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HOUSING CONSUMPTION AND INCOME IN THE LOW INCOME URBAN SETTING: ESTIMATES FROM PANEL DATA IN EL SALVADOR[1]

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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.

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I. Introduction

The estimation of the parameters of housing demand equations occupies a prominent place in the urban economics literature of developed countries (see de Leeuw [2] and Mayo [15] for thorough reviews of the state of the empirical art). Most of the research has focused on income and price elasticities of housing demand, using both aggregated and micro-level data. The main conclusions of studies, which do not suffer from aggregation or other biases, seem to be that: (a) On average, for a large segment of the population, including both renters and owners, permanent income elasticities are well below one; (b) Permanent income elasticities for owners (ranging mostly from .5 to .7 in Mayo's review) are slightly higher than estimates for renters (which ranged mostly from .3 to .5); (c) As predicted by the theory, the permanent income elasticity of demand generally exceeds that of current income; (d) Demand tends to be relatively price inelastic, although difficulties in obtaining price information render most estimates suspect; and (e) The evidence for the effect of demographic variables on demand is mixed.

There has been little work done on estimating such parameters for less developed countries, partly because of data constraints and partly because it is only in the past decade or so that urbanization and its attendant problems have become a basic policy concern. Yet, the need for such estimates is acute, especially when one considers that policies to alleviate the plight of the low income urban poor are being formulated based on ad hoc assumptions particularly about income elasticities. For example, based on "the fragmentary data available on expenditure by various income groups," Grimes [7] concludes that "as income rises and other demands are met, the share of income devoted to housing may remain constant or fall." A recent World Bank [28] publication implicitly assumes that income elasticity is unity in stating that 20% of annual

household income will be devoted to housing up to the year 2000. Strassmann [21] sets up a stock-user matrix under the assumption that "the elasticity, unadjusted for household size and other characteristics, is unity."

Relatively little work has been done to estimate the income elasticity of housing demand for developing countries using micro level data. Studies on Korea and Colombia have recently been concluded under the auspices of the World Bank (see Follain et al [3], Strassmann [21] and Ingram [11]). A primary result of these studies is that the magnitudes of estimates of income (and, to a much lesser extent, price) elasticities of housing demand are remarkably similar to those found for the developed countries. Table 1 summarizes the results found so far. The surveys which were used are based on unbiased samples of the urban populations of Korea and Colombia.[2] The best point estimate for the permanent income elasticity of housing demand in Korea is .6 for owners and .4 for renters, using a double-log specification. The Colombia studies estimate only the current income elasticity. Ingram's double-log specification for 1978 yields .47 and .67 for Cali and Bogota, respectively. Linear and semi-log specifications yield slightly lower results--down to .5. Ingram finds that the income elasticity of housing demand rises with income, although it never reaches one. Strassmann, who also finds that his estimated elasticities do not reach one, arrives at a different conclusion. He states that the .97 estimate for Cali owners is not significantly different from unity and that the .79 estimate for Cali renters is probably an underestimate because of rent control and should also be close to unity.

Despite the substantial agreement among the studies that the estimated income elasticities are less than one (at least for renters) a number of important issues need to be addressed: Are these findings robust for other data points,

either in terms of other countries or other income groups? Do they lead to the conclusion that the elasticity is close to unity or substantially less? How important is the distinction between permanent and current income and the bias implied by the permanent income hypothesis? How do the influences of demographic variables compare? The main objective of this paper is to extend the existing analyses to answer these questions and to examine the robustness of the similarity of results in such disparate environments. In particular, the income elasticity of housing demand will be estimated for El Salvador and compared with those found in the few other countries where estimates are available.

The analysis reported in this paper is based on data which are singularly suitable for estimates of the response of housing to changes in permanent income--a longitudinal survey, albeit of the lowest 70% of the income distribution curve, in two medium-sized Salvadorean cities, Sanat Ana and Sonsonate. The data were obtained from 1976-1980. To the best of the authors' knowledge, this paper represents the first attempt to systematically estimate the parameters of housing demand in El Salvador and the first analysis to use panel data to obtain an accurate measure of permanent income in any developing country study. As a measure of permanent income, simple and weighted averages of two years of current income are used. The most challenging problem to such an estimate, namely how to account for movers, is resolved by the development of a model of intra-metropolitan movement. The results are compared with those using other measures of permanent income.

The paper begins with a brief review of the findings to date for the developing countries and the derivation of the basic model. The next section reconciles this model with a theory of intra-metropolitan migration in order to account for drop-outs in the sample when calculating the averages for the permanent income measures. Then, the data and empirical results are discussed.

II. Conceptual Considerations

Standard consumer demand theory yields the following demand equation:

$$h_i = f(Z_i) \qquad (1)$$

where h_i represents housing demand, and Z_i is a row vector of explanatory variables. It should be noted that (1) is not, in the strict definition, a demand equation, because of assumptions, which are fairly standard in the literature, which need to be made in order to implement the model. It corresponds more closely to an equation describing an expansion path of expenditure with respect to income, holding other variables constant. There are a number of reasons for this. First of all, because of the heterogeneous and indivisible nature of the housing commodity, it is fairly difficult to obtain an estimate of demand. So, like most other studies of housing demand, the dependent variable used in this study is actual (for renters) or self-imputed (for owners) monthly expenditures on housing. Secondly, because of data limitations (especially with respect to variables regarding location) we are not able to incorporate a price term in our housing consumption equations (see Ingram [11] and Follain et al [3] for novel ways of estimating prices in developing countries). We do not believe that this omission seriously affects our estimation of the income coefficient.[3] The price terms would bias the income term if there were some correlation between these two independent variables. This could occur if, for example, we believed that markets were segmented so that prices varied among different neighborhoods in the city. However, because we are dealing with relatively homogeneous groups--low income households who live close to where they work and to each other in relatively small cities--we do not believe that unit prices for housing services would tend to vary a great deal across our sample or that price and income would be strongly correlated with one another.

Analysts have used alternative functional forms for (1). Because of the analytical convenience of being able to interpret a regression coefficient directly as an elasticity, the form most often used is log-linear, which, of course, assumes that a single elasticity of demand holds for all households included in an equation (see Mayo [16]). For the studies of housing demand in developing countries, Ingram uses linear, semi-log and double-log forms, while Follain et al use only the double-log form. In this analysis, we use all three.

The components of Z, then are: income and demographic characteristics. The demographic characteristics used are age, family size and sex of head. The income measure includes both current and permanent income measures. This warrants additional discussion.

The Role of Permanent Income: According to the permanent income theory, current income elasticities will be biased downwards in proportion to the ratio of variances of permanent income to current income. This bias may be particularly severe in developing countries, where the transitory component of income could have a particularly large variance because of irregular employment and earnings--a fact not captured in one-time surveys. This phenomenon is a reflection of the size and characteristics of the so-called "urban informal sector". Mazumdar [17] cites studies which estimate that over half of the total employed in major cities in developing countries are in this sector, which is characterized by such unsalaried and high variance occupational groups, such as small-scale commerce (including bankers and vendors) and personal services.

Thus, it is apparent that measures of permanent income must be found. A number of different approaches have been tried, including grouping of observations, using predicted income, using lagged income as an instrumental variable,

and using an average of income over several years (see Mayo). For developing country studies, lack of data and/or the biases introduced by some of the methods of measuring permanent income,[4] have forced analysts to either abandon correcting for this possible bias (Ingram) or using simplified assumptions. Follain et al reason that, if (permanent) consumption (C_p) is proportional to permanent income (Y_p), the level of consumption is likely to be a good proxy for permanent income.[5] We use this as one measure of permanent income.

Using Panel Data to Measure Permanent Income: The panel nature of our data base enables us to use the information contained in income measures over different years to estimate permanent income. One approach would be to take a simple average. Another would be to make use of Friedman's assumption that individuals take "their past experience, adjusted for trend, as their best single estimate of their likely future experience" (Friedman [6]). The estimate of permanent income, then, would be, at time period T:

$$Y_{pT} = r \int_{-\infty}^{T} e^{(r-\alpha)(\tau-T)} Y_{\tau} d\tau \qquad (2)$$

where α is the trend rate of growth of permanent income, and τ represents the past time periods. The term r can be viewed as the discount rate and can be explained as follows. According to the permanent income hypothesis, if a household receives transitory income, that income is invested. Now, the yield on this investment is permanent income to the household, so that its Y_p must rise by its receipt of transitory planning horizon, which is simply the reciprocal of the discount rate (see Mayer [13] for an explanation of this, since it is different from Friedman's assumption in the original 1958 piece). Friedman [5] and Bhalla [1] show that (2) leads to a scheme for weighting current income where the weights take on the following form:

$$W_\tau = r(1+\alpha)^{-\tau}/(1+r)^{-\tau} \qquad (3)$$

What parameter values should we use? In our case (see below) we have data only for two periods so that $\tau = -1,0$. We cannot use the trend rate of growth of actual income to estimate α because it contains transitory components. Instead we follow Bhalla in that households base their expectations about future receipts on the observed growth in incomes of all households. Friedman assumed a three-year horizon (for U.S. data) or an implied discount rate of r = 33 1/3% which is not radically out of line with market yields because "we are treating the value of non-pecuniary returns...from assets that cannot be readily bought or sold or for which buying and selling prices differ widely." We assume that low-income households have a relatively short horizon of two years, so that an increase in permanent income is equal to 1/2 of the transitory income receipt. We experimented with 1-3 year horizons and found very little difference in the results.

One of the most serious problems confronting a researcher who uses an average of incomes (whether weighted or not) is that, unless households are re-interviewed after they move--an onerous task for the data gatherer--only households who remain in the sample for the entire duration of the sample period would be included. If moving is the most important way in which renter families change their housing condition, households with a high income elasticity may well have a greater probability of moving than households with a low income elasticity. An estimate of the elasticity based only on nonmovers may, therefore, over-represent groups with low income elasticity. Indeed for early U.S. studies, this was a problem (Lee [14]). Since then, the Michigan Panel has followed movers and it has been easier to obtain this average measure (Ihlanfeldt [10]. However, for developing countries, the problem of doing follow-up surveys is

greater for households who are barely literate, are more mobile, and where communications are very difficult. This paper proposes another way of correcting for this potential bias using some recent econometric developments and a model of intra-metropolitan mobility.

Until very recently (see Weinberg et al), intra-urban residential mobility has received little attention in the economics literature (although discussions by sociologists and other social scientists abound--see Quigley and Weinberg [20]). Still it is an important phenomenon. In the U.S., roughly half of all those who moved at least once in the period 1970-75 were intra-metropolitan movers. In the sample being studied, 30% of all renter households and 10% of all owner-households moved in the past year. It is estimated that most of these are intra-metropolitan movers.

For urban economists the primary reason for moving is the need to adjust housing consumption--if the benefits derived by moving to a new dwelling unit exceeds the costs associated with that move, a household will be more likely to move. Let us assume for the moment that households do not have much scope for changing consumption without moving. In a world of perfect information with zero transactions and no moving costs, the decision to move would be perfectly predicted by changes in any of the parameters which define a utility maximizing household's equilibrium, such as income, relative prices or demographic factors. However, if there are relocation costs (including search costs and out-of-pocket costs associated with each type of tenure as well as actual moving costs), households' observed consumption of housing services may deviate from equilibrium consumption. (See Hanushek and Quigley [8] and Friedman et al [4] for similiar approaches.) As an example, suppose that income increases from Y_o to Y_1 for households initially consuming h_o of housing

services and x_o of all other goods in Figure 1. Given homothetic preferences (an unnecessary but useful assumption for this illustration) and no moving costs, households will consume h_1 of housing services and will thus move. However, suppose there are moving costs of the amount m, which is a lump-sum loss of income upon moving. Let m_o be the income required to make a household as well off as if it moved and adjusted its housing consumption to its equilibrium level. If $m < m_o$, the household will move and consume an amount of housing services somewhere between h_2 and h_1. If $m > m_o$, the household will remain at h_o and utility level u_o. Of course, the extra income will be used in more x-consumption. It is apparent that, the closer is m to m_o, the greater is the probability of moving. If $m \leq m_o$, the household will move.

What then determines $m_o - m$ and, thus, the probability of moving? For a given utility function, the exact (Hicksian) measure of compensating income can be derived directly. We assume m_o is the same for all households and concentrate on m. Some obvious candidates come to mind. One is the age of the household head. According to Muth, as age increases moving costs rise and the probability of moving declines. Other determinants are: family composition (such as the number of school age children), marital status of the head, density (in terms of number of persons per room), the variability of income during the past year and some measure of the occupation of the household head (see Quigley and Weinberg for a more detailed discussion).

The above model is appropriate for renters because households have to move in order to change consumption points. For owners, the explanation of the model is a little different. First of all, transactions costs are greater for owners than renters. Secondly, it is obvious that owner-occupiers enjoy some leeway in terms of changing the amount of housing services consumed without moving.

Yet, they have to make similar decisions about moving based on costs and benefits. Let us assume that owner occupiers are "efficient" consumers of housing services--that is, they convert housing stock into a consumable flow of services at least cost. If housing services are produced by operating inputs and stock (see Ingram and Oron [12]), then there will be some ranges over which the use of one type of stock (composed structure and land) would be more efficient than another. For example, with fixed lot sizes and diminishing marginal productivity of capital, a smaller lot with an existing structure will be able to support increases in capital only at increasing unit costs. It may thus be more efficient to move, if the costs of moving are covered by the monetized value of the future stream of benefits, discounted to the present. What this implies is that, depending on the household's "consumption technology" (determined by family size, skill at renovations, etc.) the same increase in income as in Figure 1 may mean that the owner household can reach h_1 without moving, after incurring some cost. We must thus use separate explanatory equations for renters and owners.

The household then faces two decisions: how much housing to consume and whether or not the housing services should be consumed in the present location. Because we need observations in two time periods to calculate permanent income, moving implies we have to correct for the problem of missing observations. We presume that the household's choice can be estimated in two steps. First we can calculate the determinants of household's decision whether or not to move, based on the conceptual framework outlined above. Then, the probability of moving can be calculated for each household and used to correct for any possible bias in the demand equation.

Let us now define the model more rigorously. The housing demand equation can be expressed linearly (or nonlinearly in logs) as:

$$h_i = Z_i\beta + \mu_i \tag{4}$$

where μ_i is some random error term, $E(\mu_i) = 0$. However, we have observations on h_i if and only if the household has not moved. In turn, we can designate the index I as the household's choice of intra-metropolitan movement (equal to 1 if the household moves during the specified time period and 0 otherwise). Then,

$$I_i = X_i\alpha - \epsilon_i \tag{5}$$

where X_i is a vector of explanatory variables which determine whether or not a household will move. These explanatory variables are derived from the conceptual framework for moving sketched above. In the truncated sample, we have observations only for those households who have not moved. The expected value of the demand equation (4) applied only to this truncated sample would yield conditional expectations:

$$\begin{aligned} E(h_i \mid Z_i,\ I \le 0) &= Z_i\beta + E(\mu_i \mid I \le 0) \\ &= Z_i\beta + E(\mu_i \mid \epsilon_i > X_i\alpha) \end{aligned} \tag{6}$$

Thus, we cannot apply ordinary least squares to (4). However, following a variation of Heckman's procedure, we can show that, if μ_i and ϵ_i are jointly distributed normally, then $\mu_i/\sigma_u^2 \sim N(0,1)$ and $\epsilon_i/\sigma_\epsilon^2 \sim N(0,1)$ and we can write

$$E(\mu_i \mid \epsilon_i > X_i\alpha) = \frac{\sigma_{u\epsilon}}{\sigma_u}\lambda \tag{7}$$

where $\lambda \equiv E\left(\frac{\epsilon_i}{\sigma_\epsilon} \mid \frac{\epsilon_i}{\sigma_\epsilon} > \frac{X_i\alpha}{\sigma_\epsilon}\right) = f\left(\frac{X_i\alpha}{\sigma_\epsilon}\right)/\left[1-F\left(\frac{X_i\alpha}{\sigma_\epsilon}\right)\right] > 0$, $f(\cdot)$ and $F(\cdot)$ are, respectively, the probability density function and cumulative density function of a standard normal variable. Thus, as a first step in estimating the housing demand equation, we can first obtain estimates of α by estimating a probit for

all observations for the index (5). This will give us the probability that a household is a "mover". The results can be used to compute the λ's by (7). The λ's are then incorporated into (6) to correct for any possible biases caused by the omission of observations of those who have moved.

III. The Data

Before proceeding to the empirical results, we need to explain the complex nature of the data base. The data base is obtained from the World Bank's Monitoring and Evaluation of Urban Development Projects in El Salvador.[6] A socioeconomic panel survey was applied to a stratified sample of the lowest 70^{th} percentile of the urban income distribution in two medium-sized Salvadorean cities, Santa Ana (pop. 160,000) and Sonsonate (pop. 100,000). They were first collected in Santa Ana in July 1976, and in Sonsonate about eight months later. Thereafter, the survey was repeated in March 1979 and March 1980 in both cities. Since these were so-called "control groups" (with whom households selected for participation in urban development projects were to be compared in order to assess impact), they were meant to be an unbiased representation of the pool from which project participants were drawn. The stratified sample in Santa Ana drew 330 households, divided approximately equally among mesones (those living in rented tenements), colonias ilegales (those living in serviced titled lots but which do not meet minimum service standards set by the government), and tugurios (shanties for squatters). The stratified sample in Sonsonate drew 140 households living in mesones and colonias (there are no tugurios in the city).

For Santa Ana, we had to drop the 100 households living in tugurios, because tugurios, which account for only 3% of the low income units in the city, were vastly over-represented in the sample. Their loss would not bias the results but their inclusion surely would. Another 29 households were dropped because of missing and/or inconsistent information. Thus, we were left with

201 households in Santa Ana, of whom 130 were renters and 71 were owners. For Sonsonate, 22 households were dropped from the sample because of incomplete data. That left us with 118 households, of whom 91 were renters and 27 were owners. The 27 observations for owners did not leave us with enough observations for the ordinary least squares and maximum likelihood estimations. Consequently, no analysis was performed on them.

The characteristics of the sample in 1980 which we strongly believe to be representative of the poorest 70% of the Salvadorean income distribution curve, are summarized in Table 2. The panel for 1980 is used to estimate the demand equations because it is the only one with all the information needed to calculate housing expenditure. The housing expenditure variable, which will be used as the dependent variable in the housing demand equations, is monthly rent paid for renters and imputed monthly rent for owners. The latter is obtained by asking respondents how much they would be willing to pay as a monthly charge for a dwelling of similar size. We believe that on average this figure is an accurate representation of the market value of the dwelling because owners frequently sublet a part of their homes and are well aware of market conditions (see Jimenez [13] for an analytical comparison of owner and appraiser valuations in a developing country).[7]

The renter households of both cities are poorer than the owner households of Santa Ana. (It should be noted that the incomes of the owner households are adjusted upwards by the imputed monthly rent.) This finding is true for current and permanent income. We use three measures of permanent income. One is consumption expenditures (PYC). Another is a simple average for two years, 1979 and 1980 for households who have not moved (PYA). The information for the first panel is not used because it was calculated in different months than the other two, which is an important consideration in a country

where seasonal employment is prevalent. Approximately 30% of the renters and 11% of the owners moved during the year. Since a great majority (90%) of those who enter the residences in our sample have moved from within the city, we assume that those who have moved out are also intra-urban migrants. The third measure is a weighted average of current income using (3) as weights (PYW). As mentioned in the preceding section we assume that each group obtains its expectations regarding the growth of future receipts based on the observed growth in income of that group. Thus, for Sonsonate renters, Santa Ana renters and Santa Ana owners, these growth rates are, respectively, 7%, 11% and 21% over the two-year period. We assume a two year horizon, so that r = .5. The resulting weights (normalized so that they equal one after two years) are:

	W_o	W_{-1}
Santa Ana Owners	.56	.44
Santa Ana Renters	.57	.43
Sonsonate Renters	.58	.42

Table 2 also shows that a smaller proportion of household heads among owners had income which varied during the year. This is consistent with the finding that owners have proportionately more skilled household heads. The owner household heads are, on average, older than their renter counterparts. There is no evidence that they are more male dominated. The larger size of owner-occupied dwellings is also evident in Table 2. Despite a larger average household size, the density of owner-occupied dwellings (as measured by the number of persons per room) is smaller than for renter households.

IV. Empirical Results

The first part of this section will briefly discuss the probit equations which generate the parameters needed to calculate the lambda variables described in Section III. The second part will present the housing consumption equations. Special emphasis will be given to the permanent income measures, as adjusted by the lambda variables.

Intra-urban Movement: Table 3 summarizes the results of the probit estimation of the equation to predict the probability that a household would move. Information from the 1979 panel was used to calculate the independent variables. We know (from the 1980 panel) which households actually moved. The dependent variable thus takes on the value of 1 for a 1979 household who is not there in 1980 and 0 otherwise. The results of the estimation give the probability that a household in 1979 will or will not move in the coming year. Or, looking at it from 1980, this gives us the probability that a household is a "nonmover".

Let us first consider the renter equations. The results show that households with older family heads tend to move less than those with younger ones, which is in keeping with what Quigley and Weinberg [20] state is the most consistently reported result in the literature. We find that age affects mobility of renters at a declining rate. The simplest explanation is that as a household's head ages, moving costs rise since this is the time when families are likely to form. As age rises even more however, these costs become less of a factor as children form families themselves and the family size may decline. It is interesting to note that this phenomenon does not hold true for owner-occupiers in the sample. The average age of owners is significantly greater than that of renters. Thus, it is probable that many owners (who are, on average, almost

50 years old) are past the family-formation stage and may, in fact, be more likely to move in with their children.

The presence of a childbearing wife (i.e., less than 40 years old) which is a proxy for potential family growth, has a negative relationship with mobility for all the samples, which is consistent with the age story. The number of students in a family has, as expected, a negative coefficient, except for Santa Ana renters. Density does not appear to be an important variable in determining whether or not a household will move. The hypothesis is that a dwelling that is already crowded would contain households who are more likely to move.

The evidence on the effects of the economic variables is also mixed. Unskilled labor tends to be more mobile. Variability in income, however, appears to lessen the probability of moving, at least among renters. Moving may be relatively more costly for those whose incomes vary.

Housing Consumption Determinants: The equations estimated in Table 3 are used to generate the lambda variable needed (to correct for the exclusion of movers) in the housing consumption equations with measures of permanent income which utilize the panel nature of the data base. The results of these latter estimates along with those using current income and permanent income proxied by consumption expenditures measures, are presented for the three groups as Appendices IA and IB (Santa Ana renters), Appendices IIA and IIB (Sonsonate renters) and Appendices IIIA and IIIB (Santa Ana owners). Three functional forms are tested: linear, semi-log and double-log (see Mayo [16] for a discussion of the relative merits of these alternative formulations). The interesting elasticities (as evaluated at the mean for the linear and semi-log forms) are calculated and presented at the bottom of each of the appendices.

In order to facilitate the analysis, these elasticities are presented in Tables 4 and 5.[8]

Perhaps the most striking feature of the estimates of the income elasticity of housing consumption obtained for this sample is their similarity to existing studies in both developing and developed countries. For renters in both cities, the estimates certainly seem to be below 1 and range from .3 to .5 (Table 4). This is consistent with most findings cited in Table 1. As with the other studies, we find that the income elasticity of demand for owners is considerably higher than that for renters. They range from .7 to unity, however, which are a bit higher than those found by Ingram and Follain et al. The finding of an almost unitary elasticity for owners is consistent with Strassmann.

As is evident when we compare the elasticities within each specification in Table 4, most of the elasticities implied by our measures of permanent income exceed those implied by current income. For all 12 equations (out of 36) which obtain the seemingly "perverse" result that the current income elasticity exceeds permanent income, the difference between the two coefficients is not significant at 5% confidence levels. Thus, in accordance with the permanent income theory, we can conclude that the permanent income elasticity of housing is higher than (or equal to) current income. However, the differences are slight, implying that the variance of transitory income is small relative to that of permanent income. This is a somewhat surprising result given our priors regarding the probable importance of transitory income among these low-income urban dwellers. The bias from using current income estimates thus appears to be small in this sample--which is different from the result obtained by Follain et al on Korean data using consumption as a proxy. We note here that the three different measures of permanent income we use also tend to give us similar results.

However consumption expenditures as a proxy consistently leads to elasticities lower than those using average incomes.

The lambda variables which were generated to correct for any possible bias resulting from the non-inclusion of movers in the permanent income estimates do not add anything to the explanatory power of the renter equations. However, they are positive and significantly greater than zero at the 10% confidence level for the owner equations. It is our belief, then, that it is still quite important to account for the possible effect of movers in the consumption equations.

Ingram, in studies of Bogota and Cali, Colombia, reports that the current income elasticity of housing demand rises with income. Follain et al found a similar result for Korea. However, they discounted it since their estimates for permanent income revealed that these decreased with income although the differences were not statistically significant. Unfortunately, the size of our samples precludes a breakdown to do such tests. However, if Ingram's results hold for El Salvador, then it is probable that the true elasticities are higher than those reported here because our sample represents only the bottom 70% of the urban income distribution.

We now turn our attention to the demographic variables of Table 5. The most consistent finding is that household size is negatively related to housing demand. The renter elasticities range from -.20 to -.01, while for owners, the values are -.30 to -.12. This negative relationship, while appearing to be counter-intuitive appears quite frequently in other studies. Ingram, for example, finds that the elasticity of housing demand with respect to family size varies from -.1 to .4 for renters and -.35 to -.2 for owners. The similarity in the magnitudes with the Salvadorean results is remarkable.

We find that female-headed households, other things being equal, spend more than do male-headed households (except among Santa Ana renters, where the resulting coefficients are not significantly different from zero). This inverse relationship is consistently found in most U.S. studies (see Mayo). We do not have any consistent findings regarding the impact of age. There are arguments for both a positive and negative relationship.

V. Conclusions

This paper estimates housing consumption equations for two medium-sized cities in a small developing country and compares the results with those found in other developing and developed countries. The results are strikingly similar, especially with regard to the most important variable, the income elasticity of housing consumption. Using panel data to calculate an estimate for permanent income by a simple average and utilizing newly developed econometric techniques to correct for the exclusion of movers we find that first of all, the income elasticity of housing demand for renters ranges from .3 to .5, while for owners it lies in the interval .7 to unity. This supports the contention that housing demand (at least for renters) is relatively income inelastic and this should be incorporated into policy makers' planning decisions. Secondly, the permanent income elasticity is larger, but only slightly so, than the current income elasticity. This implies that using current income for demand estimation may be sufficient to give us "ball park" estimates which are not misleading. Given the paucity of data in developing countries, this result may be significant. Finally, the exclusion of movers from an equation that uses an average of several years as a proxy for permanent income probably does not affect the income coefficient very much.

Appendix IA: Santa Ana Renters

DEPENDENT VARIABLE	(1) HOUSEX	(2) HOUSEX	(3) LHOUSEX	(4) LHOUSEX	(5) LHOUSEX	(6) LHOUSEX
Constant	45.2787***	56.9945*	3.1421***	2.9990***	1.7275**	1.3088
	(15.4820)	(32.8490)	(.1931)	(.3409)	(.7323)	(1.0817)
Y	.0320***		.0007***			
	(.0096)		(.0002)			
LY					.2884***	
					(.0998)	
PY		.0291***		.0007***		
		(.0111)		(.0003)		
LPY						.2867**
						(.1217)
AGEH	-1.2070*	-1.5372	-.0001	.0019		
	(.6893)	(1.0648)	(.0029)	(.0034)		
AGEH2	.0130*	.0167				
	(.0071)	(.0104)				
LAGEH					-.0170	.0721
					(.1239)	(.1621)
HHSIZE	-.2370	-.4895	-.0133	-.0231		
	(1.0850)	(1.0851)	(.0258)	(.0279)		
LHHSIZE					.0069	-.0089
					(.0921)	(.1026)
SEXH	2.5409	2.7663	.0852	.1321	.0613	.1265
	(4.0526)	(4.8829)	(.0997)	(.1180)	(.0998)	(.1206)
LAMBDA		-13.0300		-.1008		.0073
		(16.8532)		(.3375)		(.3499)
N	130	93	130	93	130	93
R^2	.12	.13	.07	.10	.09	.10
F	3.33	2.30	2.50	2.03	3.05	1.92
Elasticities:						
Income	.4173	.4255	.3344	.3519	.2884	.2867
Age	.0837	.0129	-.0044	.0880	-.0170	.0721
HHSize	-.0252	-.0557	-.0519	-.0903	.0069	-.0089
Sex of Head	.0474	.0536	.0579	.0885	.0613	.1265

***Significant at 99%
**Significant at 95%
*Significant at 90%

Appendix IB:
Santa Ana Renters

DEPENDENT VARIABLE	(1) HOUSEX	(2) HOUSEX	(3) LHOUSEX	(4) LHOUSEX	(5) LHOUSEX	(6) LHOUSEX
Constant	45.1158***	59.0095*	3.1475***	3.0350***	1.7783**	1.4707
	(15.6763)	(32.7306)	(.1957)	(.3394)	(.7478)	(1.0632)
PYC	.0299***		.0006***			
	(.0100)		(.0002)			
LPYC					.2745***	
					(.1015)	
PYW		.0312***		.0008**		
		(.0121)		(.0003)		
LPYW						.2733**
						(.1226)
AGEH	-1.1810*	-1.5837	.0001	.0016		
	(.6953)	(1.0642)	(.0029)	(.0034)		
AGEH2	.0128*	.0171*				
	(.0072)	(.0104)				
LAGEH					-.0110	.0589
					(.1244)	(.1619)
HHSIZE	-.1209	-.5625	-.0106	-.0241		
	(1.0973)	(1.1007)	(.0260)	(.0284)		
LHHSIZE					-.0128	-.0103
					(.0926)	(.1039)
SEXH	2.8506	2.6985	.0918	.1331	.0698	.1260
	(4.0797)	(4.8908)	(.1001)	(.1184)	(.0998)	(.1212)
LAMBDA		-13.6801		-.1111		-.0088
		(16.8428)		(.3386)		(.3503)
N	130	93	130	93	130	93
R^2	.10	.14	.06	.10	.08	.09
F	2.88	2.26	2.10	1.88	2.78	1.80
Elasticities:						
Income	.3852	.4222	.2839	.3729	.2745	.2733
Age	-.0736	.0001	.0044	.0741	-.0110	.0589
HH Size	-.0129	-.0640	-.0414	-.0942	-.0128	-.0103
Sex of Head	.0532	.0523	.0623	.0892	.0698	.1212

Appendix IIA:
Sonsonate Renters

DEPENDENT VARIABLE	(1) HOUSEX	(2) HOUSEX	(3) LHOUSEX	(4) LHOUSEX	(5) LHOUSEX	(6) LHOUSEX
Constant	23.4116 (16.7063)	33.0382* (19.3117)	3.0913*** (.2013)	2.9683*** (.2683)	.5323 (.8458)	.9607 (.9638)
Y	.0379*** (.0082)		.0010*** (.0002)			
LY					.4827*** (.1046)	
PYA		.0312*** (.0102)		.0009*** (.0003)		
LPYA						.3828*** (.1223)
AGEH	-.0782 (.7471)	-.6185 (.8639)	.0024 (.0035)	.0021 (.0040)		
AGEH2	.0022 (.0083)	.0073 (.0094)				
LAGEH					.0977 (.1389)	.0631 (.1635)
HHSIZE	-1.5094 (1.1191)	-1.1200 (1.2514)	-.0051 (.0277)	-.0467 (.0332)		
LHHSIZE					-.2421 (.0959)	-.1555 (.1199)
SEXH	-2.6199 (4.3834)	-8.5356* (4.7790)	-.0773 (.1104)	-.1986 (.1302)	-.1382 (.1154)	-.1973 (.1296)
LAMBDA		6.5309 (11.0456)		.2365 (.2951)		.1968 (.9633)
N	91	65	91	65	91	65
R^2	.21	.16	.21	.16	.21	.16
F	4.61	1.82	5.69	2.27	5.72	2.23
Elasticities:						
Income	.4953	.4823	.4461	.4085	.4827	.3828
Age	.1263	.0050	.0994	.0895	.0977	.0631
HH Size	-.1675	-.1462	-.0224	-.1775	-.2421	-.1555
Sex of Head	-.0438	-.1608	-.0441	-.0257	-.1382	-.1973

Appendix IIB: Sonsonate Renters

	(1)	(2)	(3)	(4)	(5)	(6)
DEPENDENT VARIABLE	HOUSEX	HOUSEX	LHOUSEX	LHOUSEX	LHOUSEX	LHOUSEX
Constant	23.0201 (15.5664)	32.6245* (19.0016)	3.0801*** (.1994)	2.9422*** (.2645)	.3908 (.8417)	.7622 (.9613)
PYC	.0396*** (.0082)		.0010*** (.0002)			
LPYC					.4997*** (.1034)	
PYW		.0378*** (.0111)		.0011*** (.0003)		
LPYW						.4214*** (.1245)
AGEH	-.0693 (.7405)	-.6332 (.8497)	.0026 (.0035)	.0026 (.0039)		
AGEH2	.0022 (.0083)	.0076 (.0092)				
LAGEH					.1132 (.1380)	.0787 (.1619)
HHSIZE	-1.5846 (1.1096)	-1.2485 (1.2287)	-.0532* (.0274)	-.0515 (.0326)		
LHHSIZE					-.2450*** (.0945)	-.1798 (.1200)
SEXH	-2.9051 (4.3479)	-9.3980** (4.7443)	-.0853 (.1094)	-.2225* (.1292)	-.1441 (.1140)	-.2170* (.1289)
LAMBDA		6.8866 (10.8625)		.2345 (.2901)		.1722 (.8057)
N	91	65	91	65	91	65
R^2	.23	.20	.22	.20	.23	.18
F	4.99	2.37	6.23	2.97	6.25	2.58
Elasticities:						
Income	.5089	.5325	.4393	.4553	.4997	.4214
Age	.1372	.0207	.1077	.1065	.1132	.0787
HH Size	-.1758	-.1630	-.2330	-.1978	-.2450	-.1718
Sex of Head	-.0486	-.1770	-.0486	-.1224	-.1441	-.2170

Appendix IIIA: Santa Ana Owners

DEPENDENT VARIABLE	(1) HOUSEX	(2) HOUSEX	(3) LHOUSEX	(4) LHOUSEX	(5) LHOUSEX	(6) LHOUSEX
Constant	-20.2852	31.6026	4.1904***	4.5281***	-2.0343*	-1.7570
	(77.1444)	(93.6577)	(.3466)	(.4836)	(1.2257)	(1.6653)
Y	.1048***		.0011***			
	(.0211)		(.0002)			
LY					.9274***	
					(.1292)	
PYA		.1100***		.0011***		
		(.0247)		(.0002)		
LPYA						1.0695***
						(.1609)
AGEH	5.0972*	3.6482	.0001	-.0064		
	(3.1165)	(3.3390)	(.0055)	(.0067)		
AGEH2	-.0472	-.0399				
	(.0298)	(.0306)				
LAGEH					.3465	.0122
					(.2280)	(.2881)
HHSIZE	-8.2633**	-6.7894	-.0401	-.0298		
	(4.1570)	(4.1572)	(.0391)	(.0370)		
LHHSIZE					-.3287**	-.2696*
					(.1556)	(.1527)
SEXH	-30.6646*	-28.0014	-.3260**	-.2317*	-.3573**	-.3025
	(17.5389)	(18.3736)	(.1656)	(.1650)	(.1489)	(.1506)
LAMBDA		90.7859*		.8378*		.6394
		(50.5490)		(.4976)		(.4679)
N	71	63	71	63	71	63
R^2	.34	.37	.33	.39	.46	.49
F	6.59	5.38	8.31	7.17	14.38	10.78
Elasticities:						
Income	.6574	.6933	.7703	.9180	.9274	1.0695
Age	.1682	-.1161	.0049	-.3176	.3465	.0122
HH Size	-.3057	-.2567	-.1965	-.1447	-.3287	-.2696
Sex of Head	-.1560	-.1409	-.2217	-.2085	-.3573	-.3025

Appendix IIIB:
Santa Ana Owners

DEPENDENT VARIABLE	(1) HOUSEX	(2) HOUSEX	(3) LHOUSEX	(4) LHOUSEX	(5) LHOUSEX	(6) LHOUSEX
Constant	-27.0908	38.6847	4.3966***	4.5869***	-.0295	-1.5625
	(85.3975)	(93.9328)	(.3800)	(.4816)	(1.3811)	(1.6408)
PYC	.0742***		.0008***			
	(.0259)		(.0002)			
LPYC					.6404***	
					(.1436)	
PYW		.1164***		.0012***		
		(.0264)		(.0002)		
LPYW						1.0503***
						(.1575)
AGEH	6.2733*	3.5828	-.0010	-.0067		
	(3.4361)	(3.3566)	(.0061)	(.0068)		
AGEH2	-.0596*	-.0395				
	(.0328)	(.0308)				
LAGEH					.3076	.0271
					(.2677)	(.2881)
HHSIZE	-4.8725	-7.3863*	-.0077	-.0354		
	(4.5691)	(4.2338)	(.0429)	(.0376)		
LHHSIZE					-.2048	-.2966**
					(.1861)	(.1542)
SEXH	-27.7379	-27.4389	-.3067*	-.3078*	-.3637**	-.3029**
	(19.4703)	(18.4526)	(.1842)	(.1655)	(.1760)	(.1505)
LAMBDA		92.4246*		.8504*		.6282
		(56.7946)		(.4992)		(.4674)
N	71	63	71	63	71	63
R^2	.19	.36	.18	.38	.27	.49
F	2.98	5.23	3.67	7.02	6.07	10.81
Elasticities:						
Income	.4456	.6795	.5425	.9282	.6404	1.0503
Age	.1512	.1257	-.0492	-.3323	.3076	.0271
HH Size	-.1802	.2792	-.0373	-.1170	-.2048	-.2966
Sex of Head	-.1411	-.1382	-.2086	-.2052	.3637	-.3029

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FOOTNOTES

[1]This paper is a substantially revised version of a section of a joint report, "Affordability, Income and Housing Consumption," read by the authors at the IBRD-IDRC Seventh Conference on the Monitoring and Evaluation of Urban Development Projects, held in Washington, D.C., 17-21 November 1980. E. Jimenez, who is a consultant to the World Bank, was primarily responsible for the section of the report from which this paper is derived and is the senior author of this paper, although the authors interacted extensively during its preparation. The authors are grateful for useful comments on an earlier draft received from S. Margolis, J. R. Follain and particularly G. K. Ingram, who also spotted an error in one of our calculations. The views expressed herein (as well as all remaining errors) are the authors' own and do not reflect the official views of the World Bank or any other institution.

[2]The former utilized data collected in 1976 in Korean urban areas for the Family Income and Expenditure Survey, while the latter was collected in 1972 as part of the Bogota Phase II planning exercise.

[3]Indeed, the few existing estimates of price elasticities have demonstrated a wide degree of variation, even when similar measures of relative housing prices have been used. For example, a widely used method in U.S. research is to use metropolitan-wide indices of housing prices. Friedman and Weinberg [4] claim that the use of these indices are most likely inappropriate since a number of analyses use the same data "produced strikingly different price elasticity estimates for rental housing".

[4]For example: Grouping around a larger unit of observation introduces aggregation biases (see Polinsky [19]); the use of lagged income as an instrumental variable will lead to upward biased parameter estimates in the presence of response lags in adjusting housing consumption to changes in demand (see Mayo).

[5]The full model (see Friedman [5]) is that $C_p = kY_p$, $Y = Y_p + Y_t$, $C = C_p + C_t$ where Y and C are actual measures of income and consumption and the subscripts p and t refer to the permanent and transitory components of these variables. Let ρ denote correlation. Friedman assumes that $\rho(Y_p,Y_t) = \rho(Y_t,C_t) = \rho(C_p,C_t) = 0$. If we were to use actual income in a consumption function, we would obtain a bias. The current income elasticity is the "true" permanent income elasticity times K, where $K = \sigma^2_{y_p} / (\sigma^2_{y_p} + \sigma^2_{y_t})$. Let us consider for the moment the following linear housing consumption equation: $h = \alpha_o + \alpha_1 Y_p + \alpha_2 Z + \epsilon$ where ϵ is some error term and Z represents other variables which may affect housing consumption. We would like to estimate α_1, the marginal propensity to consume housing out of permanent income. Since Y_p cannot be measured directly, we replace it with $(1/k)C_p$, to obtain: $h = \alpha_o + (\alpha_1/k)C + \alpha_2 Z - (\alpha_1/k)C_t + \epsilon$. Let $\mu = \epsilon - (\alpha_1/k)C_t$ be the error term and estimate this equation to obtain $\beta = \alpha_1/k$. Given k (from outside sources), we can then estimate α_1.

[6]El Salvador was just one of four countries involved in this research program aimed at learning as much as possible regarding the impact of sites and services and slum upgrading projects on the socio-economic conditions of the urban poor in developing countries. Other countries involved were Senegal, Zambia, and the Philippines. El Salvador was chosen for this analysis because of data reliability and availability.

[7]Households were also asked for the total value of the house and the imputed rent/value ratios are similar to those calculated elsewhere.

[8]As is evident from footnote 5, the estimated elasticities from equations using consumption expenditures as a measure of permanent income must be divided by k, the marginal propensity to consume. The estimation of consumption functions for our sample estimates is at $k \approx .85$.

Figure 1

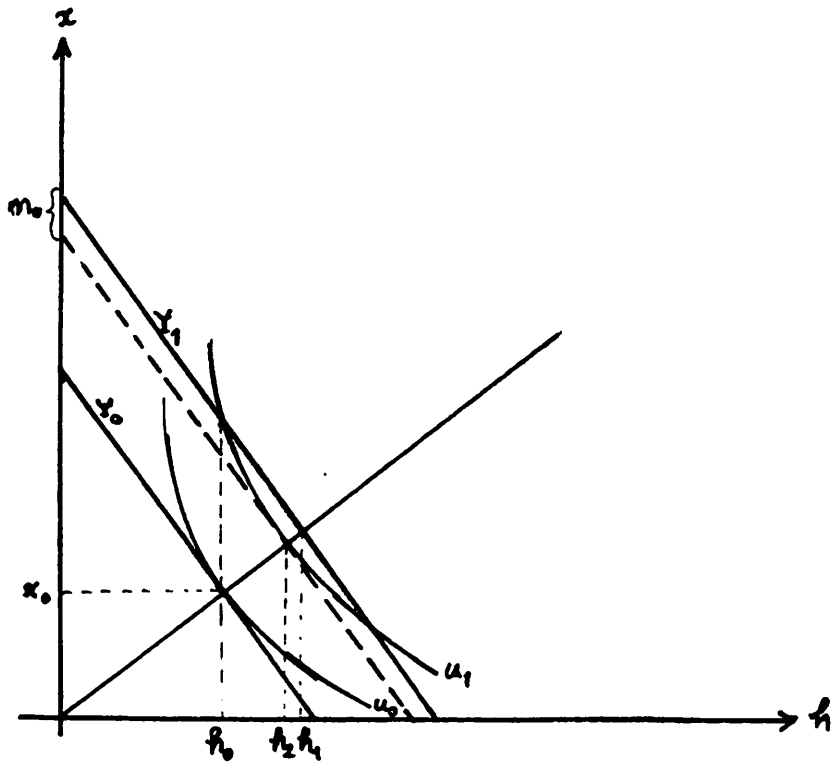

Table 1: Income Elasticities of Demand in Developing Countries

	Follain, Renaud and Lim (Korea)	Ingram (Bogota, Col.)		Strassman (Cartagena, Col.)	Ingram (Cali, Col.)	Mayo (U.S.A.) lit. rev.
	1978	1972	1978	1978	1978	
Renter						
Current	.12	.78	.67	.79	.47	.1 to .4
Permanent	.42					.3 to .5
Owner						
Current	.21		.75	.97	.73	.2 to .5
Permanent	.62					.5 to .7

Table 2: Characteristics of Low Income Urban Households in El Salvador, 1980

	Santa Ana Renters	Sonsonate Renters	Santa Ana Owners
Housing Expend. HOUSEX	36.69 (21.55)	34.16 (20.95)	132.89 (79.64)
% who moved MOBILE	.28 (.45)	.29 (.46)	.11 (.32)
Current Income Y	477.72 (210.26)	446.12 (290.42)	700.28 (405.39)
Permanent Income (Consump.Exp.) PYC	473.19 (204.31)	439.34 (288.47)	678.10 (390.17)
Permanent Income (Simple Avg.) PYA	502.66[a] (195.95)	453.85[b] (242.03)	702.64[c] (354.34)
Permanent Income (Weighted Avg.) PYW	469.30[a] (185.20)	413.63[b] (222.24)	780.15[c] (373.94)
Age of Head AGEH	43.7 (15.8)	41.4 (14.7)	49.2 (14.2)
HH Size (adult eq.) HHSIZE	3.9 (1.9)	4.4 (2.4)	4.9 (2.2)
% Male Head SEXH	.68 (.47)	.57 (.50)	.68 (.47)
Persons per room NPROOM	3.4 (2.1)	4.1 (2.6)	2.5 (1.7)
N of Students STDNTS	1.3 (1.3)	1.3 (1.5)	2.0 (1.6)
% Childbearing Wife CBWIFE	.38 (.49)	.29 (.46)	.31 (.47)
% of Heads Unskilled UNSKLD	.35 (.48)	.39 (.49)	.28 (.45)
% with Variable Y VARYY	.66 (.48)	.53 (.50)	.51 (.50)
N	130	91	71

[a] N = 93

[b] N = 65

[c] N = 63

The letter L before a variable signifies the natural log of that variable.
All average values are in constant 1980 colones.

Table 3: Probit Equations[a]

	Santa Ana Renters	Sonsonate Renters	Santa Ana Owners
CONSTANT	2.1167 (2.1508)	.8986 (.9425)	-10.4678 (-1.6669)
AGEH	-.1125 (-2.7170)	-.0558 (-1.3618)	.7027 (1.7830)
AGEH2[b]	.0011 (2.6902)	.0005 (1.1505)	-.1055 (-1.8319)
SEXH	-.2724 (-.8440)	.6660 (1.7935)	-1.2434 (-1.4742)
NPROOM	-.0311 (-.4154)	-.0668 (-.8017)	.0042 (.0230)
STDNTS	.0612 (.4851)	-.0153 (-.1144)	-.2566 (-.9402)
CBWIFE	-.0838 (-.2622)	-.5801 (-1.1526)	-.3809 (-.4863)
UNSKLD	.2732 (1.0660)	-.8906 (-1.1161)	.1709 (.3226)
VARYY	-.0350 (-.1340)	-.1601 (-.5066)	.0242 (.0411)
N	130	91	71
Non limits	37	27	8
L-RATIO	2.1023	11.3215	2.1888

[a] Numbers in parentheses are coefficients divided by approximate values of standard errors.

[b] Means AGEH squared.

Table 4: Income Elasticities

Income Variable	Santa Ana Owners	Santa Ana Renters	Sonsonate Renters
Linear Specification:			
(Y) Current Income	.6574	.4173	.4953
(PYC) Perm. Inc. Meas. by Consump.	.5242	.4532	.5987
(PYA) Perm. Inc. Meas. by Simple Avg. of Y	.6933	.4255	.4823
(PYW) Perm. Inc. Meas. by Weighted Avg. of Y	.6795	.4222	.5325
Semi-Log Specification:			
Y	.7703	.3344	.4461
PYC	.6383	.3340	.4393
PYA	.9180	.3519	.4085
PYW	.9282	.3729	.4553
Double-Log Specification:			
Y	.9274	.2884	.4827
PYC	.6404	.2745	.4997
PYA	1.0695	.2867	.3828
PYW	1.0503	.2733	.4214

All coefficients from which these elasticities were derived are significant at 99%.

Table 5: Selected Elasticities With Respect to Demographic Variables[a]

Variable	Santa Anna Owners	Santa Ana Renters	Sonsonate Renters
Age:			
AGEH + AGEH2	-.1257	.0001*	.0207
Semi Log	-.3323	.0741	.1065
Double Log	.0271	.0589	.0787
HH Size:			
Linear	-.2792*	-.0640	-.1630
Semi Log	-.1170	-.0942	-.7978
Double Log	-.2966**	-.0103	-.1718
Sex of Head:			
Linear	-.1382	.0523	-.1770**
Semi Log	-.2052*	.0892	-.1224*
Double Log	-.3029**	.1212	-.2170*

[a]These elasticities are calculated from the equations which used a weighted average of current income as a measure of permanent income.

*Indicates that the coefficient from which this elasticity was derived was significant at 90%.

**Indicates that the coefficient from which this elasticity was derived was significant at 95%.

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