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This paper contains preliminary findings from research work still in progress and should not be quoted without prior approval of the author.

The authors wish to thank David Gross, Emi Miyake, Serena Ng and Lokky Wai for their very careful research assistance. The authors have also benefitted from the comments received at seminars at MIT and Michigan State University and from Steve Mayo. However, any remaining errors are their responsibility. This paper is funded by Research Project No. RPO 672-46 of the World Bank, but the Bank is not responsible for its contents.

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# I. Introduction

The quickening pace of urbanization in the developing world has accelerated its shelter needs. It has been estimated that, while urban households accounted for 34 percent of those living in absolute poverty in 1980, they are projected to make up to 57 percent by the end of the century (World Bank, 1980). In response, national housing agencies, frequently financed by the multilateral aid agencies, have recently invested billions of dollars in innovative urban development projects which are designed to alleviate the constraints restricting the supply of adequate shelter to the needy. The approach stresses the delivery, not just of physical units of housing, but of a package of complementary services, such as water, electricity, sewage systems, waste disposal, and community facilities.

Despite the large investments implied by these urban development projects currently being undertaken in developing countries,[1] policy makers and project managers have not had access to much information regarding the magnitude and the distribution of their benefits. Measures of these benefits are complicated by the heterogeneous nature of the commodity being provided. Housing projects yield a flow of consumable services that depend upon the characteristics of the project components: the quantity and quality of the structures, the land on which they are built, the neighborhoods in which they are located, and the level of urban services with which they are provided. Since the costs depend on the components in a project package, it is crucial to know how the intended beneficiaries rank those components and to what extent they are willing to trade one for another.[2] For example, a project in a city that is richer but more densely populated would likely require a different set of housing characteristics (such as higher quality and less space) from a project in a city that is poorer and more spread out, if the same level of benefits is intended to be delivered to each project, or if each project is to be built at the same cost. In order to make the appropriate choices, project planners must have information on the trade-offs that households are willing to make among housing characteristics. If they are also concerned about the distribution of benefits, they must also know how these tradeoffs vary by household type.

Another reason for finding out about the extent and incidence of benefits has to do with cost recovery. In addition to efficiency considerations, financial constraints have forced the countries undertaking these new projects to impose user charges. Up to now, the bases for the appropriate levels of these charges have been rules of thumb about the ability to pay based on aggregate expenditure data on the proportion of household expenditures devoted to housing. It is clear, however, that this proportion depends on the package of services being offered. The derivation of willingness to pay schedules for each of the different services that compose a housing project would allow the planner to make prior estimates of the extent of cost recovery for alternative project packages.

The appropriate methodology for addressing these issues can be drawn in the now-extensive literature on the demand for urban housing characteristics. The conceptual and empirical framework upon which most of the analyses is presented in Rosen (1974). While the applications have been numerous, they have focussed almost exclusively on developed country examples.[3] Only Quigley (1982) and Follain et al (1982) have investigated the willingness to pay for housing characteristics in developing countries. These two studies bring dissimilar approaches to the estimation of characteristics demand in handling different issues--the Korean demand for space in Follain et al and the benefits of a stylized Salvadorean housing program in Quigley. Thus, it is difficult to make comparisons and draw out some general lessons which may be more widely applicable.

This paper applies a uniform methodology to household-level data sets from five cities of varying size in three developing countries: Colombia, Korea, and the Philippines. This rich information source provides the basis for what we believe is the first cross-country analysis of the characteristics demand literature. Also, unlike the previous studies, we focus on identifying the structure of preferences over a whole range of housing characteristics. Our results reveal a significant amount about how these might be comparable across disparate societies and we indicate how such information may serve as useful inputs to project development. In particular, the willingness to pay for quantity, quality, services, neighborhood and access, as well as how households are willing to trade among characteristics will be estimated and compared across cities.

Section II will present the methodology and review the refinements we introduce to circumvent the pitfalls which have been identified in the literature. This is followed by Section III which describes the data base and the variables used, and Section IV which presents the empirical results. Section V briefly summarizes the policy implications of the results as well as more specific uses to which the methodology can be put.

## II. Theoretical Framework

The methodology used in this paper follows closely Quigley's important adaptation of Rosen's two-step method of calculating the demand for housing characteristics by estimating the parameters of an explicit utility function.

These estimates are then used to measure willingness to pay as the amount of consumption of non-housing commodities a household would be willing to give up to obtain another unit of each housing characteristic. The procedure, of course, is equivalent to estimating the appropriate marginal rates of substitution (MRS).

Each household consumes z, which is a vector of housing characteristics, and x, a composite of all other goods, the price of which is unity. Households choose their consumption bundle subject to a budget constraint where income, y, is exhausted by their purchases of x and z, the housing bundle. The prices of the characteristics that make up the housing bundle are not directly observed. Only market rent $p(z)$, which is the amount paid for the entire bundle, are observed. Furthermore, the characteristics are jointly priced non-linearly. The budget constraint is thus $y = p(z) + x$.

A generalized constant elasticity of substitution (GCES) utility function, which provides enough restrictions to enable us to ensure that the observed bundles of x and z will identify points along an indifference curve, is assumed. The representative household must choose its consumption bundle (z,x) by solving the following constrained maximization problem:

$$\max_{z,x} u = [\sum_{j=1}^{m} \alpha_j z_j^{\gamma_j} + x^{\epsilon}]^{\phi} + \lambda[y - p(z) - x] \tag{1}$$

where: $\alpha_j$, $\gamma_j$, $\epsilon$, $\phi$ are parameters; $\lambda \equiv$ a Lagrange multiplier. The first-order conditions yield:

$$(\partial u/\partial z_i) \equiv \phi u[\sum_{j=1}^{m} \alpha_j z_j^{\gamma_j} + x^{\epsilon}]^{\phi-1} (\gamma_i \alpha_i z_i^{\gamma_i - 1}) = \lambda(\partial p/\partial z_i), \quad i = 1,\ldots,m \tag{2a}$$

$$(\partial u/\partial x) \equiv \phi u[\Sigma \alpha_j z_j^{\gamma_j} + x^{\epsilon}]^{\phi-1} \epsilon x^{\epsilon-1} = \lambda \tag{2b}$$

$$y = p(z) + x \tag{2c}$$

Equations (2a) to (2c) represent a system of m+2 equations and m+2 unknowns $(z,x,\lambda)$. Simplifying the system will yield:

$$p_i = (\gamma_i \alpha_i \epsilon^{-1}) z_i^{\gamma_i - 1} [y - p(z)]^{1-\epsilon}, \quad i=1,\ldots,m. \qquad (3)$$

where $p_i \equiv \partial p/\partial z_i$. The right hand side of (3) would thus be the marginal rate of substitution (MRS) in consumption between $z_i$ and x. This measures the amount of consumption of all other goods (x) that an individual is willing to pay for another unit of the $i^{th}$ characteristic.[4] In household equilibrium this must equal the unobserved marginal price of that characteristic, $p_i$.

Because of the complicated nature of the GCES utility function and the (as yet) unspecified nonlinear form of p(z), it is not possible to derive the reduced form of (3) to obtain the demand functions. Thus, the goal of this paper is to estimate jointly the system of m equations depicted in (3). (See Murray, 1975, 1978, for similar attempts at estimating first order conditions.) The biggest obstacle to achieving this is that the $p_i$'s are not observable. Following Rosen's suggestion we assume that the $p_i$'s can be calculated from a market determined price structure, p(z), which relates rents to housing characteristics. Since we do not have any prior notions about the shape of this hedonic relationship, we use the Box-Cox model which searches over alternative functional forms:

$$(p^{\lambda} - 1)/\lambda = \beta_0 + \sum_{j=1}^{m} \beta_j z_j + \mu \quad \text{for} \quad \lambda \neq 1 \qquad (4)$$

where the $\beta$'s are market-determined parameters, and $\lambda$ is a parameter used to transform p to do Box-Cox analysis, and $\mu$ is an error term. Nonlinear methods are used to find the optimal $\lambda$. Thus,

$$\hat{p} = [(1 + \hat{\lambda}\hat{\beta}_o) + \hat{\lambda} \sum_{j=1}^{m} \hat{\beta}_j z_j]^{1/\hat{\lambda}} \quad (5)$$

Taking derivatives, we obtain an expression for $\hat{p}_i$:

$$\hat{p}_i = \hat{\beta}_i[(1 + \hat{\lambda}\hat{\beta}_o) + \hat{\lambda} \sum_{j=1}^{m} \hat{\beta}_j z_j]^{(1/\hat{\lambda})-1} = \hat{\beta}_i \hat{p}^{(1-\hat{\lambda})} \quad (6)$$

which varies by observation.

The two step procedure is thus (a) to estimate (4) and calculate (6); (b) to use $\hat{p}_i$ from (6) in the log-linear estimation of (3):

$$\log \hat{p}_i = \log(\gamma_i \alpha_i/\varepsilon) + (\gamma_i - 1)\log z_i + (1 - \varepsilon)\log[y - p(x)] + \xi \quad (7)$$

for $i = 1,\ldots,m$, where $\xi$ is an error term. The estimated coefficients of (7) will identify the parameters of the utility function.

It is useful to reiterate that the system of first order conditions that is to be estimated jointly, the m equations of (7), is not a compensated demand system. This aleviates the need to specify the supply side explicitly.[5] We simply assume that households accept the price structure p(z) as given, which is justifiable because of the micro-level data set. Quigley (1982) has shown that, if the nonlinear hedonic function is known with certainty, the parameters of the utility function can be inferred from observations made on the utility-maximizing choices of the sample households. Observed marginal prices and corresponding consumption bundles can trace out a utility contour, for a sample of households who differ with respect to parameters such as income but who face the same indifference map.

A number of issues need to be discussed to relate this approach with that taken in the literature. First of all, we favor the method of starting from an assumed known indifference map to *ad hoc* assumptions that

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enables us to estimate compensated demand functions, such as $p_i = f(z, y, \text{household characteristics})$. The latter approach masks the general difficulty in deriving reduced form functions given well-behaved utility functions and nonlinearities in p(z). Furthermore, as Brown and Rosen (1982) have recently pointed out, because the $p_i$'s are exact combinations of the arguments in $f(\cdot)$, they may not add any information to that already provided by observations on quantities. Prior restrictions on the demand system and the hedonic functional forms are required if we are to avoid this problem. An explicit utility function and hedonic price relationship prevents the imposition of the necessary restrictions from being arbitrary.

Secondly, the form of (7) requires some econometric refinements. The system must be estimated jointly, i.e., with the appropriate cross-equation restraints. Instrumental variable techniques are used to overcome the simultaneity problem caused by the presence of $z_i$ on the right hand side of (7) and the fact that $\hat{p}_i$ is a function of the $z_i$ as well. This permits us to obtain consistent estimates of the utility function parameters (except for $\phi$ which is arbitrary).[6]

Thirdly, it should be noted that the approach can be compared to that taken by Follain et al in their study of crowding in Korea, which is an application of Wheaton's bid rent framework. That study estimates the parameters of the GCES utility function by dividing the sample into groups of equal utility. It is assumed that the researcher has enough information to be able to tell which socio-economic characteristics separate households into these groups.[7] Within each group, households may consume different bundles of characteristics but in such a combination so as to yield the same level of utility. Those households who consume "less housing" would also need to pay less. The parameters of the utility function can then be estimated for each group. The method we use differs from this approach since we are not required to identify households of equal utility. We only need to assume that the sample households maximize utility. Furthermore, we assume that all households face the same utility parameters.

Finally, the system defined in (7) is estimated only for continuous variables, since the marginal prices, $\hat{p}_i$, which we use as the dependent variables, cannot be derived from the hedonic equation. An alternative method of deriving the willingness to pay for dichotomous variables is used. For most of the samples, there is only one dichotomous variable (although the variable itself differs with the city). Let us call this variable $z_o$. There are n continuous variables. The utility function is thus

$$u = \alpha_o z_o^{\gamma_o} + \sum_{j=1}^{n} \hat{\alpha}_j z_j^{\hat{\gamma}_j} + x^{\hat{\varepsilon}} . \qquad (8)$$

The estimating procedure outlined above enables us to obtain estimates only of $\hat{\alpha}_j$, $\hat{\gamma}_j$, $\hat{\varepsilon}$ for j=1,...,n. However, for all households who choose not to consume $z_o$ (for whom $z_o$=0), these parameters are sufficient to calculate a measure of the maximum utility attained by these households:

$$\hat{u}_o = \sum_{j=1}^{n} \hat{\alpha}_j z_j^{\hat{\gamma}_j} + x^{\hat{\varepsilon}} \text{ for all observations } z_o=0 .$$

We also know that, within this subgroup, variations in the levels of maximum utility achieved occur among households because of differences in household characteristics. It is assumed that income, y, and household size, N, capture these differences. The following equation is estimated:

$$\hat{u}_o = \hat{g}(y,N) \quad \text{for all observations } z_o = 0, \qquad (9)$$

where $\hat{g}$ signify the estimated coefficients. Under the assumption that the behavioral relationship it implies is applicable to all households, equation (9) is then used to predict $\hat{u}_1$, the utility achieved by households who consume $z_o$ ($z_o$=1). (Note that, otherwise, we would not be able to use the coefficients of the continuous variables alone to calculate this utility level because we have no estimates of $\alpha_o$ or $\gamma_o$.) The rent, $p_1$, that a household (for whom $z_o$=1) would be willing to pay if it did not have $z_o$ can be calculated from:

$$\hat{u}_1 = \sum_{j=1}^{n} \hat{\alpha}_j \hat{z}_j^{\hat{\gamma}_j} + (y - p_1)^{\hat{\epsilon}} \quad \text{for all observations } z_o = 1. \qquad (10)$$

This amount is compared with the rent actually paid, p. The difference is the willingness to pay for $z_o$.

## III. The Data

The analysis is carried out for five cities in three developing countries: Davao, a medium-sized city in the southern Philippines; Bogota and Cali, which are, respectively, the largest and second largest cities in Colombia; Seoul, the capital of Korea, and Busan, located in southern Korea. While all three are classified as rapidly urbanizing "middle income" countries by the World Bank, there is still a substantial amount of variation among them to warrant interesting comparisons.[8]

The Davao sample is a random draw of households representing all socio-economic strata, from a sampling frame derived by updating master lists of the Philippine Census. The interviews were conducted in 1979 by the Davao Action Information Center, a non-profit foundation directed by Professor Robert A. Hackenberg of the University of Colorado. More information on how the sample was stratified and how the data were collected can be found in Hackenberg (forthcoming). In order to make the results comparable to the other studies, the 889 renters and 952 owners do not include squatters.[9]

The Colombian samples consist of 1,862 Bogota and 521 Cali households. The data were obtained from the World Bank sponsored City Study which conducted household surveys on randomly selected households of the city wide population in 1978. Since the data have been extensively described elsewhere (see Ingram, 1980, and Mohan, 1981 as two examples), only the variables of particular interest are discussed. All but one of the variables are those used and defined by Ingram in his study of housing demand in Bogota and Cali. In addition, the subsamples analyzed here are the same as those used by Ingram. The subsamples differ from the complete sample in only minor ways, such as the elimination of certain very low or very high income households.

The Korean data were obtained from the 1979 housing survey of urban households conducted jointly by the Korean National Bureau of Statistics and the Korean Housing Bank. The survey used the 1975 census sampling frame. There is some concern that this data base may be biased in that condominium dwellers of Seoul were left out of the survey. The 6,000 households in the survey came from over 20 cities. This paper focuses only on Seoul and Busan. Since the original sample was not stratified by city, the Seoul and Busan results may not be fully representative.

The variables used in the analysis are listed in Table 1. The average values are summarized in Tables 2a and 2b. There are, in general, four groups of variables to describe dwelling unit characteristics: size, quality, urban services, and neighborhood including location. The variables which are actually used for each city are limited by data availability. While we tried to make the data as comparable as possible, certain measures simply could not be constructed for all cities. For Davao, for example, there is only one size variable, which is the number of rooms in the dwelling unit, while for the Colombian cities, measures of living area were included.

Some of the quality variables are continuous indices which are explained in Table 2, as is the variable for the availability of sanitary services. The calculation of the indices follows closely that of Quigley. These indices will facilitate the derivation of marginal prices in later stages of the analysis. We experimented with dichotomous forms of these variables (that is, a different variable for each value of the index). The explanatory power of the estimating equations did not change significantly.

The neighborhood characteristics are proxied by average income in the district in which the household is located. For Davao, this is a neighborhood variable because the enumeration districts are barangays (the smallest administrative unit in the country) which have approximately 100 contiguously located households. For the Colombian cities, the neighborhood is the communa, which is a neighborhood that is similar to the barangay in size, as well as in function. For the Korean cities, neighborhoods are defined as enumeration districts.

The Davao location variable is the distance of that barangay from the CBD, which is fairly well defined in Davao as the City Hall and Central plaza. For Colombia the data allows us to develop an access variable defined as follows for this study:

$$ACCESS = w_1*CBDIST + w_2*DIST2 + \ldots + w_{13}*DIST13$$

where each $w_i$ is the percentage of total employment in a particular city (Bogota or Cali) that is employed in each of the work zones designated by Ingram; CBDIST is the distance from a residence to the Central Business District (CBD); DIST2 - DIST13 are the distances from a residence to the communa in each work zone with the highest amount of employment. This measure captures the attraction, not only of the CBD, but of other locations as well and is more appropriate for multi-centered cities.

In addition to the ACCESS variable created above, we also have constructed, from the data bases, a number of variables important to the analysis. As a measure of permanent income, we used the predicted value of a regression of current income on variables which attempt to capture the overall lifetime earnings capacity and assets of households. For the Korean and Philippine samples, this includes measures of: sex of head, age of head, household size and composition, occupation, holdings of furniture and appliance, education of the head and housing tenure. For the Colombian samples, the same measures are used plus more detailed information on the source and extent of property ownership. The results of these regressions, for the different cities, are not presented in this paper but are available from the authors.

The other computation that is crucial to the analysis is the computation of imputed monthly rent for owners. A common rule of thumb for analysis in the developed countries is to assume that imputed rent is 1 percent of value. Unfortunately, this rule is not always correct and is likely to vary inversely with the inflation rate of a country. The information that is available from the Colombian survey that suggests the rule of thumb (rent = .01 value) is a good approximation.[10] This figure is also used for the Philippines because we lack any firm evidence to the contrary. Future work should investigate the appropriateness of this assumption.

The rent to value ratio is assumed to be one-half of 1 percent for Korea. A different and smaller number is used for Korea because it is believed the rate of capital gains expectations was much larger in Korea in 1979 than in Colombia. When inflationary expectations are higher, landlords require a smaller rental rate in order to earn the market rate of return. There is little evidence available from the survey to firmly establish the exact rental rate, but what evidence does exist, is consistent with the assumption of a monthly rental rate of one-half of 1 percent.[11]

Finally, the dollar values are all reported in 1983 U.S. dollars. This is done in order to facilitate comparisons among countries. To do this the following assumptions are made regarding exchange rates: 1 $US = 7.8 Philippine pesos (1979); 1 $US = 484 Korean won (1979); and 1 $US = 39.10 Colombian pesos (1978). The source for these exchange rates is the average exchange rate published in the International Financial Statistics series. The U.S. consumer price index is then used to bring these numbers up to 1983 values.

## IV. Results

First, the results of the two-step estimation procedure--the hedonic estimation of (4) and the estimate of the reduced form parameters of the first-order conditions (7)--are presented. These results are only briefly discussed in order to focus the paper on how they are used to compute a very useful summary measure of the results--the marginal rate of substitution (MRS) between a characteristic and the non-housing commodity. Since the non-housing characteristic is assumed to have a price of unity, the MRS becomes a measure of how much households are willing to pay for one more unit of the housing characteristic.

### The Hedonic Estimates

The first step involves the estimation of an equation that predicts the rent (or imputed rent) of a particular housing unit as a function of its physical and neighborhood characteristics (equation (4)). The independent variables in the equation vary by country and, for the case of the Philippines, by tenure. The estimates of the hedonic equations for the three countries are presented as Tables A-la and A-lb of the Appendix. Ten different equations are presented since there are two cities in both Korea and Colombia.

The choice of independent variables was based on availability and prior notions regarding the most important determinants of rent. While some coefficient estimates do not conform to our *a priori* expectations, particularly in Colombia, the problem is not a serious one. The most important variables--size and quality measures--consistently produce signs in accord with our expectations.

Since the functional form for the hedonic equation cannot, in general, be specified on theoretical grounds (see Rosen, 1974), we follow other urban economists in using a Box-Cox framework to search for the appropriate one (see, for example, Goodman, 1978; Linneman, 1981; Halvorsen and Pollakowski, 1981; and Quigley, 1982). The estimation procedure used to obtain the parameters of (4) is non-linear least squares. Essentially, this procedure searches over all values of the functional form parameter ($\lambda$ = lamda) to find the parameter estimates which minimize the sum of the squared residuals.[12] This procedure produces unbiased and consistent estimates of the parameters, but it does not generally produce unbiased estimates of the t-statistics. Indeed, the procedure tends to overstate the t-statistics (see Spitzer [1982] and Blackley, Follain and Ondrich [1983]). As a result, t-statistics are not reported in Tables A-1a and A-1b.[13]

The space, quality and service variables perform the most consistently. The coefficients for ROOMS and DUAREA are always positive. The quality variables generally have positive signs, but WALLQ is negative for Bogota renters. The urban service variables--TOILET, PIPED, PHONE, COLLGAR and WIRE--all have the appropriate positive sign in their coefficient estimates.

As expected, neighborhood incomes are positively related to rental values. This captures externalities among dwellings in close proximity to one another. In order to also determine whether or not the monthly rents are also affected by the variability of income within a neighborhood, VMEANINC is included in the regression. While greater income variation is associated with lower values in Davao, the findings for the other cities are mixed.

The location variables generally have the right sign. For Davao, the data allow us only to use distance to the CBD as a variable to capture the desirability of a particular location. A more sophisticated measure which also includes the impact of other possible location of employers is available for the Colombian cities. The negative coefficients of these variables validates the hypotheses of basic location models. The Korean data base does not have any distance measures.

The results of the estimates are used to obtain (6), the marginal price of each characteristic that is a continuous variable. These prices are contained in Tables A-2a and A-2b of the Appendix. The prices are the averages of the prices for each household in the particular sample. The prices indicate how much the market price of a unit would change rather than the amount a particular household would be willing to pay for an additional unit of a characteristic. It is this latter measure that is of most interest to policymakers. The prices summarized in A-2a and A-2b are used as the dependent variables in (7) to identify willingness to pay.

Estimates of the Utility Function Parameters

The goal of this stage of the analysis is to provide estimates of the parameters of the GCES utility function. In order to do this, a system of equations is estimated. The number of equations in the system equals the number of continuous characteristics estimated in the hedonic equation minus the number of characteristics that have the unexpected sign in the hedonic. Consequently, the exact specification of the system of demand equations varies by city and tenure type.

Each system of equations is estimated by Ordinary Least Squares (OLS) with two restrictions. One, the coefficient of the log of (PERMINC - RENT) is equal across all equations; and, two, the coefficient of HHSIZE plus the coefficient of the space measure (either ROOMS or DUAREA) sum to minus unity. This is done to keep the model internally consistent with the hedonic results which provide estimates not of the price of an additional room per person (or square meter of living space per person), but rather of the price of an additional room (or square meter of living space). This is a difference between our estimates and those produced by Quigley [1982].

In addition to these two restrictions, an instrumental variables approach is used. Each right-hand side variable in the model is replaced by its predicted value from a regression that has as independent variables household current income, household permanent income and household size.

The results of the estimation are contained in Tables A-3a and A-3b of the Appendix. In and of themselves, these estimates are not very interesting since they are estimates of reduced form coefficients. However, we use these coefficients to derive measures of willingness to pay through equation (3).

Willingness to Pay Estimates

Tables 3a and 3b contain MRSs for each characteristic at the mean.[14] Consider, first, the willingness to pay measures of the various quantity variables: ROOMS, DUAREA and SPACE. The latter variable is constructed for Colombia and Korea to calculate the MRS for a 10 square meter room, a size which is quite common in this sample. It is between the average size of a room occupied by Korean renters and that occupied by Colombian renters. We have no size information for Davao residents.

In comparing the results across countries, a most consistent finding is the relatively large premium on quantity in the Korean cities, where the average household is willing to pay considerably more for an extra room ($15-$39 per month) than the average Colombian ($.21-$12 per month) or Filipino ($2-$3.50 per month) household. These figures correspond roughly to about the following percentages of rent:

| | Owners | Renters |
|---|---|---|
| Colombia | 2-5% | < 1-8% |
| Korea | 5-8% | 27-35% |
| Philippines | 10% | 15% |

Renters also seem to be willing to devote a greater proportion of rent to the purchase of another room, although strict comparisons between renters and owners cannot be made due to differences in rental measures.

Since the ROOMS variable may be a reflection of privacy rather than the size characteristic, we also calculated the willingness to pay for SPACE, or a 10 $m^2$ room. The differences were equally striking. Koreans are willing to pay $42-$53/month (10-50% of rent) compared to Colombians $3-$15/month (2-4%). In addition, the figures of MRS per room can be multiplied by HHSIZE to determine the desirability of less crowding--the willingness to pay for one more person per room. Korean WTP is more than double their Colombia or Philippine counterparts, except for Cali owners.[15]

Similar types of comparisons can be made concerning the quality and service variables, but the comparisons are made difficult by the fact that the indexes measure different things. Consequently, only a few examples are discussed to illustrate how the numbers can be used. Consider the quality variables which can be compared for Colombia and the Philippines (the Korea data have no such characteristics), WALLQ and FLOORQ. How much on average are households willing to pay to achieve the next highest value of the quality index? To obtain a brick wall (for residents of Bogota and Cali) or a smoothly finished wall (for residents of Davao), the average household is willing to spend per month (in 1983 U.S. dollars)[16].

| | Bogota | Cali | Davao |
|---|---|---|---|
| Renters | - | 2.69 | 1.33 |
| Owners | 3.96 | 3.71 | 2.51 |

These figures correspond to roughly 2-4% (Colombian cities) and 6-12% (Davao) of monthly rent. To obtain tile flooring, the average household is willing to devote per month:

| | Bogota | Cali | Davao |
|---|---|---|---|
| Renters | 6.95 | 7.43 | 5.06 |
| Owners | 53.00 | 39.56 | 7.42 |

The average owners in the three cities are willing to spend more than renters and up to a fairly narrow range of 22-34% of implicit monthly rent to upgrade the quality of their floor from cement or wood to tile.

The same formulas can be applied for the TOILET and other service characteristics. To obtain a flush toilet the willingness to pay of the average household in each city is:

| | Bogata | Cali | Seoul | Busan | Davao |
|---|---|---|---|---|---|
| Renters | 18.20 | 11.80 | 21.05 | 19.07 | 2.05 |
| Owners | 12.27 | 4.66 | 57.42 | 40.72 | .93 |

The average Korean households and the average Colombian renter households are willing to devote 15-22% of monthly rent to upgrade their sanitary facilities from pit latrines (or less) to flush toilets. Average Colombian owners and Davao residents already consume relatively high quality facilities and are willing to devote only 3-9% of monthly rent for the provision of flush toilets.

The other service variables of Table 3 are dichotomous and the method outlined in Section II is used to calculate willingness to pay. Comparisons across countries are not possible because of differences in the nature of the variables for which data were available. The average Davao residents are willing to pay almost $13.00 for an electrical connection, an amount which is over half its currently monthly rent. Since these variables (phone connection, garbage collection, electrical connection) are not crucial to the analysis, we have not presented the results of the intermediate steps to obtain the results. The estimates of equations (9) and (10) are available from the authors.

Information about the valuations households place on neighborhood characteristics is quite important. Many projects lead to changes in the type of neighborhood households locate. This may have a significant impact on the externalities distributed among the population. Neighborhood income (MEANINC), for example, might be highly correlated with a number of desirable neighborhood features such as school quality, beauty, crime, and other urban amenities and disamenities. Is there scope for raising project benefits simply by "rearranging" households?

Consider $100 in MEANINC, neighborhood mean income. This corresponds to about a 20% improvement in neighborhood income for the average Colombian and Korean renter households; 11-14% for Korean owners; and 37% for Davao residents. Tables 3a and 3b indicate that the willingness to pay for these improvements are small. Colombian and Korean households are willing to pay less than 1% of monthly rent for such improvements. Davao residents are willing to pay around 1-3 percent of rent. We conclude that the perceived benefits due to externalities are small.

The same type of statement can be made with regard to the measure of the dispersion of the income of the neighborhood. The average household appears to be unwilling to pay much to have a homogeneous neighborhood--at least, a homogeneous one defined in terms of income dispersion.

Finally, location is of great importance in a public program's benefit and cost calculation if it is to provide housing services. We were able to calculate the willingness to pay for access, measured in two ways. The measure in Davao is DIST (kilometers to the Central Business District). Living one kilometer closer to the CBD is worth about \$.55 for renters and \$.18 for owners. Or, put differently, a renter would be willing to pay about 2 percent more in rent to move from his average location (1.66 kilometers) to a location one kilometer closer to the CBD. We would consider this a relatively modest amount. It is not surprising given that households live so close to the CBD already. It suggests, therefore, that the location of a project at the Davao CBD or a couple of kilometers away would not make much difference to the success of the project. This may be significant depending on acquisition costs of alternative sites.

A more general access measure is used for Colombia that measures the general attractiveness of a location to major employment centers. (Place-of-work data were not available for the other countries.) It is, however, quite closely correlated with distance to the CBD since the CBD is the single most important employment center in Bogota and Cali. The MRSs indicate that households in Colombia are generally willing to pay more to obtain access to employment than the Davao residents are willing to pay to be closer to the CBD. Renters in both Cali and Bogota are willing to pay between \$2.58 and \$6.38 to live closer to work centers. Bogota owners, on the other hand, are not willing to pay a premium for access to employment centers. The very large number for Cali owners must be the result of a quirk in the sample, such as an unidentified outlier.

Trade-offs Among Characteristics

A potentially useful way of interpreting the results outlined in the previous subsection is to derive the amount of one characteristic a household would be willing to give up for an additional unit of some other characteristic. This can be done simply by dividing the MRS of any two characteristics. Because of the large number of possible "matchings" possible, we focus the discussion on only a few policy-relevant ones.

Project designers are frequently faced with the choice of quantity versus service or structural quality. For a particular target population, to what extent can size be substituted for quality to provide the same level of benefits? In some countries, higher quality materials may have to be imported and thus costly while land may be relatively expensive. In others, such as countries that are more highly developed, materials inputs may be cheap but land in their dense cities may be at a premium.

For our samples, the following results are found:

| | | Bogota | Cali | Seoul | Busan | Davao |
|---|---|---|---|---|---|---|
| Renters | ROOMS/WALLQ | - | .67 | - | - | 1.52 |
| | ROOMS/TOILET | .01 | .37 | .37 | 3.11 | 3.51 |
| Owners | ROOMS/WALLQ | .10 | 1.19 | - | - | .47 |
| | ROOMS/TOILET | .08 | .79 | .16 | .47 | 5.73 |

The figures are the numbers of units of quality households are willing to trade off for one more room. The Davao average renter, for example, would be indifferent between an additional room and shifting from its present wall quality (index value $= 2.5$) to a brick wall (index value $= 4 \approx 2.5 + 1.52$). However, it is difficult to infer any general trends in the trade-off between rooms and wall quality. For all subsamples except Davao residents and Busan renters, spot elasticities indicate that the average household would be indifferent between a doubling of rooms and less than doubling of the toilet facilities index.

Another critical concern is quantity versus location. Using elasticities, we can calculate the number of rooms that a household would be willing to give up to be located at the CBD:

| | Bogota | Cali | Davao |
|---|---|---|---|
| Renters | .002 | .25 | .21 |
| Owners | - | - | .39 |

This indicates that the average Davao owner, who is located 2.48 kilometers from the CBD, would be willing to give up only .4 of one room to be located at the CBD, while the average Davao renter, would be willing to give up .2 of a room. Colombian renters and owners are also willing to give up very little room to have the best access measure possible.

Willingness to Pay by Household Characteristics

This section presents estimates of the MRSs for all the characteristics by household size (Tables 4a-4c) broken down by three categories (1-2 persons; 3-5 persons; greater than 5 persons) and by permanent income quintile (Tables 5a-5c). These measures are important since housing programs are meant for particular "target" groups whose willingness to pay may differ from that of the average household. The distributional implications of alternative bundles of services provided would also be useful to obtain, since most housing projects encompass a fairly wide range of household types.

The most interesting finding from Tables 5a-5c is that the willingness to pay for an additional unit of a dwelling's size declines with household size. This is so for all measures of quantity: ROOMS, DUAREA and SPACE.

In almost every subsample (except for Korean renters, for whom the differences are small), the average 1-2 person household is willing to pay more for one more room, one more square meter or one more 10 $m^2$ room than the average household with greater than 5 members.

How do we explain these results? As household sizes rise the willingness to pay curve will shift out. At the same level of quantity, willingness to pay rises. However, larger households will also tend to occupy more space. This will tend to lower their willingness to pay for additional space. Thus, our results indicate that a housing project which added more space to what households already consumed would be more beneficial to the average small household than the average large household.

The results regarding the other groups of variables are not as dramatic but remain of some interest. Willingness to pay for quality and urban services tends to rise as household size increases, except for Colombia where no marked pattern can be discerned. There is also some evidence that the willingness to pay for access rises with household size. Larger households in Davao, for example, would benefit more from a project closer to the CBD than smaller households.

Tables 6a-6c focus on the variation in the willingness to pay measures by permanent income quintiles. Renters in Korea and all Davao residents show an increased willingness to pay for an additional room as income rises. For these households, consider a project that increased the number of rooms. If the target beneficiary population varied by income, the benefits of such a project would be regressive. The opposite pattern holds for Colombian renters and Korean owners.

Now consider the variations in the MRSs for the quality and urban service variables--STRUCQ, WALLQ, FLOORQ, ROOFQ, and TOILET--by income. The pattern reveals that the MRSs for almost all of the quality variables and the toilet facilities index increase substantially and directly with income. The MRS for STRUCQ in Davao shows this pattern most clearly. It increases by almost 7 times for renters and almost 10 times for owners as one moves from the lowest to the highest income quintile. Similarly dramatic increases are seen for WALLQ and FLOORQ in Davao and the Colombian cities. (A notable exception to the pattern involves the lowest income quintile for Colombian households, which we attribute to the probable presence of a few outliers.) These results indicate that a project that traded off increased size for greater structural quality and increased urban services would benefit a richer Colombian household more than a poorer one.

The tables reveal an interesting link between the desirability of being in a higher income neighborhood and household income. The willingness to pay for being in a richer neighborhood rises with income for almost every subsample. This reveals that richer households have the most to gain in terms of externalities associated with the neighborhood--and the most to lose in being relegated to a poorer one. The link also appears to be stronger for owners than renters, but this difference is not consistently large and given the previously stated caveat regarding owner-renter comparisons, its importance should not be stressed.

Since the willingness to pay for a better location is not estimated for Bogota owners (due to its poor performance in the hedonic) or for any of the Korean cities, and due to the fact that the number for Cali owners is unreasonable, only the MRS calculations for the following groups are meaningful: Bogota renters, Cali renters, and Davao renters and owners. For these four cases, the MRS is positively related to income. The average higher income household is willing to pay more to locate closer to an employment center (for Colombian renters) or to the CBD (for Davao residents) than the average lower income household. The strongest link exists in Davao and the weakest is for Cali renters, but even for Cali renters the MRS rises from $5.93 in the lowest quintile to $7.20, a 20 percent increase. Thus, it is quite reasonable to conclude that, at least for renters, the willingness to pay for ACCESS or DIST is quite responsive to income.

## V. Conclusions

This paper has adopted the method introduced by Quigley to obtain estimates of the marginal willingness to pay for housing characteristic in several developing countries. These estimates provide useful insights into the appropriateness of alternative designs of urban development projects. In this section, we will first review the main results derived in the paper. This will be followed by a brief discussion about other possible uses for the results.

The main conclusions revolve around the findings of the marginal willingness to pay for housing characteristics of the average household in Bogota, Cali, Seoul, Busan and Davao: (1) The average Korean household in Seoul or Busan is willing to pay significantly more in absolute dollar ammounts as well as in relation to rent for an additional unit of living space when compared to the average Colombian or Philippine household. (2) Owner households for all the cities are willing to spend within a fairly narrow range of 2-10% of implicit monthly rent for an additional room. For renters, the range of willingness to pay as a proportion of rent paid is considerably wider across the subsamples. (3) The average Colombian or Philippine owner household is willing to spend a hefty 22-34% of implicit monthly rent to upgrade its floor quality to tile material. (4) There are large differences in the willingness to pay for the upgrading of sanitary facilities, and these differences depend on the current consumption. (5) The benefits from externalities of neighboring properties, measured as the willingness to pay for increases in average neighborhood incomes, is small for the average household. Projects which attempt to "mix" household types should not overestimate the value to poorer households of being close to richer ones. (6) Our findings indicate that the desirability of being located near the CBD is relatively small. Thus, at least for Davao, proximity to the CBD is not a primary source of housing service benefits. However, proximity to employment centers (where the CBD is only one of many centers) is important for Colombian households.

We have also attempted to determine the distributional implications of providing certain packages of services. This is a concern especially for slum upgrading projects, where individual households do not apply to be project beneficiaries but are chosen by neighborhood to be the subjects of on-site development. Given the relatively wide mix of household types which are likely to be included in such a project, it is important to trace the distribution of benefits. Consider, for example, two projects, A and B, which cost the same. Project A provides smaller dwellings but higher levels of structural quality and urban services than Project B. According to our results for Colombia, the benefits of Project A would be regressive--the richer households among the recipient households would benefit more than poorer households.

Some projects can distinguish the characteristics of the intended beneficiaries (such as in sites and services projects where participants apply individually). The breakdowns of willingness to pay by household characteristics are, in this case, important in identifying the appropriate bundle of services that would yield the highest benefit for particular target groups. For example, our results lend some credence to the assertions of social scientists, such as Turner, that lower income households place a greater priority on space and access relative to quality and the level of urban services.

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## FOOTNOTES

[1]The World Bank and its IDA affiliate by themselves have lent over $4 billion in the past ten years for these shelter projects (World Bank, 1982).

[2]The conventional approach to the estimation of the benefit of the public provision of housing services is to assume that households consume a composite bundle of services. Household expenditures on housing are assumed to be a suitable proxy variable to measure this bundle. (See Muth). This approach does not allow any insights into how households trade off one characteristic for another, which would be operationally useful. Moreover, it assumes that households agree to rank heterogeneous housing services that they yield. These housing services are the units of consumption. Households, of course, may not perform this ranking in precisely the same way. If the rankings differed in a random fashion, then this would still allow the unbiased estimation of a unique demand curve. However, if the rankings differed systematically, then analysts would have to be careful that the willingness to pay for each group was taken into account. For example, a structure that was located closer to a school than another but was otherwise similar to it would most likely yield a greater flow of services to a household with children of school age than to a household composed of a childless couple.

[3]An extensive literature review, which is contained in Follain and Jimenez (1983), is beyond the scope of this paper. Much of the recent work concentrates on the demand for air quality and include: Harrison and Rubinfeld (1978a, 1978b), Nelson (1978), Freeman (1979),

[4]$-(\partial x/\partial z_i|\bar{u}) = MRS = (\partial u/\partial z_i)/(\partial u/\partial x)$.

[5]See Freeman and Blomqvist and Worley (1982) for comprehensive discussions about the possible identification problems of systems of demand equations. In Follain and Jimenez (1983) we claim, that with micro level data, it is not crucial to worry about specifying the supply side since households should be price takers.

[6]The instrumental variables are derived by regressing each of the independent variables on permanent income and household size. These results are available from the authors.

[7]The equation $u = \sum_{j=1}^{m} \alpha_j z_j^{\gamma_j} + [y - p(z)]^{\epsilon}$ is rewritten as $y - p(z) = (u - \sum_{j=1}^{m} \alpha_j z_j^{\gamma_j})^{1/\epsilon}$. An error term is added to the latter expression which is used as the estimating equation. Note that utility is assumed to be constant for each group. The groups are formed under the assumption that households within a certain income range and household size all have the same level of utility.

[8] Some interesting statistics are as follows:

| | Colombia | Korea | Philippines |
|---|---|---|---|
| GNP per capita (1980 US$) | 1,139 | 1,520 | 690 |
| Growth Rate (%) (1960-1980) | 8.0 | 7.0 | 2.8 |
| Urbanization Rate (%) | 70 | 55 | 36 |
| Growth Rate of Urban Population (%) | 3.9 | 6.4 | 3.6 |

[9] For squatter households, the price structure which relates rental or sale values to the housing characteristics would most likely differ between households in the so-called "formal" sector and those in the "informal" squatting sector where security of tenure varies. Depending upon the costs of being evicted, for example, certain urban services, to which relatively few squatting households would have access, might be valued not for their inherent usefulness, but because they may signal greater security of tenure.

[10] The survey asks owners the imputed rental value of the unit. The ratio of the mean of this variable to the mean value of the units in the sample is approximately .01. It might be added that although the variable provides some information about the mean rent to value ratio, it is not used as the dependent variable in the hedonic because the variable is believed to be subject to more measurement error than is the owner's estimate of the market value of the house. Also, this would limit the comparability of the Colombian with the other data sets.

[11] The evidence comes from an analysis of the responses of about 300 households who provided information about the value of the structure and the chonsei being paid for the unit. The ratio allows one to calculate the rate landlords earn by renting the houses--that is, the imputed rental rate. The imputed rental rate equals the market interest rate (assumed to be .36) multiplied by the ratio of chonsei to value. This calculation suggests a monthly rental rate of one-half of 1 percent.

Special computations are required to compute rental payments for some Korean renters since the form of rental tenure takes many different forms in Korea. Essentially, rental payments take two forms: monthly payment or deduction plus interest lost on equity deposited with the landlord. In order to convert the different payment schemes into a common monthly rental cost, it is assumed that the opportunity cost of funds is .36 per year.

[12] Note that the functional form parameter, lamda, is consistently close to 0. This suggests that the semi-log specification is a good approximation to the best-fit functional form.

[13] The $R^2$ statistics give some idea of the predictive power of the equations. The range of the estimates is from .339 to .650. Interestingly, the Korean model contains both the smallest and the largest values of $R^2$.

[14] The exact equations for the MRS between characteristic i and the numeraire (x) are:

$$MRS_i = \frac{\gamma_i \alpha_i \, HHSIZE^{-\gamma_i} \, z_i^{\gamma_i - 1}}{\varepsilon (PERMINC - RENT)^{\varepsilon - 1}} \qquad i = ROOMS \ \& \ DUAREA$$

$$MRS_i = \frac{\gamma_i \alpha_i \, z_i^{\gamma_i - 1}}{\varepsilon (PERMINC - RENT)^{\varepsilon - 1}} \qquad \text{for all other i's.}$$

For the Philippine data, the MRS's are computed at the mean of each characteristic. For Colombia and Korea, they are computed at the mean MRS.

[15] The WTP figures are (US$ for an additional room per person):

| | Bogota | Cali | Seoul | Busan | Davao |
|---|---|---|---|---|---|
| Renters | .90 | 21.62 | 50.35 | 136.07 | 19.26 |
| Owners | 22.56 | 67.98 | 44.20 | 111.93 | 13.61 |

[16] The calculations are derived as follows: Spot elasticities are calculated for each city as $e = (\Delta x/\bar{x})/(\Delta z_i/\bar{z}_i) = MRS\ (\bar{z}_i/\bar{x})$ for the $i^{th}$ characteristic and average values $\bar{x}$ and $\bar{z}_i$. The willingness to pay for $(\Delta z_i^*/\bar{z}_i)$, the percentage difference between the actual consumption of the $i^{th}$ characteristic and the next highest value of the index, would be $\Delta x = e(\Delta z_i^*/\bar{z}_i)\bar{x}$.

[17] A separate division is used for renters and owners in Colombia and Korea. The observations for Davao are also broken down into income quintiles, but the division is the same for owners and renters.

TABLE 1

VARIABLE LIST

| | | | |
|---|---|---|---|
| Size | ROOMS | C,K,P | Number of rooms in dwelling unit |
| | DUAREA | C,K | Size of living area ($m^2$) |
| | SPACE | C,K | A 10 $m^2$ room |
| Quality | STRUCQ | P | Structural condition index: 1 = poor, 2 = average, 3 = good |
| | WALLQ | C,P | Wall quality index:<br>C:1 = scrap or variable material; 2 = adobe or wood; 3 = prefabricated; 4 = brick<br>P:1 = scrap, bamboo; 2 = rough lumber; 3 = smooth |
| | FLOORQ | C,P | Floor quality index:<br>C:1 = earth; 2 = cement or wood; 3 = tile/synthetic<br>P:1 = earth, bamboo; 2 = wood; 3 = cement; 4 = tile |
| | ROOFQ | C | Roof quality index:<br>1 = scrap or variable material; 2 = clay, zinc or tile; 3 = concrete or cement |
| Services | TOILET | C,K,P | Sanitary quality index:<br>C:2 = none or shared; 3 = exclusive latrine; 4 = own toilet or septic tank<br>K:1 = no facility; 2 = pit latrine; 3 = flush toilet<br>P:1 = pit; 2 = public; 5 = private outhouse; 10 = private flush |
| | PIPED | K | Presence of piped water (1,0) |
| | COLLGAR | P | Garbage collected (1,0) |
| | WIRE | P | Structure wired for electricity (1,0) |
| | PHONE | P,C | Phone connection (1,0) |
| Neighborhood | DIST | P | Average number of kilometers from center of enumeration district to CBD |
| | ACCESS | C | Measure of accessibility defined in text |
| | MEANINC | C,K,P | Average income of the neighborhood:<br>C: communa; K: enumeration district; P: barangay |
| | VMEANINC | C,K,P | Variability of neighborhood income:<br>C,K: variance of income; P: standard deviation |
| Other Variables | RENT | C,K,P | Monthly rent for renters; imputed monthly rent for owners (calculated as 1 percent of the sale value for C and P; .5 percent of the sale value for K) |
| | INC | C,K,P | Current monthly household income |
| | PERMINC | C,K,P | Permanent monthly household income (described in the text) |
| | HHSIZE | C,K,P | Household size |

Country Code: C = Colombia
K = Korea
P = Philippines

TABLE 2a

MEANS OF VARIABLES: RENTERS[a]

| | COLOMBIA | | KOREA | | PHILIPPINES |
|---|---|---|---|---|---|
| | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
| ROOMS | 5.67 (3.13) | 4.70 (2.03) | 1.30 (.61) | 1.36 (.56) | 3.25 (1.22) |
| DUAREA | 67.78 (77.20) | 65.35 (72.30) | 10.99 (9.30) | 10.56 (5.50) | - |
| STRUCQ | - | - | - | - | 2.84 0.62 |
| WALLQ | 3.86 (.57) | 3.66 (.89) | - | - | 2.43 (.53) |
| FLOORQ | 2.19 (.46) | 2.64 (.52) | - | - | 2.22 (.45) |
| ROOFQ | 2.49 (.54) | 2.22 (.43) | - | - | - |
| TOILET | 2.98 (1.00) | 2.91 (1.00) | 1.52 (1.06) | 1.30 (.79) | 7.97 (2.98) |
| PIPED | - | - | .89 (.31) | .84 (.37) | - |
| COLLGAR | - | - | - | - | .67 (.02) |
| WIRE | - | - | - | - | .88 (.33) |
| PHONE | .63 (.48) | .22 (.42) | - | - | .10 (.01) |
| DIST | - | - | - | - | 1.66 (1.43) |
| ACCESS | 7.25 (2.03) | 3.30 (1.13) | - | - | - |
| MEANINC[a] | 494.84 | 443.51 | 644.90 | 574.42 | 278.09 |
| VMEANINC[a] ('000) | 155129.87 (235914.71) | 141031.35 (204746.19) | $20946 \times 10^3$ ($62871 \times 10^3$) | $106789 \times 10^3$ ($38730 \times 10^3$) | 1615.00 (1315.70) |
| RENT[a] | 80.62 | 69.14 | 144.32 | 99.07 | 23.60 |
| INC[a] | 409.28 | 405.11 | 546.88 | 502.0 | 249.50 |
| PERMINC[a] | 410.44 | 405.11 | 602.42 | 528.94 | 205.30 |
| HHSIZE | 4.27 (2.10) | 4.08 (2.19) | 3.75 (1.62) | 3.90 (1.76) | 5.44 (2.34) |
| X = INC - RENT | 328.66 | 335.97 | 402.56 | 402.93 | 225.90 |
| N | 1023 | 261 | 1434 | 512 | 889 |

[a]All figures are in 1983 US dollars.

TABLE 2b

MEANS OF VARIABLES: OWNERS[a]

| | COLOMBIA | | KOREA | | PHILIPPINES |
|---|---|---|---|---|---|
| | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
| ROOMS | 5.10 (2.97) | 4.28 (1.92) | 2.90 (1.50) | 2.55 (1.01) | 4.01 (1.46) |
| DUAREA | 173.02 (147.26) | 124.87 (87.87) | 79.64 (53.45) | 67.99 (37.33) | - |
| STRUCQ | - | - | - | - | 2.89 (0.62) |
| WALLQ | 3.90 (0.45) | 3.64 (.92) | - | - | 2.45 (0.54) |
| FLOORQ | 2.06 (.40) | 2.40 (.60) | - | - | 2.24 (0.52) |
| ROOFQ | 2.42 (.53) | 2.18 (.43) | - | - | - |
| TOILET | 3.75 (.65) | 3.70 (.70) | 2.40 (.55) | 2.09 (0.45) | 7.49 (3.12) |
| PIPED | - | - | .90 (.31) | .83 (.38) | - |
| COLLGAR | - | - | - | - | .50 (.02) |
| WIRE | - | - | - | - | .86 (.01) |
| PHONE | .66 (.47) | .25 (.43) | - | - | .12 (.01) |
| DIST | - | - | - | - | 2.48 (2.14) |
| ACCESS | 8.14 (2.46) | 4.12 (1.25) | - | - | - |
| MEANINC[a] | 574.12 | 489.47 | 721.97 | 594.30 | 267.73 |
| VMEANINC[a] ('000) | 222880.0 (345065.0) | 156660.07 (220588.96) | 13176.4 x $10^4$ (84991 x $10^3$) | 12574 x $10^3$ (8870 x $10^3$) | 1517.90 (1256.80) |
| RENT[a] | 240.38 | 138.45 | 336.98 | 252.09 | 21.82 |
| INC[a] | 678.52 | 528.09 | 879.38 | 723.67 | 302.13 |
| PERMINC[a] | 678.75 | 528.09 | 794.33 | 674.66 | 234.22 |
| HHSIZE | 5.65 (2.28) | 5.54 (2.35) | 5.17 (1.75) | 5.27 (1.68) | 6.42 (2.65) |
| X = INC - RENT | 438.14 | 389.64 | 457.35 | 471.58 | 280.31 |
| N | 837 | 260 | 956 | 300 | 952 |

[a]All figures are in 1983 U.S. Dollars.

TABLE 3a

MARGINAL RATE OF SUBSTITUTION: RENTERS[a]

| | COLOMBIA | | KOREA | | PHILIPPINES |
|---|---|---|---|---|---|
| | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
| ROOMS | .21 | 5.30 | 38.73 | 34.89 | 3.54 |
| DUAREA | .30 | .32 | 1.33 | 1.85 | -- |
| SPACE | 3.24 | 8.53 | 52.06 | 53.35 | -- |
| STRUCQ | -- | -- | -- | -- | 4.77 |
| WALLQ | -- | 7.91 | -- | -- | 2.33 |
| FLOORQ | 3.92 | 14.88 | -- | -- | 6.49 |
| ROOFQ | 8.55 | 36.02 | -- | -- | -- |
| TOILET | 17.84 | 14.20 | 14.21 | 11.21 | 1.01 |
| PIPED | -- | -- | | | -- |
| COLLGAR | -- | -- | -- | -- | 1.38 |
| WIRE | -- | -- | -- | -- | -- |
| PHONE | | | -- | -- | -- |
| DIST | -- | -- | -- | -- | .55 |
| ACCESS | 2.58 | 6.38 | -- | -- | -- |
| MEANINC | .0013 | .0006 | .00037 | .00013 | .0064 |
| VMEANINC ('000) | * | .00003 | $.0003 \times 10^{-3}$ | -- | .0023855 |
| N | 1023 | 261 | 1434 | 512 | 889 |

[a]All figures are in 1983 U.S. dollars; evaluated at mean values.

* signifies that this value is not computed because the variable had the wrong sign in the hedonic equation.

-- signifies that this variable does not exist for this city.

TABLE 3b

MARGINAL RATES OF SUBSTITUTION: OWNERS[a]

| | COLOMBIA | | KOREA | | PHILIPPINES |
|---|---|---|---|---|---|
| | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
| ROOMS | 4.00 | 12.27 | 15.24 | 21.24 | 2.12 |
| DUAREA | .17 | .30 | 2.40 | 2.04 | -- |
| SPACE | 5.73 | 15.27 | 39.28 | 41.69 | -- |
| STRUCQ | -- | -- | -- | -- | 7.15 |
| WALLQ | 39.57 | 10.30 | -- | -- | 4.57 |
| FLOORQ | 47.99 | 72.58 | -- | -- | 4.22 |
| ROOFQ | .88 | 33.54 | -- | -- | -- |
| TOILET | 49.07 | 15.54 | 95.70 | 44.75 | .37 |
| PIPED | -- | -- | | | -- |
| COLLGAR | -- | -- | -- | -- | -- |
| WIRE | -- | -- | -- | -- | 12.97 |
| PHONE | | | -- | -- | -- |
| DIST | -- | -- | -- | -- | .1835 |
| ACCESS | * | $1 \times 10^{15}$ | -- | -- | -- |
| MEANINC | .013 | .01126 | .00033 | .00024 | .0031 |
| VMEANINC ('000) | * | .00027 | -- | $.006 \times 10^{-3}$ | .0001835 |
| N | 837 | 260 | 956 | 300 | 952 |

[a]All figures are in 1983 U.S. dollars; evaluated at mean values

*signifies that this value is not computed because the variable had the wrong sign in the hedonic equation

-- signifies that this variable does not exist for this city.

TABLE 4a

Marginal Rates of Substitution for Colombia by HHSIZE

| Variables | Bogota Renters HHSIZE (1-2) | Bogota Renters HHSIZE (3-5) | Bogota Renters HHSIZE (> 5) | Cali Renters HHSIZE (1-2) | Cali Renters HHSIZE (3-5) | Cali Renters HHSIZE (> 5) |
|---|---|---|---|---|---|---|
| Mean of | | | | | | |
| HHSIZE | 1.66 | 3.87 | 7.26 | 1.62 | 3.82 | 7.31 |
| ROOMS | .18 | .20 | .27 | 4.42 | 4.38 | 5.67 |
| DUAREA | .50 | .30 | .18 | .52 | .30 | .19 |
| SPACE | 5.21 | 3.16 | 2.11 | 9.64 | 7.33 | 7.52 |
| WALLQ | -- | -- | -- | 10.44 | 7.44 | 6.48 |
| FLOORQ | 3.70 | 3.86 | 4.22 | 15.26 | 14.87 | 15.29 |
| ROOFQ | 8.12 | 8.46 | 9.05 | 7.41 | 59.57 | 7.64 |
| TOILET | 19.13 | 18.35 | 15.77 | 14.98 | 14.14 | 13.53 |
| PHONE | | | | | | |
| MEANINC | .0012 | .0013 | .0013 | .0006 | .0006 | .0007 |
| VMEANINC | -- | -- | -- | $.028725 \times 10^{-3}$ | $.028725 \times 10^{-3}$ | $.031406 \times 10^{-3}$ |
| ACCESS | 2.43 | 2.55 | 2.78 | 7.85 | 6.12 | 5.52 |
| N | 164 | 567 | 240 | 59 | 142 | 58 |

| Variables | Bogota Owners HHSIZE (1-2) | Bogota Owners HHSIZE (3-5) | Bogota Owners HHSIZE (> 5) | Cali Owners HHSIZE (1-2) | Cali Owners HHSIZE (3-5) | Cali Owners HHSIZE (> 5) |
|---|---|---|---|---|---|---|
| Mean of | | | | | | |
| HHSIZE | 1.74 | 4.26 | 7.46 | 2.00 | 4.09 | 7.40 |
| ROOMS | 11.93 | 4.51 | 2.60 | 36.50 | 13.99 | 7.28 |
| DUAREA | .54 | .19 | .11 | .96 | .34 | .17 |
| SPACE | 17.29 | 6.46 | 3.69 | 46.07 | 17.43 | 8.96 |
| WALLQ | 37.83 | 38.86 | 40.44 | 7.89 | 10.60 | 10.37 |
| FLOORQ | 59.34 | 47.57 | 47.05 | 31.02 | 72.53 | 78.56 |
| ROOFQ | .81 | .89 | .89 | 34.16 | 34.41 | 32.68 |
| TOILET | 38.59 | 48.95 | 50.42 | 10.03 | 15.61 | 16.27 |
| PHONE | | | | | | |
| MEANINC | .016 | .014 | .012 | .013 | .014 | .009 |
| VMEANINC | -- | -- | -- | $.2298 \times 10^{-3}$ | $.292229 \times 10^{-3}$ | $.216012 \times 10^{-3}$ |
| ACCESS | -- | -- | -- | $3.03 \times 10^{10}$ | $5.02 \times 10^{14}$ | $1.75 \times 10^{15}$ |
| N | 46 | 369 | 392 | 18 | 112 | 126 |

TABLE 4b

Marginal Rates of Substitution for Korea by HHSIZE

| Variable | Busan Renters HHSIZE (1-2) | Busan Renters HHSIZE (3-5) | Busan Renters HHSIZE (> 5) | Seoul Renters HHSIZE (1-2) | Seoul Renters HHSIZE (3-5) | Seoul Renters HHSIZE (> 5) |
|---|---|---|---|---|---|---|
| Mean of | | | | | | |
| HHSIZE | 1.72 | 3.95 | 6.90 | 1.70 | 3.91 | 6.50 |
| ROOMS | 29.24 | 36.99 | 34.37 | 35.05 | 40.56 | 37.14 |
| DUAREA | 1.69 | 1.90 | 1.90 | 1.31 | 1.37 | 1.22 |
| SPACE | 46.14 | 55.99 | 53.37 | 48.17 | 54.25 | 49.33 |
| TOILET | 10.19 | 11.36 | 12.07 | 13.00 | 14.40 | 15.41 |
| PIPED | | | | | | |
| MEANINC | $0.12 \times 10^{-3}$ | $0.13 \times 10^{-3}$ | $0.14 \times 10^{-3}$ | .00031 | .00038 | .00045 |
| VMEANINC | -- | -- | -- | $.000196 \times 10^{-3}$ | $.000224 \times 10^{-3}$ | $.000336 \times 10^{-3}$ |
| N | 112 | 321 | 77 | 343 | 872 | 208 |

| Variable | Busan Owners HHSIZE (1-2) | Busan Owners HHSIZE (3-5) | Busan Owners HHSIZE (> 5) | Seoul Owners HHSIZE (1-2) | Seoul Owners HHSIZE (3-5) | Seoul Owners HHSIZE (> 5) |
|---|---|---|---|---|---|---|
| Mean of | | | | | | |
| HHSIZE | 1.75 | 4.30 | 6.82 | 1.81 | 4.33 | 6.87 |
| ROOMS | 26.63 | 22.75 | 19.01 | 25.35 | 16.30 | 12.40 |
| DUAREA | 1.98 | 2.13 | 1.95 | 4.30 | 2.58 | 1.91 |
| SPACE | 46.43 | 44.05 | 38.51 | 68.36 | 42.06 | 31.51 |
| TOILET | 31.40 | 43.78 | 46.88 | 79.25 | 94.10 | 100.13 |
| PIPED | | | | | | |
| MEANINC | .0002 | .0002 | .0002 | .00026 | .00032 | .00035 |
| VMEANINC | $.00308 \times 10^{-3}$ | $.0042 \times 10^{-3}$ | $.00476 \times 10^{-3}$ | -- | -- | -- |
| N | 9 | 155 | 127 | 44 | 516 | 349 |

TABLE 4c

Marginal Rates of Substitution for Davao by HHSIZE

| Variable | HHSIZE (1-2) | HHSIZE (3-4) | HHSIZE (> 5) |
|---|---|---|---|
| | | Renters | |
| Mean of HHSIZE | 1.93 | 3.58 | 6.83 |
| ROOMS | 4.92 | 3.60 | 3.51 |
| STRUCQ | 2.89 | 3.64 | 5.63 |
| WALLQ | 1.45 | 1.75 | 2.77 |
| FLOORQ | 3.95 | 4.92 | 7.67 |
| TOILET | .66 | .75 | 1.19 |
| COLLGAR | 2.35 | 3.11 | -4.14 |
| DIST | .33 | .42 | .61 |
| MEANINC | .0042 | .0048 | .0077 |
| VMEANINC | .00155975 | .00166985 | .00280755 |
| N | 55 | 298 | 536 |
| | | Owners | |
| Mean of HHSIZE | 1.91 | 3.55 | 7.45 |
| ROOMS | 2.29 | 1.86 | 2.20 |
| STRUCQ | 3.25 | 4.10 | 8.35 |
| WALLQ | 2.06 | 2.68 | 5.30 |
| FLOORQ | 1.91 | 2.41 | 4.95 |
| TOILET | .16 | .22 | .43 |
| WIRE | 8.14 | 13.72 | 14.03 |
| DIST | .13 | .13 | .18 |
| MEANINC | .0014 | .0019 | .0037 |
| VMEANINC | .0001101 | .0001468 | .0002936 |
| N | 56 | 173 | 723 |

TABLE 5a

MRS for Columbia by PERMINC Quintile

| Variable | Bogota Renters First Quintile | Bogota Renters Second Quintile | Bogota Renters Third Quintile | Bogota Renters Fourth Quintile | Bogota Renters Fifth Quintile | Cali Renters First Quintile | Cali Renters Second Quintile | Cali Renters Third Quintile | Cali Renters Fourth Quintile | Cali Renters Fifth Quintile |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean of PERMINC | 72.17 | 207.34 | 340.79 | 496.73 | 937.73 | 138.52 | 255.84 | 347.34 | 447.68 | 837.2[illegible] |
| ROOMS | 0.16 | .19 | .20 | .24 | .25 | 5.72 | 5.42 | 5.53 | 5.14 | 4.7[illegible] |
| DUAREA | .37 | .34 | .33 | .28 | .21 | .40 | .37 | .34 | .29 | .[illegible] |
| SPACE | 3.91 | 3.36 | 3.50 | 3.01 | 2.32 | 9.71 | 9.10 | 8.96 | 8.04 | 6.[illegible] |
| WALLQ | -- | -- | -- | -- | -- | 13.64 | 6.79 | 5.60 | 2.75 | 11.[illegible] |
| FLOORQ | 2.84 | 3.53 | 3.92 | 4.27 | 4.78 | 11.49 | 13.20 | 15.39 | 16.47 | 17.7[illegible] |
| ROOFQ | 5.66 | 7.55 | 8.66 | 9.20 | 10.99 | 155.95 | 6.82 | 6.38 | 7.85 | 8.[illegible] |
| TOILET | 16.76 | 18.96 | 19.33 | 17.94 | 15.96 | 12.71 | 14.60 | 15.54 | 14.11 | 13.[illegible] |
| PHONE | | | | | | | | | | |
| MEANINC | $0.89x10^{-3}$ | $1.11x10^{-3}$ | $1.25x10^{-3}$ | $1.36x10^{-3}$ | $1.57x10^{-3}$ | $.47x10^{-3}$ | $.56x10^{-3}$ | $.61x10^{-3}$ | $.67x10^{-3}$ | .81x[illegible] |
| VMEANINC | -- | -- | -- | -- | -- | $.021448x10^{-3}$ | $.025278x10^{-3}$ | $.028725x10^{-3}$ | $.031789x10^{-3}$ | .039332x[illegible] |
| ACCESS | 1.90 | 2.34 | 2.60 | 2.82 | 3.11 | 5.93 | 5.78 | 6.59 | 6.36 | 7.[illegible] |
| N | 156 | 202 | 204 | 204 | 204 | 50 | 52 | 53 | 52 | 52 |

| Variable | Bogota Owners First Quintile | Bogota Owners Second Quintile | Bogota Owners Third Quintile | Bogota Owners Fourth Quintile | Bogota Owners Fifth Quintile | Cali Owners First Quintile | Cali Owners Second Quintile | Cali Owners Third Quintile | Cali Owners Fourth Quintile | Cali Owners Fifth Quintile |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean of PERMINC | 223.10 | 408.96 | 552.37 | 839.88 | 1370.87 | 212.56 | 335.08 | 447.38 | 586.43 | 1038.[illegible] |
| ROOMS | 4.26 | 3.77 | 3.70 | 4.19 | 4.11 | 9.31 | 8.63 | 11.65 | 13.44 | 18.[illegible] |
| DUAREA | 0.18 | 0.16 | .16 | .19 | .18 | .21 | .19 | .28 | .32 | .[illegible] |
| SPACE | 6.03 | 5.37 | 5.29 | 6.05 | 5.95 | 11.42 | 10.49 | 14.41 | 16.63 | 23.[illegible] |
| WALLQ | 34.02 | 38.01 | 40.06 | 42.28 | 43.14 | 6.02 | 8.55 | 10.65 | 11.10 | 15.[illegible] |
| FLOORQ | 47.74 | 48.11 | 56.62 | 43.71 | 43.60 | 44.93 | 62.58 | 75.31 | 69.59 | 111.[illegible] |
| ROOFQ | .66 | .86 | .91 | .94 | 1.04 | 21.33 | 29.23 | 33.12 | 37.64 | 46.[illegible] |
| TOILET | 38.81 | 44.34 | 48.45 | 53.45 | 59.84 | 9.11 | 12.94 | 15.36 | 16.97 | 23.[illegible] |
| PHONE | | | | | | | | | | |
| MEANINC | $4.43x10^{-3}$ | $6.40x10^{-3}$ | $8.00x10^{-3}$ | $14.74x10^{-3}$ | $33.23x10^{-3}$ | .003 | .005 | .007 | .013 | .[illegible] |
| VMEANINC | -- | -- | -- | -- | -- | $.007x10^{-3}$ | $.164x10^{-3}$ | $.161x10^{-3}$ | $.288x10^{-3}$ | .538x[illegible] |
| ACCESS | -- | -- | -- | -- | -- | $.211033x10^{10}$ | $97665x10^{7}$ | $380319x10^{7}$ | $161626x10^{10}$ | 184223x[illegible] |
| N | 151 | 166 | 165 | 166 | 159 | 51 | 52 | 51 | 52 | [illegible] |

TABLE 5b

MRS For Korea by PERMINC

| Variable | Seoul Renters First Quintile | Seoul Renters Second Quintile | Seoul Renters Third Quintile | Seoul Renters Fourth Quintile | Seoul Renters Fifth Quintile | Busan Renters First Quintile | Busan Renters Second Quintile | Busan Renters Third Quintile | Busan Renters Fourth Quintile | Busan Renters Fifth Quintile |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean of | | | | | | | | | | |
| PERMINC | 347.53 | 486.13 | 583.02 | 689.46 | 907.02 | 292.46 | 430.05 | 507.48 | 613.30 | 801.5[illegible] |
| ROOMS | 32.28 | 37.95 | 41.04 | 42.57 | 39.81 | 29.14 | 34.08 | 37.10 | 38.57 | 35.5[illegible] |
| DUAREA | 1.19 | 1.35 | 1.42 | 1.44 | 1.26 | 1.61 | 1.78 | 1.90 | 2.20 | 1.74 |
| SPACE | 44.23 | 51.44 | 55.28 | 56.96 | 52.39 | 45.23 | 51.84 | 56.12 | 60.56 | 52.8[illegible] |
| TOILET | 11.66 | 13.56 | 14.50 | 15.38 | 15.94 | 9.16 | 10.87 | 11.59 | 12.07 | 12.34 |
| PIPED | | | | | | | | | | |
| MEANINC | $.26\times10^{-3}$ | $.32\times10^{-3}$ | $.36\times10^{-3}$ | $.39\times10^{-3}$ | $.54\times10^{-3}$ | $0.11\times10^{-3}$ | $0.13\times10^{-3}$ | $0.13\times10^{-3}$ | $0.14\times10^{-3}$ | $0.15\times10^{-3}$ |
| VMEANINC | $.00014\times10^{-3}$ | $.00014\times10^{-3}$ | $.000224\times10^{-3}$ | $.000224\times10^{-3}$ | $.000392\times10^{-3}$ | -- | -- | -- | -- | -- |
| N | 284 | 284 | 286 | 284 | 285 | 101 | 103 | 101 | 103 | 102 |

| Variable | Seoul Owners First Quintile | Seoul Owners Second Quintile | Seoul Owners Third Quintile | Seoul Owners Fourth Quintile | Seoul Owners Fifth Quintile | Busan Owners First Quintile | Busan Owners Second Quintile | Busan Owners Third Quintile | Busan Owners Fourth Quintile | Busan Owners Fifth Quintile |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean of | | | | | | | | | | |
| PERMINC | 472.52 | 654.39 | 782.11 | 937.39 | 1125.32 | 396.58 | 559.11 | 650.68 | 766.91 | 999.9[illegible] |
| ROOMS | 18.10 | 15.40 | 14.73 | 14.65 | 13.34 | 23.75 | 22.79 | 21.47 | 19.84 | 18.5[illegible] |
| DUAREA | 2.78 | 2.37 | 2.35 | 2.39 | 2.14 | 2.08 | 2.38 | 1.97 | 1.90 | 1.9[illegible] |
| SPACE | 45.85 | 39.15 | 38.19 | 38.50 | 34.74 | 44.57 | 46.57 | 41.17 | 38.86 | 37.[illegible] |
| TOILET | 76.23 | 89.49 | 95.36 | 104.69 | 113.22 | 35.39 | 43.03 | 43.05 | 48.27 | 53.4[illegible] |
| PIPED | | | | | | | | | | |
| MEANINC | $.27\times10^{-3}$ | $.31\times10^{-3}$ | $.32\times10^{-3}$ | $.36\times10^{-3}$ | $.38\times10^{-3}$ | $.21\times10^{-3}$ | $.24\times10^{-3}$ | $.25\times10^{-3}$ | $.24\times10^{-3}$ | $.27\times10^{-3}$ |
| VMEANINC | -- | -- | -- | -- | -- | $.00392\times10^{-3}$ | $.0042\times10^{-3}$ | $.00476\times10^{-3}$ | $.00448\times10^{-3}$ | $.00476\times10^{-3}$ |
| N | 178 | 188 | 188 | 179 | 176 | 56 | 56 | 60 | 60 | 59 |

TABLE 5c

MRS FOR DAVAO BY PERMINC

(in U.S. Dollars)

| | Renters | | | | |
|---|---|---|---|---|---|
| | First Quintile | Second Quintile | Third Quintile | Fourth Quintile | Fifth Quintile |
| | less than 109.18 | 109.37-146.07 | 146.25-213.96 | 214.14-289.75 | greater than 189.75 |
| Mean of PERMINC | 94.16 | 124.96 | 173.02 | 239.88 | 400.25 |
| ROOMS | 2.39 | 2.51 | 3.02 | 3.75 | 5.15 |
| STRUCQ | 1.72 | 2.61 | 3.80 | 6.45 | 11.84 |
| WALLQ | .90 | 1.21 | 1.90 | 3.00 | 5.95 |
| FLOORQ | 2.57 | 3.47 | 5.14 | 8.05 | 16.76 |
| TOILET | .35 | .54 | .83 | 1.35 | 2.48 |
| COLLGAR | .40 | -.85 | 2.42 | 4.95 | -.93 |
| DIST | .24 | .33 | .44 | .61 | 1.03 |
| MEANINC | .0024 | .0035 | .00497 | .0086 | .0016 |
| VMEANINC | .0008808 | .00126615 | .00174325 | .0031562 | .0056151 |
| N | 171 | 188 | 196 | 173 | 171 |

| | Owners | | | | |
|---|---|---|---|---|---|
| Mean of PERMINC | 91.76 | 128.45 | 172.15 | 243.45 | 398.98 |
| ROOMS | .90 | 1.13 | 1.54 | 2.17 | 3.46 |
| STRUCQ | 1.67 | 2.80 | 4.53 | 7.99 | 17.32 |
| WALLQ | 1.04 | 1.81 | 2.87 | 5.14 | 11.06 |
| FLOORQ | 1.05 | 1.75 | 2.64 | 4.40 | 10.30 |
| TOILET | .084 | .14 | .24 | .41 | .92 |
| WIRE | 3.85 | 5.67 | 10.22 | 17.29 | 16.67 |
| DIST | .055 | .073 | .15 | .17 | .35 |
| MEANINC | .00077 | .0013 | .0019 | .0034 | .0077 |
| VMEANINC | .0000734 | .0001101 | .00016515 | .00027525 | .00061 |
| N | 173 | 156 | 174 | 213 | 272 |

APPENDIX

TABLE A-1a

Box-Cox Hedonic Regression -- Renters

| | COLOMBIA | | KOREA | | PHILIPPINES |
|---|---|---|---|---|---|
| | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
| CONSTANT | 5.841 | 4.557 | 18.966 | 40.211 | 1.005 |
| ROOMS | .005 | .079 | 1.510 | 9.241 | .216 |
| DUAREA | .005 | .005 | .045 | .402 | -- |
| SPACE | -- | -- | -- | -- | -- |
| STRUCQ | -- | -- | -- | -- | .269 |
| WALLQ | -.014 | .054 | -- | -- | .132 |
| FLOORQ | .077 | .271 | -- | -- | .360 |
| ROOFQ | .171 | .054 | -- | -- | -- |
| TOILET | .349 | .254 | .565 | 3.082 | .056 |
| PIPED | -- | -- | 1.897 | 1.889 | -- |
| COLLGAR | -- | -- | -- | -- | .130 |
| PHONE | .368 | .056 | -- | -- | .241 |
| DIST* | -- | -- | -- | -- | -.00003 |
| ACCESS | -.050 | -.079 | -- | -- | -- |
| MEANINC | .037 | .012 | .014 | .036 | .00036 |
| VMEANINC (000,000s) | -.00017 | -.0005 | -.0000055 | .000025 | -.00013 |
| $R^2$ | .617 | .574 | .402 | .339 | .608 |
| $\hat{\lambda}$ | .032 | .085 | .15 | .31 | 0.0 |
| N | 1023 | 261 | 1434 | 512 | 889 |

*Number of meters, not kilometers, is used in the estimation.

TABLE A-1b

Box-Cox Hedonic Regression : Owners

| | COLOMBIA | | KOREA | | PHILIPPINES |
|---|---|---|---|---|---|
| | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
| CONSTANT | 5.174 | 3.666 | 16.808 | 5.480 | -1.551 |
| ROOMS | .064 | .240 | .220 | .024 | .211 |
| DUAREA | .003 | .006 | .036 | .002 | -- |
| SPACE | -- | -- | -- | -- | -- |
| STRUCQ | -- | -- | -- | -- | .675 |
| WALLQ | .613 | .182 | -- | -- | .434 |
| FLOORQ | .651 | .735 | -- | -- | .342 |
| ROOFQ | .011 | .685 | -- | -- | -- |
| TOILET | .342 | .158 | 1.512 | .048 | .034 |
| PIPED | -- | -- | 2.374 | .054 | -- |
| COLLGAR | -- | -- | -- | -- | .287 |
| PHONE | 1.470 | .766 | -- | -- | -- |
| DIST* | -- | -- | -- | -- | -.000017 |
| ACCESS | .020 | -.090 | -- | -- | -- |
| MEANINC | .148 | .153 | .0029 | .00025 | .00026 |
| VMEANINC (000,000s) | .00001 | -.003 | .0000047 | -.00000053 | -.000021 |
| $R^2$ | .648 | .751 | .650 | .431 | .611 |
| $\hat{\lambda}$ | .122 | .094 | .14 | -.13 | .06 |
| N | 837 | 260 | 956 | 300 | 952 |

*Number of meters, not kilometers, is used in the estimation.

TABLE A-2a

Mean Marginal Prices of the Continuous Characteristics for Renters[a]

| | COLOMBIA | | KOREA | | PHILIPPINES |
|---|---|---|---|---|---|
| | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
| ROOMS | .22 | 5.92 | 39.65 | 35.14 | 3.33 |
| DUAREA | .33 | .36 | 1.20 | 1.67 | -- |
| SPACE | -- | -- | -- | -- | -- |
| STRUCQ | -- | -- | -- | -- | 4.14 |
| WALLQ | * | 4.04 | -- | -- | 2.03 |
| FLOORQ | 5.09 | 20.34 | -- | -- | 5.54 |
| ROOFQ | 10.73 | 5.36 | -- | -- | -- |
| TOILET | 21.93 | 19.09 | 14.98 | 11.84 | .86 |
| DIST | -- | -- | -- | -- | .055 |
| ACCESS | 3.36 | 5.92 | -- | -- | -- |
| MEANINC | .0016 | .00088 | .00036 | .00014 | .00055 |
| VMEANINC (1000) | * | .00004 | .00014 | * | .00022 |
| N | 1023 | 261 | 1434 | 512 | 889 |

[a]All figures are in 1983 US dollars; evaluated at mean values

*Signifies that this value is not computed because the variable had the wrong sign in the hedonic equation.

--Signifies that this variable does not exist for this city.

TABLE A-2b

Mean Marginal Prices of the Continuous Characteristics for Owners[a]

| | COLOMBIA | | KOREA | | PHILIPPINES |
|---|---|---|---|---|---|
| | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
| ROOMS | 5.03 | 14.61 | 15.03 | 26.95 | 1.89 |
| DUAREA | .21 | .34 | 2.36 | 2.41 | -- |
| SPACE | -- | -- | -- | -- | -- |
| STRUCQ | -- | -- | -- | -- | 5.93 |
| WALLQ | 47.96 | 11.12 | -- | -- | 3.80 |
| FLOORQ | 51.04 | 44.84 | -- | -- | 3.53 |
| ROOFQ | 0.90 | 41.84 | -- | -- | -- |
| TOILET | 26.83 | 9.63 | 97.80 | 57.07 | .30 |
| DIST | -- | -- | -- | -- | .018 |
| ACCESS | * | 5.50 | -- | -- | -- |
| MEANINC | .012 | .0093 | .00034 | .00031 | .00026 |
| VMEANINC (1000) | * | .0002 | * | .00056 | .000018 |
| N | 837 | 260 | 956 | 300 | 952 |

[a]All figures are in 1983 US dollars; evaluated at mean values.

*Signifies that this value is not computed because the variable had the wrong sign in the hedonic equation.

--Signifies that this variable does not exist for this city.

TABLE A-3a

ESTIMATES OF THE SYSTEM OF EQUATIONS

RENTERS

| VARIABLE INDEPENDENT | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
|---|---|---|---|---|---|
| ROOMS | | | | | |
| INTERCEPT | 1.376 | 4.040 | 3.990 | 4.632 | - 2.528 |
| | ( 13.309) | ( 15.261) | ( 10.522) | ( 9.560) | (-12.114) |
| LOG OF ROOMS | - 1.132 | - 1.243 | - 1.107 | - 1.285 | - 0.378 |
| | (- 9.364) | (- 7.044) | (-17.612) | (-25.637) | (- 6.284) |
| LOG OF HHSIZE | 0.132 | 0.243 | 0.107 | 0.285 | - 0.622 |
| | ( 1.090) | ( 1.378) | ( 1.696) | ( 5.689) | (-10.328) |
| DUAREA | | | | | STRUCQ: |
| INTERCEPT | 3.039 | 2.635 | 2.880 | 4.407 | - 5.541 |
| | ( 23.485) | ( 7.745) | ( 6.956) | ( 8.658) | (-24.479) |
| LOG OF DUAREA | - 0.663 | - 0.668 | - 1.250 | - 1.535 | 1.738 |
| | (-11.948) | (- 5.666) | (-19.213) | (-26.204) | ( 7.595) |
| LOG OF HHSIZE | - 0.337 | - 0.332 | 0.250 | 0.535 | - |
| | (- 6.065) | (- 2.815) | ( 3.846) | ( 9.133) | |
| WALLQ | | | | | |
| INTERCEPT | - | 5.472 | - | - | - 5.988 |
| | | ( 1.519) | | | (-29.003) |
| LOG OF WALLQ | - | - 2.657 | - | - | 1.741 |
| | | (- 0.917) | | | ( 7.424) |
| FLOORQ | | | | | |
| INTERCEPT | 2.945 | 2.890 | - | - | - 4.907 |
| | ( 6.452) | ( 2.065) | | | (-22.909) |
| LOG OF FLOORQ | - 0.080 | 0.946 | - | - | 1.862 |
| | (- 0.134) | ( 0.659) | | | ( 6.533) |
| ROOFQ | | | | | |
| INTERCEPT | 2.591 | 10.164 | - | - | - |
| | ( 0.679) | ( 1.502) | | | |
| LOG OF ROOFQ | 1.163 | - 9.857 | - | - | - |
| | ( 0.272) | (- 1.140) | | | |
| TOILET | | | | | |
| INTERCEPT | 5.593 | 4.700 | 3.058 | 3.697 | - 7.759 |
| | ( 32.064) | ( 12.851) | ( 8.051) | ( 7.560) | (-28.361) |
| LOG OF TOILET | - 1.208 | - 0.968 | - 0.474 | - 0.681 | 1.192 |
| | (- 7.024) | (- 2.972) | (- 2.598) | (- 4.210) | ( 8.303) |
| MEANINC ('000s) | | | | | |
| INTERCEPT | 1.532 | 0.283 | - 9.359 | 5.739 | -18.185 |
| | ( 6.003) | ( 0.454) | (- 8.880) | ( 4.009) | (-16.223) |
| LOG OF MEANINC | 0.086 | 0.148 | 1.588 | - 1.242 | 1.071 |
| | ( 0.787) | ( 0.565) | ( 8.305) | (- 4.577) | ( 6.530) |
| VMEANINC ('000,000s) | | | | | |
| INTERCEPT | - | - 3.223 | -17.032 | - | -16.702 |
| | | (- 5.003) | (-12.854) | | (-22.272) |
| LOG OF VMEANINC | - | 0.179 | 0.904 | - | 0.724 |
| | | ( 1.223) | ( 6.460) | | ( 6.482) |
| ACCESS | | | | | DIST: |
| INTERCEPT | 2.212 | 6.254 | - | - | -11.030 |
| | ( 4.418) | ( 3.835) | | | (- 5.297) |
| LOG OF ACCESS | 0.131 | - 3.246 | - | - | - 0.245 |
| | ( 0.525) | (- 2.291) | | | (- 0.904) |
| PERMINC-RENT | | | | | |
| INTERCEPT | 0.197 | 0.0242 | 0.465 | 0.393 | 1.013 |
| | ( 25.031) | ( 9.007) | ( 14.017) | ( 9.384) | ( 36.834) |
| N | 1023 | 261 | 1434 | 512 | 889 |

TABLE A3-b

ESTIMATES OF THE SYSTEM OF EQUATIONS

OWNERS

| | BOGOTA | CALI | SEOUL | BUSAN | DAVAO |
|---|---|---|---|---|---|
| ROOMS | | | | | |
| INTERCEPT | 5.206 | 2.826 | 6.716 | 6.813 | - 5.174 |
| | ( 46.805) | ( 5.653) | ( 23.513) | (14.775) | (-20.177) |
| LOG OF ROOMS | 0.070 | 0.199 | - 0.393 | -0.578 | - 0.439 |
| | ( 1.082) | ( 1.309) | (- 5.968) | (-4.599) | (- 5.274) |
| LOG OF HHSIZE | - 1.070 | - 0.199 | - 0.607 | -0.422 | - 0.561 |
| | (-16.597) | (- 7.875) | (- 9.224) | (-3.361) | (- 6.736) |
| DUAREA | | | | | STRUCQ: |
| INTERCEPT | 1.590 | - 1.935 | 5.746 | 6.713 | - 7.542 |
| | ( 7.843) | (- 3.164) | ( 14.652) | (10.937) | (-23.720) |
| LOG OF DUAREA | 0.140 | 0.313 | - 0.241 | -0.758 | 1.253 |
| | ( 2.556) | ( 2.673) | (- 4.319) | (-5.681) | ( 3.961) |
| LOG OF HHSIZE | - 1.140 | - 1.313 | - 0.759 | -0.242 | - |
| | (-20.864) | (-11.213) | (-13.590) | (-1.816) | |
| WALLQ | | | | | |
| INTERCEPT | - 1.269 | - 2.070 | - | - | - 7.907 |
| | (- 0.216) | (- 1.660) | | | (-26.366) |
| LOG OF WALLQ | 5.241 | 2.401 | - | - | 1.390 |
| | ( 1.204) | ( 2.528) | | | ( 4.091) |
| FLOORQ | | | | | |
| INTERCEPT | 3.199 | - 2.382 | - | - | - 7.625 |
| | ( 1.643) | (- 1.136) | | | (-27.605) |
| LOG OF FLOORQ | 3.810 | 5.571 | - | - | 1.102 |
| | ( 1.374) | ( 2.217) | | | ( 3.423) |
| ROOFQ | | | | | |
| INTERCEPT | - 1.410 | 0.329 | - | - | - |
| | (- 0.457) | ( 0.095) | | | |
| LOG OF ROOFQ | 3.777 | 2.476 | - | - | - |
| | ( 1.051) | ( 0.555) | | | |
| TOILET | | | | | |
| INTERCEPT | -11.049 | -11.190 | 6.624 | 5.835 | -10.920 |
| | (- 4.681) | (- 3.913) | ( 15.213) | ( 7.116) | (-31.271) |
| LOG OF TOILET | 12.515 | 9.300 | 0.743 | 0.780 | 6.871 |
| | ( 6.863) | ( 4.167) | ( 2.310) | ( 0.722) | ( 4.660) |
| MEANINC | | | | | |
| INTERCEPT | 0.053 | - 3.504 | - 0.432 | 4.481 | -20.960 |
| | ( 0.226) | (- 6.455) | (- 0.443) | ( 1.762) | (-12.061) |
| LOG OF MEANINC | 1.707 | 1.753 | 0.367 | -0.621 | 0.964 |
| | ( 18.834) | ( 10.884) | ( 2.289) | (-1.327) | ( 3.797) |
| VMEANINC | | | | | |
| INTERCEPT | - | - 6.747 | - | -2.661 | -20.213 |
| | | (- 9.430) | | (-1.832) | (-17.359) |
| LOG OF SDING | - | 0.831 | - | -0.270 | 0.514 |
| | | ( 6.087) | | (-1.824) | ( 2.959) |
| ACCESS | | | | | DIST: |
| INTERCEPT | - | 79.016 | - | - | - 1.616 |
| | | ( 2.182) | | | (- 0.292) |
| LOG OF ACCESS | - | -57.562 | - | - | - 1.951 |
| | | (- 2.174) | | | (- 2.736) |
| PERMINC | | | | | |
| INTERCEPT | 0.107 | 0.488 | 0.264 | 0.274 | 1.400 |
| | ( 8.765) | ( 8.673) | ( 9.947) | ( 6.582) | ( 34.371) |
| N | 837 | 260 | 956 | 300 | 952 |

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