World Bank Reprint Series: Number 269

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The Case of Korea

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Journal of Development Economics 11 (1982) 249–272. North-Holland Publishing Company

HOUSING CROWDING IN DEVELOPING COUNTRIES AND WILLINGNESS TO PAY FOR ADDITIONAL SPACE*

The Case of Korea

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Received September 1979, final version received February 1982

The very rapid rate of urban population growth in developing countries is placing great strain on their housing stock. Housing policies which are aiming at reducing or eliminating crowding are generally based on notions of 'needs' and 'standards of adequacy' which are more often based on arbitrarily selected criteria than on domestic economic conditions. The aim of this paper is to evaluate the willingness to pay for additional housing space by households and the validity of target housing standards. The three methods used show consistently that — at least in Korea — the willingness to pay for additional space is less than 25 percent of the value of an extra unit of space, everything else being equal.

1. Introduction

In developing countries, rapid demographic, as well as economic growth, leads to concentration in cities. This high rate of growth of urban population places strains on the housing stock and leads to severe crowding. The elimination of this housing crowding has been the objective of housing policy. Three typical objectives found in policy documents are: to improve the ratio of number of dwellings to number of households, to improve

*This is a completely revised version of an earlier paper entitled 'The Economics of Housing Crowding in Developing Countries'. The revisions were suggested by an anonymous referee to whom we are grateful. This paper is one of several produced as part of a study of the Korean Housing market sponsored by the World Bank. Responsibility for the papers varied. Follain is the onc primarily responsible for this paper.

0304–3878/82/0000–0000/$02.75

standards of quality generally defined in terms of number of persons per room or floor space per person, and to increase levels of homeownership because housing is a major means of asset accumulation and homeowners are often claimed to make better citizens. Such policy objectives are based on the notion of 'needs' and 'standards' of adequacy which do not necessarily take into account actual housing demand, the price of housing nor the ability to pay of households.

Unrealistic objectives in low income countries can distort government investment priorities in the housing sector where they intervene frequently. Public housing units that are built have often overshot their mark by a considerable margin. For instance, the Korea National Housing Corporation built 30–40 pyong units in the early 1970s (one pyong equals 3.3 square meters); it later moved to a range of 15–25 pyongs. It is now building units of even less than 15 pyongs while permitting subletting to a second household, which is finally consistent with prevailing average housing market conditions (see table 4 below).

A possible source of considerable mischief may be a frequently mentioned crowding threshold of 2 persons per room, a misleading ratio if not related to floor area. By recent United Nations definition, a room must have at least four square meters; two square meters per person would be crowded indeed.[1] In the Korean survey used in this paper, there are 2.5 persons per room but the floor area is 4.16 square meters per person. By contrast the 1973 French public housing standard for a two-room unit is 42–46 square meters while the Soviet Union uses 38–48 square meters.[2]

In recent years considerable efforts have been made to develop more realistic housing programs. A variety of low-cost, low-income housing solutions are being tried around the world. But, at present, if much is known from engineering studies about cost interaction between a large number of design parameters such as lot size, street width, type of pavement, water and sanitation systems, electricity networks, etc. ... we know very little about household preferences for space, adequate style, occupancy, better access to work or about trade-offs between land and structure or between interior space and dwelling quality.

As part of the objective of better understanding the various dimensions of housing demand, the present paper constitutes a first attempt at estimating the value that households place on important dimensions of housing units such as number of rooms, floor space and land space in a developing country. At present, even in developed countries, quantitative studies of the demand for the various attributes of housing are scarce, because data

[1] *Global Review of Human Settlements*, United Nations Conference on Human Settlements, Vancouver 1976, A/Conf. 70/A/1, p. 221.

[2] *Major trends in Housing Policy in ECE Countries*, p. 34, United Nations, ECE/HPB/29, New York, 1980.

requirements are stringent and also because appropriate methods of analysis are still being developed.

Because there is no widely accepted method of estimating the value that households place on living space, the approach proposed by this paper is to use three different estimation procedures, each with its own strengths and conceptual limitations, to determine whether they yield consistent estimates of household willingness to pay for space. The first estimation procedure uses direct estimation of the demand for living space relying on different measures of the price of space. The second approach is the bid-rent approach developed and discussed by, among others, Alonso (1964), Wheaton (1977) and Galster (1977). The third approach involves the valuation of various living space characteristics through the estimation of hedonic price indices.

In addition to the availability of adequate analytical procedures, the estimation of the willingness to pay for additional space requires appropriate data. Fortunately, in Korea, a very unique data set has been collected by the Korean government in 1976. It contains a reasonably rich set of information about housing units in urban areas. In addition, unusually useful land price and construction cost data were available. This Korean data base has permitted this first attempt at a quantitative evaluation of what households might be willing to pay for more housing space in a developing country.

The paper is organized as follows. In the first section, information on crowding in Korea and other countries is presented. Important aspects of the Korean housing market, which must be understood in order to model household behavior in that market, are described together with the data used. The three alternative methods of estimating the willingness to pay are presented successively together with the estimation results. The final section compares the outcomes of the three analyses and their convergence. Some of the major policy implications of the results are discussed; they amply justify a continuing systematic investigation of the many dimensions of the demand for housing in developing countries.

2. Dimensions of crowding in Korea and other countries

2.1. Overview

It is difficult to accumulate international data on housing conditions that are truly comparable. Table 1 presents data that were collected for selected countries for various years. They show the ratio of the number of dwellings to the number of households, the average number of persons per room and the percentage of dwellings with more than three persons per room. Most of these numbers are tentative and would not permit more than a crude international cross-section analysis relating levels of income to the extent of crowding. They help place Korea in a broader international context, but they

Table 1

Housing conditions in selected countries.[a]

	(1) 1976 GNP per capita in U.S. Dollars	(2) Dwelling units per household	(3) Persons per room	(4) Percent with 3 persons/room	(5) Year
India	150	0.963	2.8	n.a.	1971
Pakistan	170	0.943	3.1	59.0	1960
Indonesia	240	0.981	1.6	24.2	1971
Egypt	280	0.823	1.6	15.5	1960
Thailand	380	0.990	n.a.	n.a.	1970
Philippines	410	n.a.	n.a.	30.1	1967
Morocco	540	0.791	2.1	34.4	1971
Colombia	630	0.709	n.a.	n.a.	1964
Korea, Rep	670	0.782	2.7	n.a.	1970
Turkey	781	n.a.	2.0	29.2	1965
Mexico	1090	1.000	2.2	n.a.	1970
Brazil	1140	0.942	1.0	4.9	1970
Poland	2860	0.836	1.3	n.a.	1970
U.K.	4020	0.954	0.6	0.1	1971
Japan	6910	0.989	1.1	3.9	1968
France	6550	0.953	0.9	2.7	1968
Germany	7380	0.942	0.7	n.a.	1972
U.S.	7890	1.000	0.6	0.	1970

[a]Source: United Nations, *Human Settlements*, Statistical Appendix 1977.

still provide only limited insight into the exact dimensions of crowding in a developing country.

Korean housing standards are still extremely low in spite of the very high rate of increase in income over the last 15 years when the average growth rate of GNP has been around 10 percent per year. At the time of the 1975 census the nationwide ratio of urban households to housing units was 1.28. This situation is due to the very high rate of urban growth[3] as well as the destruction of a significant proportion of the housing stock during the Korean War. Between 1955 and 1975 the population living in cities over 50,000 grew from 5.3 to 16.8 million.

The analysis reported in this paper is based on the Family Income and Expenditure Survey regularly conducted by the Bureau of Statistics of the Economic Planning Board of the Korean government, which has been supplemented with a matching Special Housing Survey on dwelling characteristics conducted in July 1976.[4] The complete sample consists of

[3]Over the period 1950–1970 South Korea experienced the highest rate of urbanization in the world for countries with more than 15 million people in 1950. See Renaud (1977).

[4]The original questionnaire was prepared by Raymond Struyk at the time of a review of the Korean housing policy for the fourth 5-year plan, 1976–1981.

1293 households from 17 cities in Korea. The principal sample used in this paper, however, is slightly smaller: certain observations viewed as extreme outliers in typical Korean urban markets have been excluded. These exclusions reduced the sample to 1012, but we feel the resulting sample is more representative of the typical Korean population (see details of exclusions in table 2).

Table 2

Rent and rent/income ratios by income class.[a]

Income class (won)[b]	Monthly rent/consumption expenditures	Standard deviation	Monthly rent	Standard deviation	N
Under 39,999	0.19	0.10	5658	2537	186
40,000 to 59,999	0.15	0.07	7609	4121	313
Greater than 59,999	0.14	0.08	13032	9208	513

[a]This sample excludes 281 households from the total sample. Those excluded are: (1) households from the Island of Jeju, (2) those with reported rent in excess of consumption expenditures, (3) households residing in units with more than 30 persons occupying it, (4) households residing in apartments, (5) those with incomes less than or equal to zero, and, (6) those with calculated shares of rent attributable to land not between zero and one.

[b]The 1976 foreign exchange rate was 502 wons to one U.S. dollar.

2.2. Structure of housing consumption

In 1976, the average monthly consumption expenditures of the principal sample was 70,800 won. The median rent to consumption expenditures ratio is about 15 percent. The ratio for three income classes is reported in table 2. The data indicate a decline from 19 percent in the lowest group to 14 percent in the highest income group. Average rent for the lowest income group is 5658 won per month and over 13,000 in the highest group. The mean is 10,000 won per month.

In most developed countries households are classified into owner-occupants and renter-occupants with no further breakdown. In Korea, however, periodic income and expenditure surveys distinguish seven types of tenure. In addition to homeownership, the rental arrangements are in order of frequency: chonsei, security deposit with monthly payment, declining chonsei, pure rental, free housing, and government housing. These various rental arrangements are distinguished from one another by their payment schemes, terms of contract, and sometimes eligibility criteria.[5]

[5]Chonsei works as follows: instead of a monthly rent the households give a deposit varying generally between 250,000 and 600,000 won to the landowner, who places the funds on the money markets or uses them; the total deposit is returned in whole (in the case of pure chonsei)

Table 3 lists rent and rent/consumption ratios for three groupings of households by tenure. The rent/consumption ratio is similar among tenure types, but owners tend to have larger monthly rental expenditures. For our principal sample, owners comprise about 48.2 percent, almost identical to that for the entire sample. The percentage of households who use the pure chonsei arrangement — 28.8 percent — is also quite consistent with the full sample percentage and data from other sources.

Table 3

Rent and rent/income ratios by tenure.[a]

Tenure	Monthly rent/consumption expenditures	Standard deviation	Monthly rent	Standard deviation	N
Owner	0.15	0.08	11,741	8887	488
Chonsei	0.15	0.06	8,104	4431	291
Other[b]	0.16	0.11	8,719	7442	233

[a]Same sample as in table 1.

[b]This category regroups the ot‸.. forms of tenure: free housing, government housing, security deposit, declining chonsei, and monthly rent.

2.3. *Extent of crowding in Korean cities*

Several measures of crowding are presented in table 4 for the principal sample and for Seoul separately. These measures are: the size of inside living space exclusively used by the household (measured in pyongs); the number of rooms per household; the size of the lot. Each living space measure refers to the amount of space available for *exclusive* use by the household. In addition, each measure is reported on a per person basis.[6] For units

or in part at the end of the lease (declining chonsei). The pure rent, Western style, is used only by the poorest households.

During the periodic income and expenditure surveys, most households are asked what their imputed monthly rental charge is. This is easy to do for most Korean households — even for owners — because subletting of rooms is so common. For households with rental arrangements which are declining chonsei or rent with security deposit, it is necessary to compute the implicit monthly rental charge. For a declining chonsei the imputed rent is estimated as

$$R=\sum_{t=1}[(A-D\cdot t)i+D]\ t,$$

where A = amount of original chonsei, D = monthly deduction from chonsei, n = period, i = curb market interest rate. For security deposits with monthly rent, R is equal to the monthly rent to which is added the deposit multiplied by the monthly curb rate. The unregulated money market monthly rate for the sample households is estimate‸. by taking the rate of imputed rent to chonsei deposit in the sample chonsei data. The average value of $i=$ 0.00326/month is very consistent with the regular monetary market surveys conducted by the Bank in Korea during the same period.

[6]The average household size for the principal sample is 4.84 persons, For Seoul, the average household size was 4.80 according to the 1975 Census.

Table 4

Some measures of the extent of residential crowding.

Measures of crowding[b]	Full sample[a] Mean	Full sample[a] Standard deviation	Seoul ($N=420$) Mean	Seoul ($N=420$) Standard deviation
Pyongs of inside living space[c]	6.03	7.00	5.65	6.00
Pyongs of inside living space per person	1.26	1.27	1.20	1.25
Number of rooms	1.87	1.00	1.80	1.00
Number of rooms per person	0.40	0.23	0.39	0.21
Pyongs of lot size	16.6	14.0	13.5	9.0
Pyongs of lot size per person	3.60	2.89	2.97	1.96

[a]Same as that used in tables 1 and 2.

[b]All measures refer to space available for *exclusive use* by the household. This should not be confused with the average size of dwelling units which is approximately twice as large.

[c]One pyong equals 3.3 square meters.

occupied by more than one household, lot size for exclusive use is prorated according to the share of rooms of the dwelling unit to which the household has exclusive use.

The different measures more precisely convey the general points made in the introduction that Koreans reside in very crowded housing by developed country standards. For example, the average pyongs of living space per person is 1.26 for the principal sample and only 1.20 for Seoul households. The data also convey another important point; that is, there is substantial variation in the extent of crowding as measured by the ratio of the mean to the standard deviation. The ratio for the principal sample is nearly one, and for the Seoul sample it is 0.96. These ratios show that there is significant variation in the extent of crowding among households in Korea. This great variation in crowding conditions is very important for public policy toward low income housing. It may also be noted that for estimation purposes the dispersion of the data can be expected to strengthen the quality of quantitative estimates.

3. Estimating the willingness to pay for more space

Three possible methods of estimation of the household willingness to pay for more space can be considered. Each has its own strengths and limitations and none can be considered unequivocally superior to the other. The first method consists of imputing the value of an additional unit of space from the estimation of a demand function which is aspatial in character but from which a measurement of the willingness to pay for additional space can be directly derived. Recognizing that the price of housing varies across space, the bid–rent approach is based on the existence of a housing price schedule which varies across the city rather than on an average price. However, it leads to estimation problems that require specification of the utility functions to be assigned to various groups of households. A third approach is to rely on direct estimation of the willingness to pay through the estimation of hedonic price indices. It can be related theoretically to bid–rent functions of consumers and producers, but requires the assumption that the stock of housing attributes in the market is fixed and that the price of each attribute is demand determined. As is also well known, the structure of the estimating equations is also important for hedonic indices. Taken together, these three approaches can provide a clearer appraisal of the willingness to pay for space and of the economic response of Korean households to crowding.

3.1. Direct demand approach

The first approach, which is the most obvious, simply asserts that the utility of the households depends upon the non-housing goods consumed by the household, the quantity of inside living space consumed by the household, and the size of the lot occupied by the household. The household is assumed to maximize this utility function subject to a budget constraint which includes prices of the two measures of residential living space.

Households are assumed to maximize $u=u(s_1,s_2,x)$ subject to the budget constraint; $y-T(k)=x+p_1s_1+p_2s_2$, where u is the utility of the household; s_1 is the quantity of inside living space and s_2 is the lot size; x is the quantity of non-space goods; y is the permanent income of the household; k is the time it takes to travel from the house to the city center; $T(k)$ is the amount of transportation expenditure incurred by the household, which is explicitly introduced because of the important trade-off between space and location in housing; p_1 is the price per unit of inside living space; and p_2 is the price per unit of land. The price of x is assumed to be unity. The result of this maximization process is a demand function which relates the quantity of residential space to the income of the household net of transportation cost and the price of the two major dimensions of residential living space: inside space and lot size. That is, $s=s(p_1,p_2,y-T(k))$.

As noted earlier, two different measures of inside living space are used: the *size* of the rooms (in pyongs) occupied by the household and the *number* of rooms used exclusively by the household. Lot size is prorated, if needed, to each household. The price of a pyong of living area and the price of a room are both measured by a construction cost index developed by the Korean National Housing Corporation. The data are based upon the non-land costs of constructing a particular type of apartment unit in eleven cities.[7]

The price of a pyong of land is available because the Korean government keeps systematic records of land prices. Each year three land prices for each neighborhood, or Dong, of each city are published.[8] The chosen measure of the price of land faced by a household for this study is assumed to be the average of the high, middle and low prices of land per pyong in the Dong in which the household resides.

Permanent income of the household is measured by consumption expenditures of the household. This proxy is frequently used as a measure of permanent income. Earlier work with this particular sample focused on the demand for overall housing [Follain, Lim and Renaud (1980)], and in that work it was found that the use of consumption expenditures gave much higher estimates of the income elasticity than household current income. Since this is consistent with the permanent income hypothesis, consumption expenditures are used in this study with two modifications. Rent is subtracted from consumption to avoid any possible simultaneity bias. Also, transportation costs are subtracted from consumption. Transportation costs are measured by the value of the time it would take to travel to the center of the city since we do not know where the household works. The measure used is one-half the wage rate of the household times the time needed to travel to the city center. Based on various transport analyses, the wage rate is assumed equal to total consumption expenditures divided by 2500. The 2500 figure is based upon the assumption that Koreans work about 250 days per year and average about 10 hour work days. An important demographic variable that also is likely to affect the space demands of a household is the size of the household. Consequently, each demand equation estimated includes the size of the household as an independent variable.

The demand equations for living space are expected to be reasonably well-approximated by a double-log functional form. This permits the various versions of the demand for living space to be estimated by Ordinary Least

[7]These cities are Seoul, Busan, Incheon, Chuncheon, Daejon, Jeonju, Daegu, Masan, Chungju, Weonju, and Suwon. For the five cities in the sample not represented in these unpublished data, we assign the cost figures provided for the nearest city. Because of the close geographic proximity of these cities this is probably not a serious error. The theoretical justification for this approach is that competitive forces eventually eliminate significant differences in construction costs between two nearby areas as long as transportation costs and localized market powers are not too great.

[8]A Dong is an administrative subdivision of Korean cities. In Seoul, the number of households in one Dong varied between 1000 and 8000 households in 1975; a typical figure would be 3000 for Seoul. The official Korea Appraisal Board has been maintaining records of land prices by Dong since at least 1962 in most cities. This rather remarkable monitoring system is used in various ways in the implementation of land policies. See Doebele and Hwang (1977) for an up-to-date review of Korean urban land policies and Mills and Song (1979) for an analysis of these data.

Squares (OLS). The coefficients of the estimation are then directly interpreted as elasticities of demand.

The price elasticity estimate produced by the OLS analysis is an ordinary price elasticity. In order to impute the values that households are willing to pay for living space, compensated price elasticities are needed. The compensated price elasticities are calculated by using the Slutsky equation expressed in elasticity form; i.e., $e_p^c = e_p^0 + we_y$, where e_p^c and e_p^0 are the compensated and ordinary price elasticities, respectively; w is the share of consumption attributed to living space and e_y is the income elasticity of the demand for living space. Elsewhere [Follain, Lim and Renaud (1980)], it has be n shown that the share of land in the rental bill is about 0.33. We assume th the share of space, then, is 0.67.

Once the compensated price elasticities are calculated, it is possible to calculate the household's willingness to pay for an additional unit of living space. We define demand as $q = ap^e$, where q is the quantity demanded of a particular measure of living space, a is the constant term that depends upon non-price variables in the equation, p is the own-price of q. For this case, willingness to pay (WTP) for an additional unit of living space is the area under the inverse version of the demand curve. That is,

$$WTP = \left(\frac{1}{a}\right)^{1/e_p^c} \left[\frac{e_p^c}{1+e_p^c}(\bar{q}+1)^{(1+e_p^c)/e_p^c} - \bar{q}^{(1+e_p^c)/e_p^c}\right].$$

This expression is evaluated for typical values of q. The constant term, a, depends upon the values of the non-own price variables in the demand equation and their estimated coefficients; therefore, a is also evaluated for typical values of the non-own price variables — non-rental consumption expenditures, family size and either the price of land for the inside living area equations or the construction price index for the lot size equation.

Three demand equations for living space are estimated and the results of the estimation are presented in table 5. The own-price elasticity is negative in each equation. Furthermore, the t-statistics are all in excess of 1.46 indicating significance at the 85 percent level. The own price elasticity of the demand for inside living space is given by two measures: the demand for rooms and the demand for inside living area (measured in pyongs). Both the own price elasticity of the demand for rooms and the own price elasticity of the demand for inside living space are quite close to minus unity, that is, -0.90 and -0.98, respectively. The own price elasticity of the demand for lot size is much lower, -0.35, although interestingly, the t-statistic for this coefficient is quite large, 11.29. None of the cross-price elasticites are significantly different than zero.

The income elasticities for the three space characteristics are less differentiated than the price elasticity estimates: the demand for inside living

Table 5

Estimates of the demand for residential space.[a]

	LROOMS	*LPYONGS*	*LSHLOT*
CONSTANT	7.44 (1.43)	7.69 (0.95)	6.29 (0.87)
LCONPP	−0.90 (−2.09)	−0.98 (−1.47)	−0.39 (−0.66)
LLANDA	0.01 (0.50)	0.001 (0.03)	−0.35 (−11.29)
LNRCON	0.31 (11.98)	0.45 (11.41)	0.41 (11.55)
LFAM	0.46 (11.55)	0.58 (9.44)	0.34 (6.10)
R^2	0.28	0.24	0.26

[a] *t*-values are in parentheses. *LCONPP* = natural logarithm of the construction price index. *LLANDA* = natural logarithm of the land price per Dong. *LNRCON* = natural logarithm of non-housing expenditures. *LFAM* = natural logarithm of family size. *LROOMS* = natural logarithm of the number of rooms exclusively used by the household. *LPYONGS* = natural logarithm of the size of the living space (in pyongs) exclusively occupied by the household. *LSHLOT* = natural logarithm of the size of the lot (in pyongs) exclusively occupied by the household.

area has the largest income elasticity, 0.45; the income elasticity of the demand for lot size is estimated to be 0.41; while the lowest income elasticity is associated with the demand for rooms, 0.31. All income elasticities have *t*-statistics in excess of 11.0. The elasticity of the demand for living space with respect to family size varies between 0.34 (lot size) and 0.58 (inside living area), and *t*-statistics are all quite large.

Using the estimates of the ordinary price elasticities and the Slutsky equation, compensated *price* elasticities for each of the various measures of living space are computed. They are

$$e_p^c \text{ (rooms)} = -0.87,$$

$$e_p^c \text{ (inside living area)} = -0.94, \quad \text{and}$$

$$e_p^c \text{ (lot size)} = -0.35.$$

These estimates are close to the ordinary price elasticity estimates since the income elasticity estimates proved to be small and the share of total expenditures devoted to living space is small.

Estimates of the compensated price elasticities allow willingness to pay estimates to be developed for various measures of living space. These estimates are based upon mean values for households who reside in Seoul. We do not directly observe the price of a pyong of inside living area or the price of a room. However, in order to estimate the willingness to pay, it is necessary to have values for the prices of an additional pyong of inside living area or an additional room. We assume that 67 percent of the rental expenditures are attributable to space and the other third to lot size [see Follain, Renaud and Lim (1980)]. The price of a room is taken to be equal to the share of rental expenditures devoted to space divided by the average number of rooms in a Seoul dwelling unit (1.8). This yields a rental price per room of 4000 wons per month. The price of a pyong of floor space is constructed similarly. In 1976, there were an average 13.5 pyongs in the typical Seoul dwelling unit and the rental price per pyong of floor space is estimated to be 558 wons.

The estimates of the values that households place upon additional units of living space are presented in table 6 both in monetary units and as ratios of willingness to pay to rental price per unit of space. The results indicate that a household would be willing to pay 1130 won per month for an additional room which is only 28 percent of the estimated going rental price. Similarly an additional pyong of floor space is valued at 118 won per month or only 21 percent of the estimated market value. The willingness to pay for an additional pyong of lot size is found to be negligible.

Table 6

Willingness to pay (WTP) for living space — Direct demand approach.

Additional space	Absolute value	Ratio to rental value
1 more room (rental price of a room assumed to be 4000 won)	1130 won per month	28.3 percent
1 more pyong of inside living area (rental price of a pyong assumed to be 558 won/month)	118 won per month	21.1 percent
1 more pyong of lot size[a]	negligib.e	negligible

[a]Estimating equation and parameter estimates

$$WTP_i=(1/a_i)^{1/e_i}\{e_i[(2.8)^{(1-e_i)/e_i}-(1.8)^{(1-e_i)/e_i}]\}/(1+e_i),$$

$i=1$ applies to number of rooms where $e_i=0.87$, and

$a_1=e^{7.44}\cdot\text{land price}^{0.01}\cdot\text{non-rental consumption}^{0.31}\cdot\text{family size}^{0.46}$,

$i=2$ applies to size of living area where $e_2=-0.94$, and

$a_2=e^{7.69}\cdot\text{land price}^{0.001}\cdot\text{non-rental consumption}^{0.45}\cdot\text{family size}^{0.58}$,

$i=3$ applies to lot size where $e_3=0.35$, and

$a_2=e^{6.29}\cdot\text{construction price}^{-0.39}\cdot\text{non-rental consumption}^{0.41}\cdot\text{family size}^{0.34}$.

3.2. Bid–rent approach

The direct demand approach has at least two shortcomings. First, it is necessary to assume that the price per unit of space is properly measured by the construction costs. While not being an unreasonable assumption in a long-term context it is also clear that the market value of an additional room or unit of floor space may be greater than the construction cost in the short-run due to excess demand and an inelastic supply. Another problem is that the direct demand estimation implicitly assumes that the neighborhood (in Korea the *Dong*) constitutes the appropriate market. In fact, the market is larger and a housing land price schedule for the metropolitan market rather than an average price per Dong should be used.

As an alternative to the direct demand estimation of the value of space, the bid–rent model can be used to meet these two problems. The bid–rent model was developed by Alonso (1964) in his analysis of urban land markets. It was empirically implemented by Wheaton (1977) and Galster (1977). The bid–rent theory of urban housing markets is based upon three important assumptions. First, housing is treated as a heterogeneous commodity that is indivisible so that households purchase a bundle of spatial and physical housing characteristics by paying a single rental or purchase price for the housing unit. Second, households are assumed to bid for the existing housing stock of an urban housing market so that all households of similar income levels and preferences obtain the same level of utility. Third, housing prices within the urban market vary so that this equal utility condition is maintained.

The bid–rent model can be derived from the maximization of the household utility function under constraints including travel costs. The budget constraint is

$$y-T(k)=x+r,$$

where r is the rental payment a household makes for a particular housing unit and the other terms are as defined earlier. The utility function is similar to that used in the direct demand approach; it also takes into account household desire for accessibility. It can be represented as $u=u(x,z)$, where z is the vector of attributes associated with the dwelling unit.

To obtain the bid–rent function, the utility function is solved in terms of x, i.e., $x=x(u,z)$. Then this inverse version of the utility function is inserted in the budget equation which is solved for r. The result is the bid–rent function:

$$r=y-T(k)-x(\bar{u},z).$$

It shows the maximum amount a household with utility level u would be willing to pay for a particular unit characterized by the vector z. The parameters of the bid–rent function are those of the utility function so that once the bid–rent function is estimated it is possible to calculate the value of an additional unit of space to a household. It will be equal to the marginal rate of substitution between a unit of housing space and the numeraire (x).

The estimation of the bid–rent function presents two difficulties. The first involves the choice of a particular utility function. We use the Cobb–Douglas utility function, i.e.,

$$\mu = \alpha_0 \ln x + \sum_{i=1}^{n} \alpha_i \ln z_i,$$

where n is the number of attributes. Use of this functional form gives rise to the following bid–rent function:

$$\ln(y - T(k) - r) = x(\bar{u}, Z) = \frac{1}{\alpha_0} \ln \bar{u} - \frac{\alpha_1}{\alpha_0} \ln Z_1 - \frac{\alpha_2}{\alpha_0} \ln Z_2 \ldots \frac{\alpha_n}{\alpha_0} \ln Z_n.$$

A CES utility function was also tried to estimate the bid–rent function, but convergence of the non-linear estimation could not be achieved.

The second problem associated with the estimation of the bid–rent function is that the function involves the number u — the actual level of utility of a particular group. Since utility is, at best, difficult to measure, we choose groups of households that are expected to be of roughly equal utility. We use three criteria to divide the household population. Only households who reside in Seoul are selected; this insures that all households compete in the same market. The other two criteria are income and household size. Because of the number of observations per cell, only two different income classes are defined — above 50,000 won per year and below 50,000 won per year. Two different strata of household size are used: those with more than 4 persons and those with 4 or less. These criteria give rise to four different household groups.

Admittedly, this division of the households into groups of equal utility is imperfect. However, the criteria employed by Wheaton (1977) and Galster (1977) were not much more stringent, yet their analyses provided very valuable insights on housing demand. Following Wheaton and Galster, permanent income is also added to control for the fact that the stratification is imperefect. Based on our earlier analysis of the demand for housing services, consumption-expenditures are used as a proxy for permanent income.

The bid–rent function based on the Cobb–Douglas utility function is estimated for *four* different groups of households. Included in the equation are two living space variables, the natural logarithm of consumption expenditures and seven variables that measure some attribute of the dwelling unit and its location. The two living space variables are *LPYONGS* — natural logarithm of pyongs of inside living space — and *LSHLOT* — natural logarithm of pyongs of lot size. The number of rooms is excluded since it is highly correlated with the number of pyongs for some groups thus making it difficult to obtain precise estimates of the importance of inside living space for a household's bid–rent.

The seven attributes of the dwelling unit include the distance to the city center in natural logarithms (*LDISTC*) and two zero-one variables that indicate whether the exterior of the unit is made of cement blocks (*CEMENT*) and whether the unit has piped water (*PIPE*). Four other zero-one variables are entered to measure the age of the structure. They are: house built since 1975 (*A75*), house built between 1969–1974 (*A69*), house built between 1964–1968 (*A64*), and house built between 1959–1963 (*A59*). As mentioned earlier the final variable in the equation, the natural logarithm of consumption expenditures (*LCONSUM*), is included as a proxy for the variations in utility among the members of each subgroup.

Only the estimates of the bid–rent function for group 3 — the high income group with fewer than 5 persons — are in table 7, the estimates of the other three bid–rent functions are in the appendix. Instead of presenting a detailed description of each set of estimates, only the aspects of the results most pertinent to this paper are discussed.

Table 7

Estimates of the bid–rent function[a] (group 3[b]).

	LBID
CONSTANT	−2.24 (−4.20)
LPYONGS	−0.05 (−2.05)
LSHLOT	−0.04 (−1.52)
LCONSUM	1.15 (25.32)
LDISTIC	0.14 (4.66)
A75	0.06 (0.96)
A69	0.02 (0.53)
A64	0.03 (0.68)
A59	0.10 (2.46)
PIPE	0.01 (0.18)
CEMENT	0.03 (1.13)
R^2	0.87

[a] *t*-values in parentheses.

[b] This group consists of households with less than or equal to 4 members and monthly consumption of at least 50,000 won. *LPYONGS* = natural logarithm of the size of living space in pyongs. *LSHLOT* = natural logarithm of the size of lot space in pyongs. *LCONSUM* = natural logarithm of the consumption expenditures. *LDISTC* = natural logarithm of the distance to city center. *A75*–*A59* = zero-one variables indicating years in which unit built. *PIPE* = zero-one variables indicating presence of piped water. *CEMENT* = zero-one variables indicating cement exterior. *LBID* = natural logarithm of consumption expenditure minus transportation and rental expenditures.

Despite the problems inherent in trying to choose groups of households with roughly equal welfare levels, the estimation results are quite reasonable in that the signs are generally as expected and most coefficient estimates are statistically significant. Most importantly, the coefficients of *LPYONGS* and *LSHLOT* are the expected signs for all groups but the first — low income households with less than five persons. The coefficient of *LPYONGS* is significant at the 10 percent level in two of the four equations. The coefficient of *LSHLOT* is significant at the 15 percent level in two of the four. This performance is consistent with that reported by Wheaton (1977) and Galster (1977).

The coefficient estimates of *LPYONGS* and *LSHLOT* are used to compute the household's willingness to pay for additional units of living space. Willingness to pay is defined as the marginal rate of substitution (*MRS*) of non-rental consumption expenditures for either an additional pyong of inside living space or an additional pyong of lot size. For the Cobb–Douglas utility function, the *MRS* of non-rental consumption for inside living space is α_1/α_0 *NRCON/PYONGS* where *NRCON* is the amount of non-rental consumption expenditures and *PYONGS* is the size of the inside living area. α_1/α_0 is simply the coefficient of *LPYONGS* in the bid–rent function. The *MRS* of non-rental consumption expenditures expenditures for lot size is α_2/α_0 *NRCON/SHLOT*. α_2/α_0 is the coefficient of *LSHLOT* in the bid–rent function and *SHLOT* is the mean value of lot size. Since we assume the price of non-rental consumption expenditures is equal to unity, the *MRS*'s calculated are in won and indicate how much households are willing to pay for an additional pyong of either inside living space or lot size.

Table 8 presents the calculated values of the willingness to pay of each of the four groups. The *MRS* is computed on the basis of mean values of *PYONGS* and *SHLOT* for each group. The results depend upon the income of the household as measured by consumption expenditures and the size of the household. The value of an additional pyong of space increases rapidly with income and family size. However, if we calculate the ratio to the rental value of one pyong as done earlier, the highest value of this ratio is only 16.4 percent. Note, too, that the value of an additional pyong of lot space declines very rapidly with income and family size; this is consistent with the diminishing marginal value of more land given the considerable differences in lot size between group 2 and group 4. It is also quite notable that for the lowest income group with the smallest family size (group 1) the willingness to pay for more space is negligible.

3.3. Hedonic price index approach

A third possible approach to estimate the value that households place on residential living space is to rely on the estimation of hedonic price indices.

Table 8

Willingness to pay for living space — Bid–rent approach.

Willingness to pay for: (won)	Group 1 Family size 4 consumption 50,000 won per month	Group 2 Family size 4 consumption 50,000 won per month	Group 3 Family size 4 consumption 50,000 won per month	Group 4 Family size 4 consumption 50,000 won per month
An additional pyong of inside living space	[a]	207	567	657
An additional pyong of lot size based upon mean values	[a]	346	230	18
Characteristics of the group				
Size of inside living area (pyongs) exclusive use	3.13	4.03	5.43	7.66
Size of lot (pyongs)	9.65	10.62	12.8	17.1
Non-rental/consumption expenditures	30,000	33,390	66,917	75,161
Number of sample households in this group	82	63	111	164

[a]Denotes insignificant value.

Rosen (1974) has provided a theoretical analysis of hedonic indices which shows that the equilibrium hedonic price function may be derived from the bid–rent functions of consumers and producers. A survey of some recent applications and an analysis of U.S. metropolitan housing markets using hedonic indices can be found in Follain and Malpezzi (1980). Essentially, the hedonic index approach leads to the estimation of regressions having as the dependent variable the rental value of the dwelling unit. The attributes of the dwelling and its neighborhood are the independent variables. The regression estimates can be interpreted as the value given to each attribute on the housing market under equilibrium.

For analysis, a hedonic index is estimated for households which reside in Seoul. The dependent variable is the dwelling unit rent and the independent variables include the size of the living area (measured in pyongs of floor space), the size of the lot (also in pyongs) the distance of the unit from the center of the city, and other variables describing physical characteristics of the housing unit. The regression is estimated in semi-log form with the dependent variable being the natural logarithm of rent. This form is frequently employed in hedonic analysis. It has the advantage of allowing the dollar value of an attribute to vary depending up on the size and quality of the overall unit.

To evaluate the value of space the important parameter estimates are those of the floor space and lot size variables. We assume that the stock of attributes is fixed, therefore, the price of each attribute is demand determined. This assumption combined with the chosen functional form allows an easy interpretation of the coefficients. The coefficient of the floor space variable indicates the percentage increases in the rental value which a dwelling unit can command if its floor area is increased by one pyong, holding total lot size constant. The coefficient of the lot size variable indicates the increase in rental value associated with a one pyong increase in lot size, holding the floor area constant.

The Seoul sample size derived from the principal sample has 420 households. The independent variables are similar to those used for the estimation of the bid-rent function, but the variables *PYONGS*, *SHLOT* and *DISTC* are entered directly instead of using their natural logarithms. The hedonic equation presented in table 9 has 13 parameters describing housing characteristics; three more have been added to those used for the bid–rent estimation; the presence of modern toilet facilities, of modern washing facilities and of modern kitchen facilities.

For such a reasonably simple specification, the hedonic regression performs well; R^2 is 0.3618 and 10 out of the 13 independent variables are significant at the 10 percent level or better. Of the three insignificant variables, *CEMENT* and *COOK* have signs opposite to what should have been expected. Most notably the coefficients of the various age variables

Table 9

Estimates of the hedonic index.[a]

	LRENT
CONSTANT	8.91 (73.24)
PYONGS	0.019 (3.09)
SHLOT	0.012 (3.55)
DISTC	−0.021 (−2.79)
A75	−0.26 (−2.69)
A69	−0.07 (−1.05)
A64	−0.14 (−1.86)
A59	−0.28 (−4.18)
PIPE	0.35 (5.09)
TOILET	0.25 (2.37)
WASH	0.12 (1.67)
CEMENT	−0.05 (−1.08)
COOK	−0.25 (−0.98)
R^2	0.36

[a]*t*-values are in parentheses. *TOILET*= zero-one variable indicating presence of modern toilet. *WASH* = zero-one variable indicating presence of modern wash facilities. *COOK* = zero-one variable indicating presence of modern cooking facilities. All other variables defined in table 7.

indicate that the most valuable housing type are the oldest units built before 1959, reflected in the equation by the intercept. This preference may be explained by two factors: first at the time of the survey the government had already been encouraging new housing construction south of the Han River and restricting constructions to the North; the new South bank residential areas are relatively far from the city center.[9] Another important explanation could be a remaining strong preference for traditional style Korean houses well adapted to their social functions and preferred to more standardized modern units.

The parameter estimates of the two important variables, pyongs of lot size and pyong of floor area, are significant at better than the 1 percent level. The coefficient of the floor space variable is 0.019 and has a *t*-value of 3.09. It indicates that an increase in floor space of one pyong will increase monthly rental expenditures by 1.9 percent. Since the average dwelling rent for Seoul is 11,230 wons per month this yields an estimated rental value for one more

[9]The Korean government, like that in many other less developed countries, wanted to limit the growth of population in the capital city of Seoul to deal with the problems of congestion, overcrowding and insufficient urban services. Another reason is related to national defense. Seoul is located only 30 miles south of the demilitarized zone where occasional conflicts with the North Koreans are witnessed.

pyong of 213 wons. As mentioned earlier, if the short-term supply of housing attributes is fixed the price of the attributes is demand determined and the hedonic coefficient also represents the household willingness to pay for an additional pyong of floor space. Similarly, the hedonic coefficient for lot size indicate a willingness to pay for one more pyong of lot of 135 wons per month.

4. Conclusions

In this paper we have attempted to explore the empirical support which might exist for housing policies with specific standards of quality defined in terms of floor space per person or persons per room. As we have noted quantitative housing targets are based on notions of 'needs' which might not necessarily be supported by actual household willingness to pay for meeting such targets.

The results of the analysis based on the three alternative methods chosen are presented in table 10. It indicates that a typical household in the year of the survey might be willing to pay between 118 to 657 won per month more for an additional pyong of floor space (one pyong equals 3.3 square meters). One additional pyong of lot size would be even less valued with a range between nothing and 346 wons per month.

In comparison with household expenditures for housing related expenditures such as water, fuel, house repairs, furniture and utensils or transport, these figures are quite small. If we develop estimates of the average rental value per pyong of floor space or land area we find that the ratio of the willingness to pay for more space compares to the average cost of a unit of space falls well below one; in fact, below 0.25. A third point of reference which does not require many data manipulations is the construction cost of one pyong of housing experienced by the Korea National Housing Corporation in 1976 of 217,000 won. Using the highest estimated value of an additional pyong of floor space, the discount rate needed to equate the marginal value of one pyong to its marginal cost is slightly over 3 percent per year. This discount rate falls well below the interest rates observed on the costs market and on the unregulated money markets of Korea; in 1976 such rates were in the range of 35 percent per year. These three points of reference show that the estimated benefit of additional space measured by a household's willingness to pay is far less than the cost of providing it. This appears to be true for more rooms, more floor space and more land.

The surprising finding is not that the cost of providing an additional unit of space is larger than its private marginal valuation. We would expect that to happen in competitive housing markets. What is unexpected is that the three alternative methods used all indicate that the marginal valuation is less than one-fourth of the cost of additional space.

Table 10

Willingness to pay for more space: Summary table (in wons).[a]

	Additional pyong of floor space	Additional room	Additional pyong of lot area
Direct demand approach (all cities)			
Estimated value	118 won/month	1130 won/month	[b]
(Ratio to unit rental value)	(21.1 percent)	(28.3 percent)	[b]
Bid-rent approach (Seoul)			
Group 1	[b]	—	[b]
Group 2	207 won/month	—	346 won/month
Group 3	567 won/month	—	230 won/month
Group 4	657 won/month	—	18 won/month
Hedonic index (Seoul)			
Estimated value	213 won/month	—	135 won/month
(Ratio to unit rental value)	(16 percent)	—	(24 percent)
Average estimated rental value per unit (Seoul)	1332 won/pyong/month	4000 won/pyong/month	558 won/pyong/month

Average household expenditures for housing related items in Seoul in won per month: (1) water: 486, (2) home repairs: 323, (3) furniture and utensils: 2638, (4) fuel: 2379, (5) transport: 3165.

[a]502 won = 1 U.S. dollar in 1976.
[b]Denotes insignificant value.

This finding has important policy implications. Under conditions of slow or zero household income growth, it may be unwise to build housing projects which have as their primary goal the provision of larger units to low and moderate income household. Such projects would not be self-financing in the sense that beneficiary households would be willing to pay for the full cost of the units. The government would have to make up the gap between the marginal valuation of space and its marginal cost.

The results provide indirectly a better understanding of the impact of household income growth on housing demand. In table 6 we have income elasticity estimates of the demand for room, floor space and additional land, which are respectively of 0.306, 0.451 and 0.406. It has been the rapid growth of household incomes in Korea over the last 20 years which has provided the impetus for greater housing units. In periods of slow growth the emphasis of public policy should be on more units of a fairly constant size to accommodate the rapidly growing number of households, rather than on providing increasingly larger units, which would then require government subsidies.

The estimates obtained in this analysis provide other indications of the nature of Korean housing markets. The income estimates obtained indicate that Korean households should be expected to demand more floor space ($e=0.451$) than additional rooms ($e=0.306$) when their income grows. A distinction might also be made between the price elasticity of the demand for floor area and that for land. The greater elasticity of the demand for building space (about -0.9) than for land area (about -0.35) might be compared with the elasticity of substitution between land and structure estimated by us elsewhere [Follain, Lim and Renaud (1978)] to be for Korea, of 0.65. The analysis also suggests that room demand is more price sensitive and floor space more income sensitive.

A comparison of the income elasticity estimates of the demand for space obtained here with the greater income elasticity of the demand for housing services estimated by Follain, Lim and Renaud (1980) shows that there are other components of a dwelling unit which are valuable in addition to space, such as access to piped water and electricity, better public services, improved sewer systems and other neighborhood characteristics. The household valuation of such housing features should also be investigated, as it might provide additional insight into the relative policy value of housing upgrading projects against projects providing new housing units.

Further estimations of the willingness to pay for additional space in other developing countries based on similar or other procedures would be very important to clarify the context of housing policy. The results presented here indicate that, under conditions of slow or no household income growth, the benefits to be expected from housing projects may be narrowly circumscribed. Housing policy regarding size should be closely tailored to expected income growth if governments are to avoid giving subsidies. In case of doubt, the first results presented here support policies aiming at more units of current average size rather than larger units.

Appendix

Table A.1

Estimates of the bid-rent function[a] (groups 1, 2 and 4[b]) *LBID*.

	Group 1	Group 2	Group 4
CONSTANT	−3.44 (−4.08)	−3.34 (−3.98)	−2.29 (−3.45)
LPYONGS	0.022 (0.49)	−0.025 (−0.71)	−0.07 (−1.82)
LSHLOT	0.01 (0.24)	−0.11 (−2.88)	−0.004 (−1.10)
LCONSUM	1.29 (16.13)	1.30 (16.28)	1.16 (20.20)
LDISTIC	0.04 (0.74)	0.07 (1.61)	0.11 (1.98)
A75	−0.01 (−0.13)	−0.12 (−1.49)	0.08 (1.06)
A69	−0.02 (−0.26)	−0.15 (−2.70)	0.10 (1.63)
A64	0.04 (0.52)	−0.03 (−0.72)	0.07 (1.09)
A59	−0.05 (−0.86)	−0.02 (−0.46)	0.14 (2.47)
PIPE	−0.05 (−0.98)	−0.06 (−1.47)	−0.04 (−0.67)
CEMENT	0.01 (0.28)	0.07 (2.05)	−0.04 (−0.82)
R^2	0.80	0.85	0.75

[a]*t*-values are in parentheses.
[b]Definitions of these groups are the same as given in table 8.

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