Migration, Poverty, and Housing: Welfare Comparisons Using Sequential Stochastic Dominance*

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Abstract

Welfare comparisons may be sensitive to the assumptions made about economies of scale within households. This paper uses recent advances in sequential stochastic dominance techniques to show how to test for the robustness of poverty and housing quality comparisons to assumptions about economies of scale. The method is applied to a comparison of migrant and non-migrant households in Honduras. While simple comparisons based on per capita income and the estimated rental value of the dwelling suggest that migrants do better than non-migrants for poverty, but worse for housing quality, none of the two group is found to dominate the other for reasonable welfare thresholds when assumptions regarding economies of scale are relaxed.

Keywords: Migration, poverty, housing, equivalence scales
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1. Introduction

When comparing the extent to which different groups of households are able to satisfy their basic needs, an analyst faces three main problems. The first problem is the identification problem. In order to identify those who do not meet their basic needs, the analyst must select a threshold under which basic needs are not met. For example, in order to identify the income poor, a poverty line must be defined. A poor household is then a household whose equivalent income is below the poverty line. A similar procedure may be followed for other basic needs. To identify child malnutrition, it is a common practice to rely on stunting, which is defined as having a height at least two standard errors below international standards for the child's age. To identify sub-standard housing conditions such as crowding, one needs a definition of the minimum number of rooms to be available for families of various sizes. To identify fuel poverty, one would need an estimate of the amount of energy needed to meet basic energy needs.

The second problem is the aggregation procedure. In order to transpose household or individual deprivation into an aggregate measure, the analyst must select an index. The most commonly used indices for poverty are the FGT (Foster, Greer, and Thorbecke, 1984) poverty measures, but other measures can be used as well. The FGT measures can also be applied to other indicators of well-being such as child malnutrition, house crowding, and fuel poverty.

The third problem in comparing indicators of unmet basic needs between groups relates to the possibility that the various groups differ in needs. This is the problem with which we are concerned in this paper. For example, in order to make comparisons of poverty between households of different size, the analyst must select an equivalence scale in order to transform household income into equivalent income. The main idea that lies behind the use of an equivalence scale is that there exist a part of household total income that is used for public goods. Therefore, household needs do not increase in the same proportion than household size. Buhmann et al. (1987) use a simple parametric equivalence scale which is only function of the number of individuals in the household to show the important empirical impact of different equivalence scale elasticity on poverty measurement. Coulter, Cowell and Jenkins (1992b) use the same type of parameterization and analyze its implication for the theoretical impact of equivalence scales on poverty measurement (see also Coulter, Cowell and Jenkins (1992a)). Banks and Johnson (1994), Jenkins and Cowell (1994) and Duclos and Mercader-Prats (1999) generalize the analysis for a class of parameterized equivalence scales extended to take household composition into account. These papers, in addition to those of Phipps (1991), Burkhauser, Smeeding and Merz (1996), and De Vos and Zaidi (1997), also find that international comparisons of poverty and poverty profiles are strongly influenced by assumptions on household needs. The empirical question that is addressed in this paper is whether the ordinal comparisons of unmet basic needs of various groups are robust or not to the assumptions made regarding the extent to which economies of scales exist within households for the particular welfare indicator chosen. In some cases such as that of child malnutrition, there are no or few economies of scales (in food consumption) since each child must be able to meet nutritional requirements. But for household income, for housing, and for energy consumption, economies of scale clearly exist within households.

The difficulties involved in taking into account economies of scale within households when making welfare comparisons between household groups have been recognized in the literature on income poverty. Atkinson (1987) and Foster and Shorrocks (1988a, b) were the first to develop stochastic dominance conditions for robust ordinal poverty orderings. But these conditions are usually applied to distributions of equivalent incomes leaving open the problem of selecting a particular equivalence scale. To avoid this problem, following Atkinson and Bourguignon (1984), Atkinson (1992) developed a first order "sequential" stochastic dominance condition that enables the analyst to test for the robustness of the poverty ordering to the choice of the equivalence scale (the term sequential is used to denote the procedure which consists of checking for robustness for various groups sequentially, with the groups typically defined according to household size). Jenkins and Lambert (1993) generalized this result to enable comparisons of populations with different demographic structures. Chambaz and Maurin (1998) proposed a condition for second order sequential stochastic dominance and proved the necessity of the condition. Finally, Duclos and Makdissi (1999) generalized those sequential stochastic dominance conditions to any order of dominance, proved the necessity of the dominance conditions, and used those conditions to develop a method that enables the analyst to identify the subsets of poverty lines, poverty indices, and equivalence scales that are consistent with a given poverty ordering.

In this paper, we follow upon Duclos and Makdissi's work and we suggest that their method can be applied not only to income poverty, but also to other indicators of unmet basic needs where there are potential economies of scale such as housing. The empirical application consists of testing whether in Honduras, recent migrants to or within urban areas are better off than non-migrant urban households in terms of income poverty and housing quality. The methodological tools are presented in section 2. In section 3, they are applied to a recent survey for Honduras, with the somewhat surprising result that migrants do as well as non-migrants at their place of destination for poverty, and better than non-migrants for housing quality.

2. Sequential Stochastic Dominance: Methodology

We want to compare the unmet basic needs of households who have migrated to those of households who have not migrated. We use two indicators of unmet basic needs: income poverty and sub-standard housing quality as measured by the estimated rental value of the household's dwelling being below a given threshold. Our goal is to test whether migrants are more likely to be income poor and to live in poor housing conditions than non-migrants.

The outcome of the comparison between migrants and non-migrants is unclear on a priori grounds. Because migration yields the promise of higher earnings, it has been considered as one of several strategies used by poor households to emerge from poverty. But even if migration brings earnings gains on average, it may lead to higher risk and vulnerability among migrant households whose members are young, poorly educated, and without good social networks. Even if migrants do well on the income scale, they may be forced to live in poor housing conditions regardless of their financial success, at least in the short run (i.e., soon after they have migrated). Indeed, recent migrants often live in the outskirts of cities in self-built housing units. In new and growing cities, this may be due to a lack of housing stock within the city itself. In older cities, this may be because centrally located buildings are occupied by the urban born or by long term-migrants who have progressively relocated there.

The question as to whether migrants are better or worst off than non-migrants must be settled empirically. One simple way to compare migrants and non-migrants would consist in using the value of welfare indicators for the two groups with a single equivalence scale. Following standard practice, we could use per capita income for poverty, and household rental value for housing quality. Using data from the March 1999 Encuesta Permanente de Hogares de Propósitos Múltiples (EPHPM) for Honduras, the density function for per capita income has been graphed for recent migrants now living in urban areas and for other urban households (the survey asks whether households have been living in their current place of residence for less than five years; this is the variable used to identify recent migrants). Similarly, Figure 2 provides the density functions for housing rental value for the two groups. A quick look at the two Figures would suggest that migrants are doing better than non-migrants for per capita income and thereby poverty, while non-migrants are doing better for housing quality, at least at the bottom of the distribution. While such an interpretation of Figures 1 and 2 would not contradict conventional wisdom about the gains and costs from migration, it could be deceptive. In fact, it could very well be that taking into account household size would reverse the findings.

As indicated in Figure 3, migrant households tend to be smaller than non-migrant households (some members of the migrant's family typically remain at the place of origin of the migrant). Using per capita income may thus suggest that migrants are less likely to be poor than non-migrants, while they may be as likely, or perhaps even more likely to be poor than migrants when economies of scale for larger (non-migrant) households are taken into account. For housing, the hypothesis that non-migrants do better than migrants when the household rental value is the measure of well-being could be reversed if the rental value were to be adjusted to take into account family size. It is to avoid such problems that we apply the tools of sequential stochastic dominance to both income poverty and an index of housing quality in this paper.

In the rest of this section, we describe our methodology for obtaining robust comparisons of unmet basic needs. Let us assume that for both migrants and non-migrants, there are six different household types, namely household with one, two, three, four, five, and six or more individuals. Let $F_{Mk}(x)$ be the cumulative distribution of income or housing quality x

for the households of k individuals among the migrants. The distribution is defined over an interval $[0, a]$, with for example a being the maximum value observed in the sample. $F_{Nk}(x)$ is defined analogously for non-migrants. Let θ_{Mk} represent subgroup k's population share among migrants. For all integer s we define:

$$D^1_{Mk}(x) = F_{Mk}(x) \text{ and } D^s_{Mk}(x) = \int_0^x D^{(s-1)}_{Mk}(y)\,dy. \tag{1}$$

The function $D^1_{Mk}(x)$ is simply the cumulative density function. Each higher order function (with the order being equal to s) is obtained as the surface below the previous curve and the horizontal axis representing income. The functions can thus be linked to the Foster-Greer-Thorbecke (1984) class of poverty indices, although as suggested by Atkinson (1987), we consider here the non-normalized version of this index whereby $FGT(\alpha, z) = \int_0^z (z-x)\,dF(x)$. As noted by Ravallion (1994), the functions can also be expressed as:

$$D^s_{Mk}(z) = (s-1)!FGT(s-1, z). \tag{2}$$

We assume that the poverty lines which can be applied to the various groups of households defined by household size are such that $z_1^+ \leq z_2^+ \leq ... \leq z_6^+$ where z_k^+ is the maximum level for determining whether a household of k individuals does not meet its basic needs (in the case of poverty, z is a standard poverty line; in the case of housing, z is some level of housing quality at which the dwelling meets minimum quality requirements). This assumption simply means that the maximum poverty and housing deficiency lines for a given household size cannot exceed the poverty and housing deficiency lines for larger households, since larger households have higher needs than smaller households. If we consider an additive poverty or housing deficiency index, which need not belong to the FGT class, total poverty P can be written as:

$$P_M = \sum_{k=1}^{6} \theta_{Mk} \int_0^a p_k(x)\,dF_{Mk}(x) \tag{3}$$

where $p_k(x) \geq 0$ is the contribution of a household of size k and total income (or housing quality) x to aggregate poverty. Note that we have $p_k(x) = 0$ if $x \geq z_k$. In order to use the sequential stochastic dominance results obtained by Duclos and Makdissi (1999), we must assume that for any poverty measure $P \in \Pi^s$ (where Π is a set of poverty measures and s is the order of dominance), we have:

$$(-1)^i p_6^{(i)}(x) \geq (-1)^i p_5^{(i)}(x) \geq ... \geq (-1)^i p_2^{(i)}(x) \geq (-1)^i p_1^{(i)}(x) \geq 0 \quad \text{for all } i \in \{1, 2, ..., s\} \tag{4}$$

where $p_k^{(i)}(x)$ is the ith derivative of the function $p_k(x)$. For $s = 1$, this assumption implies that an increase in household income (or housing quality) x diminishes poverty, whatever the household type to which this increased income (or housing quality) accrues. It also says that, for a given household income (or housing quality) x, the potential for such poverty reduction is greater for households with more members (because for any given level of household income, the individuals living in this households are further away from the poverty line since the income available must be shared among a larger number of individuals). For $s = 2$, the assumption says that the poverty indices respect the Pigou-Dalton transfer principle which stipulates that an equalizing transfer of one dollar to a poor from a richer household decreases poverty, and this effect is again stronger across households of larger sizes. For $s = 3$, the indices are sensitive to so-called favorable composite transfers and this sensitivity is more important for larger households. These composite transfers are such that a favorable Pigou-Dalton transfer within the lower part of the distribution, accompanied by a reverse Pigou-Dalton transfer within the higher part of the distribution, reduces poverty if the variance of the distribution has not increased. The assumption in equation (4) makes these principles normatively more important for larger households than for smaller ones. This normative principle has been introduced by Kolm (1976) into the inequality measurement literature. Kakwani (1980) has adapted the principle to the poverty measurement context. Finally, the normative interpretation of s > 3 can be made using Fishburn and Willig's (1984) generalized transfer principle by recalling that for every order s, this principle will be normatively more important for larger households.

Under the above assumptions, Duclos and Makdissi (1999) show that poverty will be lower for the first group M (migrants) than for the second group N (non-migrants) for all poverty indices respecting the principles associated with the sth order of stochastic dominance if and only if:

$$C^s_{Mk}(x) \leq C^s_{Nk}(x) \text{ for all } x \leq z^+_k, \text{ for all } k = 1 \text{ to } 6. \tag{5}$$

where $C^s_{Mk}(x) = \sum_{l=k}^{6} \theta_{Ml} D^s_{Ml}(x)$ and $C^s_{Nk}(x)$ is defined analogously. Those curves (which shall be referred to as "C-Curves") are sums of the curves $D^s_{Mk}(x)$ for households of size k or above weighted by the population shares of each household group. The principle behind the C-Curves is that according to the normative guidelines expressed above, an income loss for one household at some income level can be compensated by an equivalent gain in income for another household provided that the gain is captured by a household of a larger size (i.e., a household whose members are further away from the poverty line). This idea is put in practice in condition (5) by checking whether at each level of income below the maximum poverty line, and sequentially (starting from the household group with the highest household size) for each household group of size $k = 1, ..., 6$, a comparatively lower income level observed for the migrants versus the non-migrants for the households in group k is more than compensated by a higher level of income among migrants as compared to non-migrants among the household groups of higher size.

The condition (5) is easy to apply empirically because it involves only checking for the non intersection of the C-curves up to a maximum poverty line. There will be less poverty for migrants than for non migrants if and only if for all household sizes, $C^s_{Mk}(x)$ lies everywhere under $C^s_{Nk}(x)$ up to the maximum poverty line z^+_k for this household size. For example, if we consider only two different household sizes, i.e., households with one and two members, we must check first if the curve $C^s_{M2}(x)$ lies everywhere under $C^s_{N2}(x)$ up to the maximum poverty line z^+_2 for households of size two, and then check if $C^s_{M1}(x)$ lies everywhere under $C^s_{N1}(x)$ up to the maximum poverty line z^+_1 for households of size one.

There exists an implicit maximum equivalence scale underlying the maximum poverty line z^+_k for household of k individuals. For example, if the maximum poverty line for households of size two is twice the maximum line for households of size one, this would mean that we would accept (but not necessarily assume) the possibility that there are no economies of scale for households of size two as compared to households of size one. In this example, denoting by m^+_2 the maximum equivalence scale admissible for households of size two, we would have $m^+_2 = 2 = z^+_2/z^+_1$. More generally, the implicit maximum equivalence scales for all household groups k derived from the maximum poverty lines are such that:

$$m^+_k = z^+_k/z^+_1,\ \ k = 1, ..., 6. \tag{6}$$

Now suppose that the test of first order sequential stochastic dominance proposed in (5) has failed and that we therefore cannot infer a robust poverty ordering over an initially specified set of poverty indices and poverty line upper bounds z^+_k. Instead of concluding that the distributions cannot be robustly ranked, three alternative routes can be followed to determine whether dominance can be secured over smaller subsets of poverty indices and poverty lines than initially envisaged. The first route increases the order of stochastic dominance s until a poverty ordering becomes robust over all of the pre-specified ranges of poverty lines. The second route consists of finding a lower maximum value for the admissible poverty line for households with a single member while maintaining unchanged the given order of dominance s as well as each of the maximum equivalence scales admissible for households of more than one member, such that the ratios z_k^+/z_1^+ remain unchanged. The third route consists of finding the critical ratios z_k^+/z_1^+ up to which a poverty ordering is robust for the given maximum poverty line z_1^+ for single individuals and the pre-specified order of stochastic dominance s. Two of these three alternative routes can be followed at the same time if the analyst is not willing to relax the third constraint.

In practice, we can start by finding the intersection points for the C-curves defined in 5. For each order of dominance s, if we have six groups of households $k = 1, ..., 6$, we need to test for six intersections. That is, we must find six critical values σ_k^s, $k = 1, ..., 6$, which correspond to the maximum value of ξ respecting the condition (7) below:

$$C_{Mk}^s(x) \leq C_{Nk}^s(x) \text{ for all } x \leq k\xi, \text{ for all } k = 1 \text{ to } 6. \tag{7}$$

This gives us a set of upper poverty line bounds σ_1^s, σ_2^s, ... , σ_6^s, that may or may not obey the assumption made on the rankings of the maximum poverty lines. To ensure that the assumption is validated, i.e. that $z_k^+ \leq z_{k+1}^+$, we must proceed by iteration, defining first $z_6^s = \sigma_6^s$, and then setting the remaining z_k^s as follows:

$$z_k^s = \min\left(\sigma_k^s, z_{k+1}^s\right), \text{ for all } k = 1, ..., 5. \tag{8}$$

Interpreting z_1^s as the robust upper bound for the poverty line of households with a single member, we may use the vector $z^s = (z_1^s, ..., z_6^s)$ to estimate the sets of equivalence scales for which a poverty ranking will be robust at order s. This critical set of equivalence scales is given by $m(k) \in [1, \min(k, z_k^s/z_1^s)]$. Note that if we fix a maximum bound z_1^+ for the poverty line for single people, and if $z_1^+ < z_1^s$, the robust set of equivalence scales can be extended to $\left[1, \min\left(k, z_k^s/z_1^+\right)\right]$ instead of $[1, \min(k, z_k^s/z_1^s)]$.

3. Empirical Results

We first compare recent migrants now living in urban areas with rural households. For this comparison, in the case of income poverty, there is only one no intersection in the C-curves for the various household size groups ($k = 1, ..., 6$). Denoting by M the migrants living in urban areas and by R the rural households, the intersection is for households with a single member, with $C^1_{M1}(x)$ crossing $C^1_{R1}(x)$ at a value of 30,600 Lempiras per month per person. This value is extremely high. Indeed, a reasonable poverty line would be in the range of 500 to 600 Lempiras per person per month (US$ 1 = 15 Lempiras), as discussed in World Bank (2001). This implies that recent migrants living in urban areas are less poor than rural households. The same dominance is observed for housing quality, as measured by the rental value of the house.

Having found that recent migrant households who now live in urban areas are better off than rural households, we now focus on the comparison between migrant urban households (still denoted by M) and other urban households (denoted by N for non-migrants). For income poverty, there is an initial (i.e., for low levels of income) dominance of the migrant group over the non-migrants for households of 1 to 5 individuals, while the non-migrants dominate migrants for households of 6 or more individuals. In such a case, it is impossible to obtain a robust poverty ordering between the two groups of households even by restricting the set of poverty measures under consideration because the initial dominance of a C-Curve on the other will not change when increasing the order of dominance (see Davidson and Duclos (2000)).

For housing, our measure of quality is the predicted rental value of the dwelling (see the Appendix for details). Contrary to what one might have expected, there is restricted dominance of migrants over non-migrants, but this is obtained only for very low rental values.

The first column of table 1 provides the values σ_k^s under which $C_{Mk}^s(x)$ lies under $C_{Nk}^s(x)$. The other columns provide the values for higher orders of dominance. To find the highest quality threshold per person for which migrants dominate non-migrants at any given order of dominance, we must divide the values provided in table 1 by the number of households in the corresponding groups. For example, if we consider all additive poverty measures in Π^1 and all equivalence scales in $[0, k]$, we must restrict the housing quality threshold for a single person to lie between 0 and 14.50 (= 87/6), since the binding σ_k^s is for households of 6 or more individuals. This is extremely low, so that for practical purposes, we can say that there is no dominance.

Even though dominance is obtained only for very low rental values which are well below what would be necessary to have decent housing in urban areas in Honduras, it is still interesting to explain how the method to establish sequential stochastic dominance works when assumptions are relaxed for the order of dominance or the admissible equivalence scales. If we do not wish to restrict too much the maximum admissible housing quality threshold, we have two alternatives. First we can restrict the set of housing quality measures. For example, if we restrict the set to measures respecting the Pigou-Dalton transfer principle (i.e., if we use Π^2), the maximum admissible quality threshold increases to 18.3. If we restrict it to Π^3, we can consider all quality thresholds between 0 and 25.3. Finally, if we restrict it to Π^4, we can consider all quality thresholds between 0 and 33.2. Since these housing quality thresholds remain very low, from a policy point of view, one can still say that migrants do not fare better than non migrants in cities.

The other alternative is to restrict the set of admissible equivalence scales. Assume for the sake of the argument that we want to consider all housing quality thresholds between 0 and 40 Lempiras per month (i.e., a rental value of housing of less than three US dollars per month). Then, migrants dominate non-migrants for any equivalent scale in the intervals shown in the Table 2. The maximum equivalence scale is set again by the households with six or more members, with the upper bound 2.18 for the equivalence scale being equal to 87/40 (in the case of households of two, the maximum equivalence scale is two). One way to interpret this maximum is to consider the parametric functional form of equivalence scale suggested for income in Buhmann et al. (1988), namely $m(n) = n^{\varepsilon}$, where ε is the elasticity of the equivalence scale with respect to the number of members in the household (at one extreme, ε may be equal zero if housing is a public good within the household; at the other extreme, ε may be equal to one if there is no economies of scale in housing, which is of course highly unlikely). If we consider additive measures in Π^1 and housing quality thresholds between 0 and 40, we must restrict ε to lie between 0 and 0.43 (since $6^{0.43} = 2.18$). If we restrict the set to measures respecting the Pigou-Dalton transfer principle (Π^2), ε must lie between 0 and 0.56. If we restrict the set to Π^3, ε must lie between 0 and 0.75. Finally, if we restrict the set to Π^4, ε must lie between 0 and 0.90. Many equivalence scales used in practice for poverty measurement have an elasticity of income that lower than 0.59 (e.g., the OECD parametric equivalence scale ε is 0.5). Since it is reasonable to assume that economies of scale are larger for housing than for income poverty, the values suggested in table 2 would be reasonable to assume dominance of the migrants over the non-migrants, but this would still apply only to the extremely low maximum threshold of 40 Lempiras per month for housing rental value. In other words, while the empirical results obtained for housing quality enable us to demonstrate the method in some detail, the conclusion remains that for reasonable housing quality thresholds (i.e, thresholds which do enable households to live in decent conditions), there is no sequential stochastic dominance of migrants over non-migrants.

4. Conclusion

This paper has used recent advances in sequential stochastic dominance techniques to compare the well-being of recent migrant households living in urban areas of a central American country to that of other, non-migrant urban households. The comparison of migrant and non-migrant households constitutes a good application of sequential dominance techniques because one group (migrant households) tends to include households of a smaller size than the other group (non-migrant households). Simple comparisons based on the use of per capita income and the rental value of housing as the welfare indicators suggest that migrants do better than non-migrants for poverty, while non-migrants do better than migrants for housing. Both results are found, however, to be highly sensitive to the use of specific equivalence scales. When sequential stochastic dominance techniques are used, migrants do not dominate non-migrants for poverty. For housing, migrants are found to dominate non-migrants, but this is true only for extremely low rental values, so that for practical and policy purposes, it is not feasible to rank the two groups. Still, when recent migrants living in urban areas are compared to rural households, sequential dominance is observed for both poverty and housing quality in favor of the migrants. Overall, the results suggest that in Honduras, recent migrants are probably achieving gains in income and housing quality when they move from rural to urban areas, and that their level of welfare is on par with that of urban households who did not migrate over the last five years.

A Estimating housing quality through hedonic rental regressions

The indicator of housing quality used in this paper was obtained from a standard hedonic regression. For the households renting their dwelling, we denote by R_i the rent paid. L_i

represents geographic location (vector of geographic dummies), U_i is a dummy variable which assumes a value of one when the household is in an urban area and a value of zero for rural areas, and H_i is a vector of dwelling characteristics. We estimated the following regression:

$$\ln R_i = \beta_0 + \beta_1 L_i + \beta_2 U_i + \beta_3 H_i + \eta_i, \tag{A.9}$$

where η_i is the random error term.

The vector of dwelling characteristics includes the type of housing, namely, whether it is a house or apartment, a shack, a room, or a 'barracon'; the type of material for the walls and the floor, namely, stone, cement, wood, etc.; the type of access to water, namely public service, well, river, etc.; the type of sanitation, namely, indoor, latrine, connection to 'tuberia', etc.; the number of rooms; and the access to electricity. The regression results are then used to compute the expected rental value of housing for all households (both those who rent their dwelling and those who are owners), with one caveat. In order not to take into account the impact of geographic location on rental value, i.e. in order to assess only the quality of housing rather than its location, the geographic effects are not taken into account in the prediction.

In the regression, the omitted variables are the region of Atlanta, rural areas, a large cabin or single room for housing size, a dirt floor, water from a well, river or other source, water obtained outside the property, no sanitary installation or a sanitary installation of collective use, and no access to electricity. The results of the regression are given in table A1.

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Table 1: Critical σ_k^s for housing between migrants and non-migrants, Honduras 1999

	s = 1	s = 2	S = 3	S = 4
σ_1^s	154	198	250	305
σ_2^s	153	185	237	288
σ_3^s	137	181	237	290
σ_4^s	90	233	296	360
σ_5^s	117	256	323	399
σ_6^s	87	110	152	199

Source: Authors' estimates using March 1999 EHPHM.

Table 2: Admissible equivalence scales for housing quality below 40 Lempiras/month

	s = 1	s = 2	s = 3	s = 4
m(2)	[1,2]	[1,2]	[1,2]	[1,2]
m(3)	[1,2.18]	[1,2.75]	[1,3]	[1,3]
m(4)	[1,2.18]	[1,2.75]	[1,3.80]	[1,4]
m(5)	[1,2.18]	[1,2.75]	[1,3.80]	[1,4.98]
m(6)	[1,2.18]	[1,2.75]	[1,3.80]	[1,4.98]

Source: Authors' estimates using March 1999 EHPHM.

Table A1: Hedonic regression for rental value of housing, Honduras 1999

	Coefficient	Standard error
Geographic location (department)		
Colon	10.02	16.25
Comayagua	-17.52	14.63
Copan	-18.53	23.37
Cortes	24.40*	10.88
Choluteca	-30.88^{+}	18.01
El paraiso	15.86	16.46
Francisco	-12.70	11.29
Intibuco	-17.65	20.51
La paz	-58.04*	21.00
Lempira	-2.85	21.41
Ocotepeque	-19.43	21.07
Olancho	6.56	20.20
Sta Barbara	-44.68*	17.02
Valle	-62.04*	19.67
Yoro	-6.93	16.01
Urban	34.60*	8.45
Type of housing		
House or apartment	13.23^{+}	7.44
Shack	-14.93	27.83
Walls and ground		
Stone or cement walls	34.31*	13.61
Adobe walls	11.77	13.68
Wooden walls	4.68	14.27
Ground made of cement blocks	30.71*	10.13
Ground made of clay blocks	29.19	20.73
Ground made of cement boards	11.48	9.54
Ground made of wood	17.01	14.73
Water, sanitary and electricity		
Public service	-2.38	15.93
Collective or private service	-23.12	17.42
Inside the house	34.60*	12.98
Inside the property	21.16^{+}	11.98
Modern sanitary	15.93	18.92
Latrine	-8.13	12.91
Sanitary connected with pipeline	12.73	15.00
Sanitary connected to septic tank	-9.72	13.60
Sanitary of individual use	9.24	7.34
Electricity from ENEE (public)	60.13*	11.41
Electricity from collective service	70.70	49.43
Number of rooms	13.64*	1.56
Constant	373.67*	23.71

Source: Authors' estimates using March 1999 EHPHM. The coefficients with * are significant at the 5% level and the coefficients with $^{+}$ at the 10% level. $R^2 = 0.52$. N= 1175 (renters only).

Figure 1: Density function for per capita income (Lempiras/month)

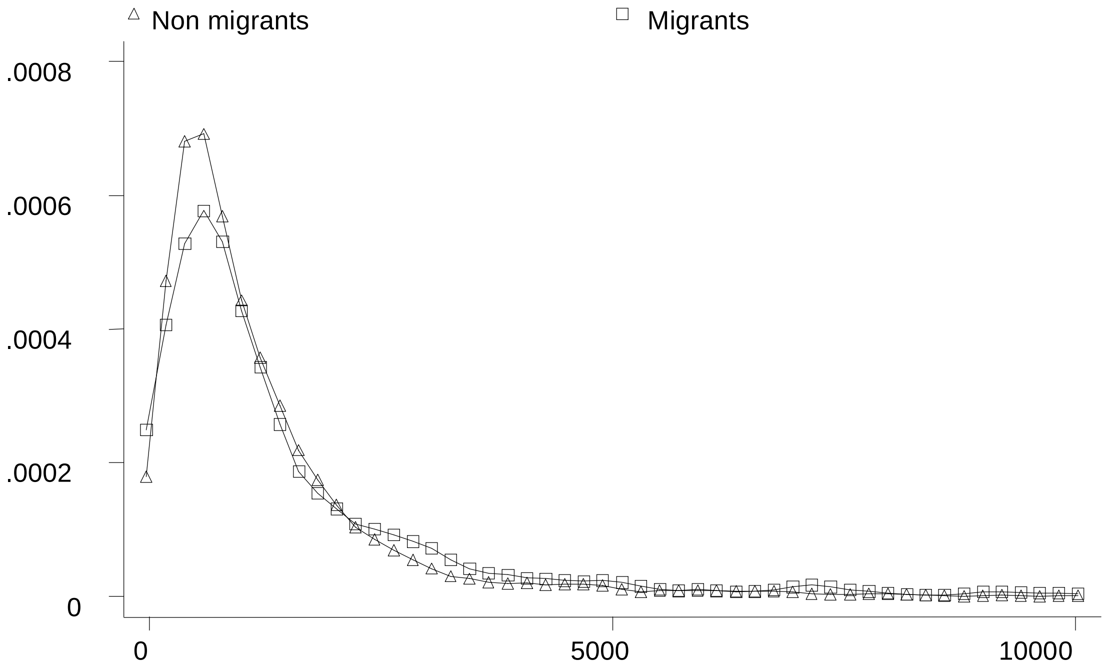


Figure 2: Density function for estimated household rent (Lempiras/month)

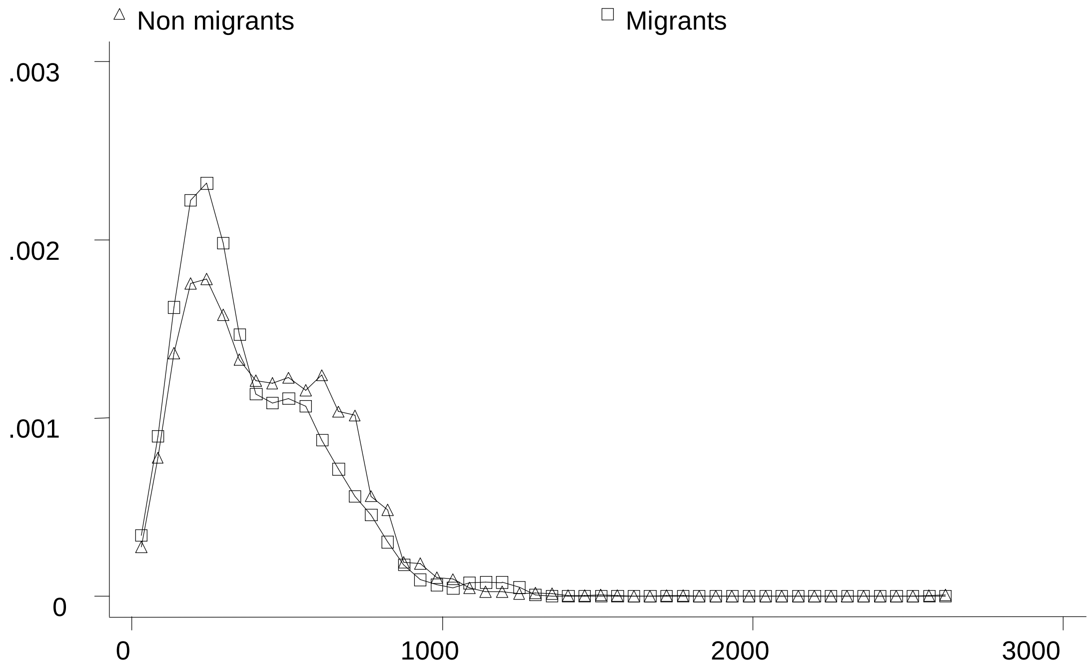
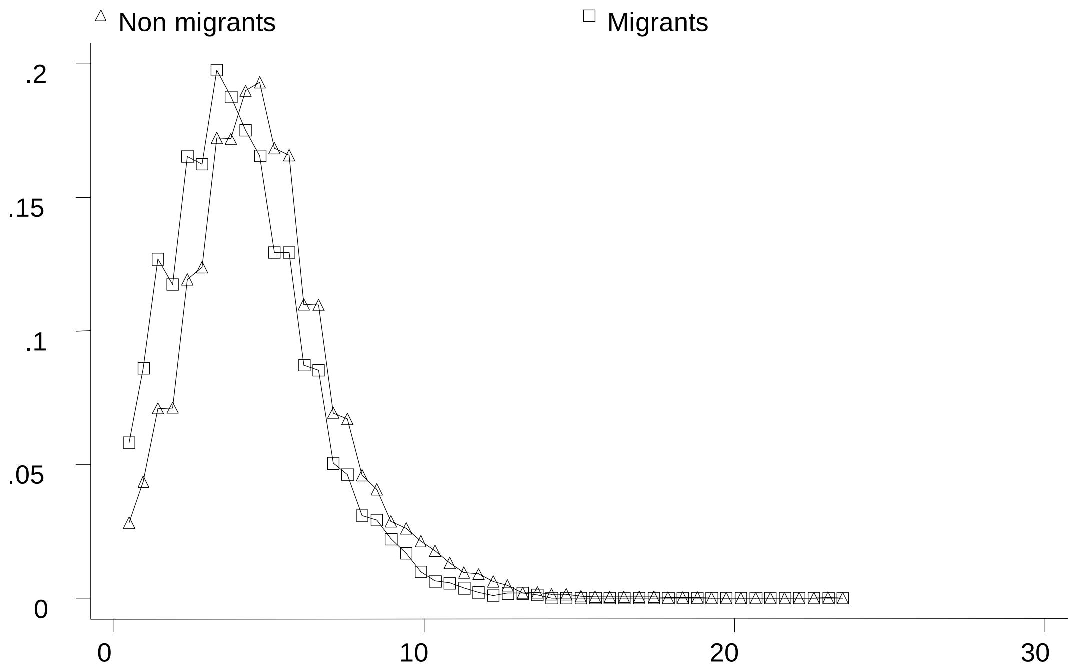


Figure 3: Household size



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