.6317**	−13.5647**	−10.9631**
	(−4.945)	(−4.909)	(−4.184)	(−3.833)
EDU 2	−11.0204**	−9.6888**	−9.05769**	−5.95157*
	(−3.682)	(−3.631)	(−3.639)	(−2.248)
EMP	14.5950**	19.4241**	18.4816**	19.1212**
	(4.412)	(4.204)	(4.840)	(4.621)
N	1025	678	687	674
R^2	0.30	0.34	0.32	0.26
SSR	14.06	11.58	10.93	38.68

ity among several of the variables. Undoubtedly, relevant characteristics are missing from the equation, examples being neighborhood amenities and type of building material. Such data is not available. Nevertheless, the estimated rent performs reasonably well, and most variables have the correct signs and are significant.

Finally, from Table 1, a hedonic equation (8) can be formed with eight variables which affect the price of rental housing services. These include toilet systems (*TOILS*), toilet facilities (*FTOIL*), kitchen facilities (*FKITC*), main gate facilities (*FMAG*), entrance facilities (*FENT*), water facilities (*WATR*), heating systems (*HEAT*), and floor space (*SPACE*).

B. Permanent and Transitory Income

As we discussed in Section III, the choice of a durable good like housing depends on permanent and transitory income. The list of variables and their OLS estimation coefficients for equation (10) are represented in Table 2.

The results are generally consistent throughout the four areas. All variables have the same signs throughout the four areas except for the age-squared variable (*AGE*2). Although we were careful in

interpreting the results of standard errors because of possible heteroskedastic errors and inconsistent estimates of standard errors, it is noteworthy to observe that most key variables are statistically significant. The signs of the coefficients are found to be correct in most cases, and the unexpected sign of the *AGE2* variable for satellite cities is accompanied by a *t* value small enough to accept the null hypothesis of a zero coefficient. *R*-square values range between 0.26 and 0.34, the average being 0.30. Clearly, many relevant variables are excluded from the equations. Not surprisingly, education (*EDU*) and employment status (*EMP*) have a significant influence on permanent income by their regression. Similarly, the impact of the number of family members (*NFM*) is positive. We discover as expected that *AGE2* variables have negative signs, which reflect diminishing returns. On the other hand, income level significantly reflects education level, which means that the earning rate on education investment is very high in Korea.

C. The Tenure Choice Equation

Table 3 represents the maximum likelihood parameter estimates of the effects of the tenure choice specific variables on each area. According to the results of this model estimation, the distance to the central business district (*CBD*) was chosen in an attempt to represent the locational characteristics. It is interesting to note that *CBD* has a negative effect on the probability of choosing Chonsei in satellite, medium and small, and industrial cities, while it has a positive effect in metropolitan cities. It is also statistically significant for all cities. This may be interpreted as follows: In general, the rental price of housing increases as the *CBD* increases if the marginal benefit from environmental conditions is greater than the marginal cost of transport. In metropolitan cities, rental housing units farther from the *CBD* provide better environmental conditions because rental housing closer to the downtown area is confronted with air pollution and/or noise. Therefore, the marginal probability of choosing Chonsei in metropolitan cities increases as the *CBD* increases. In all other cities the probability of choosing Chonsei may be associated with the commute time to work, since these cities —even industrialized cities— do not have serious problem, noise or air pollution problems, relative to metropolitan cities.

As for the house value *HUV*, it has a significantly positive effect in medium and small cities, but negative effects in all other cities.

TABLE 3
TENURE CHOICE–LEVEL 1

Variable	Metropolitan	Satellite	Medium & Small	Industrial
CBD	0.04126*	−0.00186*	−0.04882+	−0.13043*
	(2.5905)	(−2.046)	(−1.777)	(−2.512)
HUV	−0.00002	−0.00009	0.00015*	−0.00001
	(−1.532)	(−1.639)	(2.224)	(−0.186)
NRM	0.90115**	1.36973**	0.86662**	1.05522**
	(3.056)	(3.299)	(3.052)	(3.059)
NFM 1	−0.11391	−0.15233+	−0.51838*	0.03005
	(−1.329)	(−1.751)	(−2.391)	(0.064)
NFM 2	0.04609*	0.31357+	0.05229*	0.55920+
	(2.184)	(1.915)	(2.180)	(1.744)
NHH	−0.33745**	−0.33159**	−0.30445**	−0.22728*
	(−2.751)	(−2.780)	(−3.274)	(−2.551)
AGE 1	−0.52569+	0.54574	0.13891	−0.11754*
	(−1.677)	(1.584)	(0.368)	(−2.247)
AGE 2	−0.10264	0.72044+	0.31111*	0.58983
	(−0.392)	(1.771)	(2.078)	(1.424)
EDU 1	−0.54273*	0.09886	0.03178	−0.94270**
	(−2.302)	(0.233)	(1.087)	(−2.584)
EDU 2	−0.11317	0.13447	−0.39911+	−0.32419
	(−1.408)	(0.443)	(−1.736)	(−1.160)
DEC 1	−0.06004	0.11348	0.09741	−0.15211
	(−0.321)	(1.476)	(0.480)	(−0.631)
DEC 2	−0.32430	−0.17596+	−0.41701	−0.09336
	(−1.344)	(−1.652)	(−1.373)	(−1.344)
ln Q	0.44879**	0.16347+	0.11622+	0.68592**
	(2.727)	(1.812)	(1.654)	(2.950)
Y_P	0.00926**	0.00769**	−0.00593**	0.00387**
	(2.742)	(2.273)	(2.344)	(2.712)
Y_T	0.00210+	0.00593+	0.00463+	−0.00190
	(1.673)	(1.654)	(1.730)	(−0.226)
N	1025	678	687	674
$L(B)$	−334.84	−249.07	−242.86	−247.61
$L(0)$	−710.47	−469.95	−476.19	−467.18
LR	751.26	441.76	466.66	439.14
ρ^2	0.51	0.47	0.49	0.47

Note: 1. $L(B)$: the value of log likelihood function at the maximum likelihood coefficient value
2. $L(O)$: the value of the log likelihood function when all parameters are zero
3. ρ^2: a statistic equal to $1 - |L(B)/L(0)|$
4. *LR*: a likelihood ratio statistic is equal to $-2|L(0) - L(B)|$

The positive effect in medium and small cities is possibly due to the fact that tenants choose Chonsei because high priced houses are generally of higher quality. In all other cities, however, there are more opportunities for tenants to use the funds that would have gone towards the lump sum deposit of Chonsei, for purposes other than the acquisition of buying housing services. Because the amount of Chonsei deposit rises with the value of the house, tenants in such cities are likely to prefer monthly rent to Chonsei.

The number of rooms (*NRM*) has the expected significance of being one of the most important measures. In general, some Chonsei arrangements can secure larger living spaces than might be possible under the monthly rent system; So, *ceteris paribus,* as the need for the number of rooms increases, the probability of choosing Chonsei increases.

The estimated number of family members (*NFM*) coefficient for households of less than two is negative and has a statistically significant impact on tenure choice for satellite and medium and small cities. The coefficient for a household of two to five members is positive and has a significant impact on tenure choice for all cities. This may be interpreted as an indication that larger households will choose Chonsei as a rental housing alternative.

An additional possibility is that larger households — exceeding five family members—may be unable to afford the Chonsei alternative because of other expenditures. Thus, the set of coefficients for family size can exhibit a somewhat inverse U-shaped curve, peaking at a five-person family in all cities. In other words, the probability of choosing Chonsei goes up as family size increases, but then possibly declines when the family size exceeds five persons. This inverse U-shaped size effect may be attributed to the fact that budget constraints compel the largest families to sacrifice housing consumption for non-housing consumption, despite a greater need for the space.

The number of households in a building (*NHH*), which might be a proxy for neighborhood conditions, has a significantly negative effect on tenure choice. This is counter to expectations, because it is generally assumed that the Chonsei tenants have a negative impact on choosing buildings with larger numbers of families living together, as the possibility of disharmony with other tenants or deterioration of privacy as greater.

The head of the household's age (*AGE*) shows the expected sign for five equations. Since $AGE3$ is an omitted variable, $AGE1$ and

*AGE*2 were expected to have negative signs. But most *AGE*2s showed positive signs. This indicates that when the head of the household is less than 30, there is a negative effect on the probability of choosing Chonsei, whereas when the head of the household is between 30–49 or older than 50, there is no statistically significant difference in the probability of choosing Chonsei.

Education levels of the heads of households (*EDU*) has the expected negative coefficient in each city, but the variables are positive for satellite cities and are not significant. Again since *EDU*3 is an omitted variable, *EDU*1 and *EDU*2 were expected to have negative signs. This means that as the education level of the head of household increases, the probability of choosing Chonsei increases. The variables of the decision maker are insignificant in all the cities, except for *DEC*2 in satellite cities.

On the other hand, as expected, the coefficients for quantity of housing services ($ln\, Q$) and permanent income (Y_P) are statistically significant for the probability of choosing Chonsei in the equations for all cities. As hypothesized, transitory income also shows a positive effect on tenure choice except for industrial cities, and is significant. Moreover, the statistical significance of permanent income is much higher than that of transitory income. In all equations permanent income shows stronger effects on the probability of choosing Chonsei.

Finally, the models show relatively good predicative power as reflected in the rho-square statistic (ρ^2), which is used as measure of the goodness of fit. In addition, we can reject the null hypothesis that all parameters are jointly zero at the 99 % level for the four areas.

D. The Conditional Equations

Table 4 represents the estimation results for type of housing occupation choice using maximum likelihood estimation of a logit, given tenure choice as level 2. The coefficients for housing value variables (*HUV*) show negative signs for six out of eight equations and are statistically significant, except for in industrial cities. Unlike the case of tenure choice, this variable has a negative effect on type of housing occupation choice. This implies that as housing value increases, tenants tend to choose partial units of rental housing rather than wholes unit of rental housing. In general, landlords of highly priced housing might charge a high rent because of high

TABLE 4
TYPE OF HOUSING OCCUPATION CHOICE GIVEN TENURE CHOICE-LEVEL 2

Variable	Metropolitan		Satellite	
	$P(W/C)$	$P(W/MR)$	$P(W/C)$	$P(W/MR)$
HUV	−0.00001*	0.000005	−0.00003*	−0.00001*
	(−2.202)	(1.065)	(−2.398)	(−1.964)
NRM	0.18115**	0.13992**	0.24621**	0.17532**
	(6.001)	(7.392)	(6.170)	(7.829)
NHH	−0.23192**	−0.05521**	−0.18683**	−0.03733**
	(−2.864)	(−2.838)	(−3.138)	(−3.973)
NFM 1	−0.00400	−0.01354	−0.05249	−0.06767+
	(−0.083)	(−0.341)	(0.942)	(−1.665)
NFM 2	0.06000*	−0.01248	0.09185*	−0.05682
	(2.072)	(−0.388)	(2.422)	(−1.498)
DEC 1	−0.04814+	−0.01193	0.07079*	−0.00710
	(−1.718)	(−0.460)	(2.134)	(−0.256)
DEC 2	0.02330	−0.00683+	−0.05544	−0.00854
	(0.614)	(−1.720)	(−1.119)	(−0.256)
ln Q	0.03399*	−0.06611	−0.01435	0.05361**
	(2.357)	(−1.124)	(−1.551)	(2.451)
Y_P	0.00169*	0.00112**	−0.00290	−0.00043
	(2.155)	(2.086)	(−0.551)	(−0.316)
Y_T	0.00091	0.00013	0.00049**	0.00094+
	(1.210)	(1.103)	(2.455)	(1.916)
N	672	353	420	258
L(B)	−203.29	−129.68	−151.38	−98.36
L(0)	−465.79	−244.68	−291.12	−178.83
LR	525.02	230.00	279.48	160.94
ρ^2	0.50	0.47	0.48	0.45

Note: 1. *W*: Whole Unit
2. *C*: Chonsei
3. *MR*: Monthly Rent

maintenance costs or, possibly, high interest payments. Tenants then may prefer a partial unit of rental housing which would require a smaller amount of rent.

As expected, the number of rooms has a statistically significant positive effect on the probability of choosing the type of occupation. This effect seems to be a reflection of the increasing preference for a whole unit with an increasing number of rooms. On the other hand, the number of households in a building shows a significant negative effect on the choice of the whole unit of rental housing. This indicates that the probability of choosing a whole unit of rental housing

TABLE 4
(CONTINUED)

Variable	Medium and Small		Industrial	
	P(W/C)	*P(W/MR)*	*P(W/C)*	*P(W/MR)*
HUV	−0.00006**	−0.00002+	−0.00001	0.000003
	(−2.834)	(−1.747)	(−1.390)	(0.300)
NRM	0.18082**	0.20500**	0.19801**	0.18477**
	(5.231)	(7.452)	(6.770)	(6.364)
NHH	−0.25477*	−0.12930*	−0.19331**	−0.08365*
	(−2.057)	(−2.010)	(−3.240)	(−2.335)
NFM 1	0.04496	0.10875	0.11308+	0.11836+
	(0.763)	(1.596)	(1.660)	(1.803)
NFM 2	0.09467*	0.17364**	0.14552**	0.13767*
	(2.323)	(2.916)	(2.857)	(2.381)
DEC 1	−0.19065	−0.03059	0.05533	−0.01245
	(−0.617)	(−0.770)	(1.475)	(−0.364)
DEC 2	−0.16761**	−0.04380	−0.09898*	−0.05454*
	(−3.166)	(−1.195)	(−2.424)	(−1.397)
ln Q	0.10408**	−0.04542	0.00555	0.03235
	(2.942)	(−1.195)	(0.153)	(0.949)
Y_P	−0.00086	0.00377+	0.00409+	0.00110*
	(−0.462)	(1.686)	(1.647)	(2.506)
Y_T	0.00211+	−0.00002	−0.00200	−0.00011
	(1.753)	(−0.009)	(−1.559)	(−0.097)
N	415	272	426	248
L(B)	−152.45	−113.1	−159.45	−99.70
L(0)	−287.65	−188.5	−295.28	−171.90
LR	270.40	150.80	271.66	144.40
ρ^2	0.47	0.40	0.46	0.42

decreases with an increasing number of households in a building.

The number of family members variable (*NFM*) behaves as we might expect. A larger family size increases the probability of choosing a whole unit. However, as already discussed, family size may also act as a constraint upon housing expenditures. The larger the family, *ceteris paribus,* the more income that must go towards non-housing expenses. Consequently, a family which exceeds five persons may be unable to choose whole units of rental housing. The estimated two family size variables, *NFM*1 and *NFM*2, reflect these situations well in most cities.

The results for decision maker variables (*DEC*) are quite interesting. Traditionally, Korean society is known as a patriarchal

TABLE 5
MULTINOMIAL EQUATION-LEVEL 2
(METROPOLITAN)

Variable	P (*WC/WM*)	P (*PC/WM*)	P (*PM/WM*)
HUV	−0.00002**	0.00002**	−0.000006
	(−2.662)	(3.112)	(−0.956)
NRM	0.19288**	−0.05639*	−0.01530**
	(4.382)	(−2.574)	(4.404)
NHH	−0.15278**	0.09047**	0.07556**
	(−7.512)	(6.384)	(5.997)
NFM	−0.00614	0.01098	−0.00135*
	(−0.990)	(1.083)	(−2.151)
DEC 1	−0.04671*	0.03041	0.01758
	(−2.089)	(0.832)	(0.545)
DEC 2	0.03610	−0.10885*	0.07755+
	(1.260)	(−2.325)	(1.874)
ln Q	0.07948**	0.01069	−0.04160+
	(2.101)	(0.338)	(−1.864)
Y_P	0.00251*	0.00198	−0.00445**
	(2.186)	(1.056)	(−2.677)
Y_T	0.00186*	−0.00004*	−0.00151
	(2.825)	(−2.042)	(−1.587)
$L(B)$	−746.6	$L(0)$	−1185.1
LR	877		
ρ^2	0.37	χ^2	19.28

Note: 1. *WC*: Whole Chonsei
2. *WM*: Whole Monthly Rent
3. *PC*: Partial Chonsei
4. *PM*: Partial Monthly Rent

system. Hence, all decisions generally are seen to be made by the husband. However, our results show that when the decision maker is the husband, *DEC*1, the variable is not significant except for two cases. Rather, it is when the decision maker is the wife, *DEC*2, or the family, *DEC*3 (which is an omitted variable) that these seems to be a strong effect on the type of housing occupation choice. This may reflect that Korean society has been becoming more westernized and/or modernized.

Again, the quantity of housing services (*ln Q*) and income variables (Y_P and Y_T) are expected to have a positive effect on the type of housing occupation choice. The positive coefficients of these variables are statistically significant while the negative coefficients are not. In industrialized cities, the transitory income variable is

TABLE 5
(CONTINUED)
(SATELLITE)

Variable	*P* (*WC/WM*)	*P* (*PC/WM*)	*P* (*PM/WM*)
HUV	−0.00003*	0.00005*	−0.00001
	(−2.130)	(2.537)	(−1.541)
NRM	0.25099**	−0.06793*	−0.19483**
	(4.901)	(−2.238)	(−4.199)
NHH	−0.11108**	0.04563*	0.07431**
	(−7.983)	(2.504)	(4.573)
NFM	−0.00618	0.01311	−0.00777+
	(−0.790)	(0.929)	(−1.659)
DEC 1	0.02966	−0.02780	−0.00237
	(1.169)	(−0.608)	(−0.582)
DEC 2	−9.06481+	0.03002	0.03133
	(−1.796)	(0.462)	(0.540)
ln Q	0.00868	−0.03156+	0.00888
	(1.374)	(−1.755)	(0.238)
Y_P	−0.00087	0.00295	−0.00149+
	(−0.611)	(1.148)	(−1.655)
Y_T	0.00088+	0.00061	−0.00148
	(1.981)	(0.380)	(−1.022)
L(*B*)	−583.1	*L*(0)	−857.4
LR	547.8		
ρ^2	0.32	χ^2	16.4

negative and in all cases insignificant. Thus, no great meaning should be attributed to these conditional coefficients for transitory income.

This model shows somewhat less predictive power than the tenure choice model, as reflected in the rho-square statistic which was used as a measure of the goodness of fit. In addition, the null hypothesis that all the parameters are jointly zero can be rejected at the 99 % level of significance for all estimated equations.

E. Estimation Results for the Multinomial Choice Model

In order to compare it to our hierarchical logit model, the multinomial logit models were estimated by maximum likelihood estimation at the second level. This estimation of multinomial logit model explores whether or not there is a violation of the Independence of the Irrelevant Alternatives (*IIA*) assumption, and whether the difference from hierarchical logit model estimations is significant.

TABLE 5
(CONTINUED)
(MEDIUM AND SMALL)

Variable	*P(WC/WM)*	*P(PC/WM)*	*P(PM/WM)*
HUV	−0.00002*	0.00005**	−0.000008
	(−2.649)	(3.943)	(−0.673)
NRM	0.20237**	−0.05749*	−0.14778**
	(3.186)	(−2.448)	(−4.070)
NHH	−0.14055**	0.97577**	0.11188**
	(−7.399)	(4.014)	(6.662)
NFM	−0.00519	0.02347	−0.01336+
	(−0.607)	(0.793)	(−1.747)
DEC 1	0.01994	−0.00361	0.02120
	(0.745)	(−0.089)	(0.588)
DEC 2	−0.07430	−0.01712	0.10779+
	(−1.802)	(−0.271)	(1.919)
ln Q	0.13688**	−0.12167**	0.06344
	(2.956)	(−2.878)	(0.687)
Y_P	−0.00007	0.00019	−0.00199+
	(−0.049)	(0.082)	(−1.919)
Y_T	0.00068+	0.00014	−0.00170
	(1.645)	(0.085)	(−1.149)
L(B)	−563.4	*L*(0)	−866.84
LR	606.88		
ρ^2	0.35	χ^2	17.2

Table 5 presents these estimation results, which are consistent with our hierarchical choice model estimations.

The tables also provide the Chi-square values for the test of the *IIA* assumption. According to Hausman and McFadden's (1984) suggestion, the following estimation procedure was used. First, the model is estimated as shown in Table 5. Then the choice sets are restricted by removing "whole unit of rental housing given monthly rent" for the second level and the models are estimated with the restricted set of alternatives. The following test statistic

$$(\hat{B}_r - \hat{B}_f)' [Cov(\hat{B}_r) - Cov(\hat{B}_f)]^{-1} (\hat{B}_r - \hat{B}_f) \qquad (12)$$

is asymptotically Chi-square distributed with K degree of freedom,[11] where $\hat{B}_r$ is the estimated coefficients from the res-

[10]This logit computer package is developed by William H. Greene and is known as *LIMDEP*.

[11]See Hausman and McFadden (1984).

TABLE 5
(CONTINUED)
(INDUSTRIAL)

Variable	*P(WC/WM)*	*P(PC/WM)*	*P(PM/WM)*
HUV	−0.00001*	0.00001	−0.00005
	(−2.185)	(1.302)	(−0.402)
NRM	0.21115**	−0.05739*	−0.15748**
	(3.559)	(−2.081)	(−6.414)
NHH	−0.12735**	0.08651**	0.06582**
	(−7.930)	(4.914)	(4.223)
NFM	−0.00120	0.00470	−0.00394*
	(−0.127)	(0.623)	(−2.285)
DEC 1	0.00523	−0.02615	0.01371
	(0.188)	(−0.566)	(0.334)
DEC 2	−0.06112+	0.06255	0.01713
	(−1.951)	(1.217)	(0.375)
ln Q	0.07036**	0.96306	−0.10812**
	(2.607)	(1.424)	(−2.743)
Y_P	0.00391*	0.00609+	−0.00916*
	(2.090)	(1.986)	(−2.354)
Y_T	−0.00168+	0.00138	0.00013
	(−1.776)	(0.887)	(0.095)
L(B)	−595.3	*L*(0)	−850.4
LR	510.2		
ρ^2	0.30	χ^2	16.9

tricted set of alternatives; $\hat{B}_f$ is the estimated values for the same subvector of coefficients from the model with a full choice set; and *Cov* $(\hat{B}_r)$ and *Cov* $(\hat{B}_f)$ are the covariance matrices of two corresponding estimated coefficients. K is defined as the number of elements in the subvector of coefficients identifiable from the restricted choice set model.

All Chi-square values for the *IIA* test are significant at a 90 percent level. Therefore, we can reject the null hypothesis of a multinomial logit model structure at this level of significance.

V. Concluding Remarks

This study attempts to build a Korean rental housing choice model, in which households choose their dwelling units using a hierarchical logit analysis. The models were estimated using household level disaggregate data from the 1986 Korea National Housing Cor-

poration Interview Survey. Separate models were estimated for four regions: metropolitan, satellite, medium and small, and industrial cities.

Several important results were obtained from the estimation. First, the hedonic price equation that predicts the rent (or imputed rent) of a particular housing unit as a function of its physical characteristics shows regional variations across cities. Specifically, the hedonic price index is much higher in metropolitan cities than in all other cities.

Second, the coefficients of permanent and transitory income are significant. This suggests that with an imperfect housing capital market, such as Korea's, transitory income also has some impact on the choice of rental housing.

In comparing permanent and transitory income, the coefficients of permanent income are greater than the coefficients of transitory income. This reflects that the marginal probability to choose rental housing out of permanent income is greater than the marginal probability to choose rental housing out of transitory income. Thus, although permanent income plays the more important role in the choice of rental housing, transitory income also affects the choice in the Korean rental housing market.

Third, the principal motivation for estimating separate models for each area was a prior expectation that important behavioral differences exist among different cities. This analysis shows a significant difference in the estimated coefficients of different areas.

Finally, all models give generally good results. To determine how well the model predicted choices, an overall goodness of fit statistic was calculated for each of the specifications of the model. The results indicate that it is both possible to consider an extensive number of causal hypotheses and likely to prove fruitful.

In comparison with the hierarchical logit mode, all the estimated multinomial logit models show that there is significant dependence among rental housing alternatives. Thus, even though the results of the multinomial logit model are almost consistent with a hierarchical logit model, there is no reason to use the multinomial logit model with a violated assumption in the Korean rental housing market analysis. Thus, we still prefer the hierarchical logit model to the multinomial logit model.

Appendix

CBD = distance to central business district,
HUV = house value,
RENT = imputed rent,
NRM = number of rooms,
*NRM*1 = 1, if number of used room is 1;
= 0, otherwise,
NRM2 = 1, if number of used rooms is 2;
= 0, otherwise,
*NRM*3 = 1, if number of used rooms is more than 3;
= 0, otherwise,
NHH = number of households in a building,
SPACE = floor space of rental housing,
PERES = period of residence,
PERES 1 = 1, if period of residence is less than 1 year;
= 0, otherwise,
PERES 2 = 1, if period of residence is 1–2 years;
= 0, otherwise,
PERES 3 = 1, if period of residence is more than 2 years;
= 0, otherwise,
NFM = number of family members,
NFM 1 = 1, if number of family members is 1–2;
= 0, otherwise,
NFM 2 = 1, if number of family members is 3–5;
= 0, otherwise,
NFM 3 = 1, if number of family members is equal to or more than 6;
= 0, otherwise,
AGE = age of household head,
AGE 1 = 1, if the age of the household head is less than 29 years old;
= 0, otherwise,
AGE 2 = 1, if the age of the household head is 30–49 years old;
= 0, otherwise,
AGE 3 = 1, if the age of the household head is equal to or more than 50 years old;
= 0, otherwise,
EDU = educational level of household head,
EDU 1 = 1, if educational level of household head is less than

junior high school;
= 1, otherwise,

EDU 2 = 1, if educational level of household head is high school;
= 0, otherwise,

EDU 3 = 1, if educational level of household head is more than 2 years college;
= 0, otherwise,

EMP (employment status) = 1, if employed;
= 0, otherwise,

INCOME = household income,

TOILS (toilet system) = 1, if flush toilet;
= 0, otherwise,

FTOIL (toilet facilities) = 1; if there is an independent toilet;
= 0, otherwise,

FKITC (kitchen facilities) = 1, if there is independent kitchen;
= 0, otherwise,

FMAG (main gate facilities) = 1, if there is an independent main gate;
= 0, otherwise,

FENT (entrance facilities) = 1, if there is an independent entrance;
= 0, otherwise,

WATR (water facilities) = 1, if public (piped) system;
= 0, otherwise,

HEAT (heating system) = 1, if modern (boiler) system;
= 0, otherwise,

DEC = decision maker of housing choice,

DEC 1 = 1, if the decision maker of housing choice is a husband;
= 0, otherwise,

DEC 2 = 1, if the decision maker of housing choice is a wife;
= 0, otherwise,

DEC 3 = 1, if the decision maker of housing choice is a family;
= 0, otherwise.

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