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Strategies and Analysis for Growth and Access

SAGA Working Paper
March 2004

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Strategies and Analysis for Growth and Access (SAGA) is a project of Cornell and Clark Atlanta Universities, funded by cooperative agreement #HFM-A-00-01-00132-00 with the United States Agency for International Development.

Robust Multidimensional Spatial Poverty Comparisons in Ghana, Madagascar, and Uganda[1]

by

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Abstract

We investigate spatial poverty comparisons in three African countries using multidimensional indicators of well-being. The work is analogous to the univariate stochastic dominance literature in that we seek poverty orderings that are robust to the choice of multidimensional poverty lines and indices. In addition, we wish to ensure that our comparisons are robust to aggregation procedures for multiple welfare variables. In contrast to earlier work, our methodology applies equally well to what can be defined as "union", "intersection," or "intermediate" approaches to dealing with multidimensional indicators of well-being. Further, unlike much of the stochastic dominance literature, we compute the sampling distributions of our poverty estimators in order to perform statistical tests of the difference in poverty measures.

We apply our methods to two measures of well-being, the log of household expenditures per capita and children's height-for-age z-scores, using data from the 1988 Ghana Living Standards Survey, the 1993 *Enquête Permanente auprès des Ménages* in Madagascar, and the 1999 National Household Survey in Uganda. Bivariate poverty comparisons are at odds with univariate comparisons in several interesting ways. Most importantly, we cannot always conclude that poverty is lower in urban areas from one region compared to rural areas in another, even though univariate comparisons based on household expenditures per capita almost always lead to that conclusion.

Keywords: Multidimensional Poverty, Stochastic Dominance, Ghana, Madagascar, Uganda

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[1] This research is supported by the SAGA project, funded by USAID cooperative agreement #HFM-A-00-01-00132-00 with Cornell and Clark-Atlanta Universities, and by the Poverty and Economic Policy (PEP) network of the IDRC. For more information, see http://www.saga.cornell.edu and www.pep-net.org.
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1. Introduction

It is common to assert that poverty is a multi-dimensional phenomenon, yet most empirical work on poverty, including spatial poverty, uses a one-dimensional yardstick to judge a person's well-being, usually household expenditures or income *per capita* or per adult equivalent. When studies use more than one indicator of well-being, poverty comparisons are either made for each indicator independently of the others,[3] or are performed using an arbitrarily-defined aggregation of the multiple indicators into a single index.[4] In either case, aggregation across multiple welfare indicators, and across the welfare statuses of individuals or households, requires specific aggregation rules, and no such rules can be devised such as to receive unanimous approval.[5] Multidimensional poverty comparisons also require estimation of multidimensional poverty lines, a procedure that is ethically and empirically problematic even in a unidimensional setting.

Taking as a starting point our conviction that multidimensional poverty comparisons are ethically and theoretically attractive, our purpose in this paper is to apply quite general methods for multidimensional poverty comparisons to the particular question of spatial poverty in three African countries, Ghana, Madagascar, and Uganda. We have developed the relevant welfare theory and accompanying statistics elsewhere (Duclos, Sahn, and Younger, 2003). Our purpose in this paper is to give an intuitive explanation of the methods, and to show that they are both tractable and useful when applied to the question of spatial poverty in Africa.

We start in section 2 by considering poverty comparisons that involve two or more measures of well-being, and by asking whether poverty is lower in population A than in population B. Here, we make an important distinction between intersection and union definitions of poverty.[6] If we measure well-being in the dimensions of income and height, say, then a person could be considered poor if her income falls below an income poverty line *or* if her height falls below a height poverty line. We may define this as a union definition of multidimensional poverty. An intersection definition, however, would consider a person to be poor only if she falls below *both* poverty lines. In contrast to earlier work, the tests that we use are valid for both definitions. In fact, they are valid for any choice of intermediate definitions for which the poverty line in one dimension is a function of well-being measured in the other dimension.

Throughout, our poverty comparisons use the dominance approach initially developed in Atkinson (1987) and Foster and Shorrocks (1988a,b,c) in a unidimensional context.[7] It is well-known that one important advantage of this approach is that it is capable of generating poverty orderings that are robust to the choice of a poverty index over broad classes of indices – the orderings are "poverty-measure robust." In our multidimensional context, this further means robustness over the

[3] This would involve, say, comparing incomes across regions, and then mortality rates across regions, and so on.

[4] The best-known example of this is the Human Development Index of the UNDP (1990), which uses a weighted mean of some averaged indicators across the population.

[5] Such rules have been the focus of some of the recent literature: see for instance Tsui (2002) and Bourguignon and Chakravarty (2003). Bourguignon and Chakravarty (2002) also give several interesting examples in which poverty orderings vary with the choice of aggregation rules.

[6] For further recent discussion of this, see Bourguignon and Chakravarty (2003,2002), Atkinson (2002) and Tsui(2002).

[7] Atkinson and Bourguignon (1982,1987) first used this approach in the context of multidimensional social welfare. See also Crawford (1999).

manner in which multidimensional indicators interact to generate overall individual well-being. As mentioned above, our orderings are also "poverty-line robust" in the sense of being valid for the choice of any poverty frontier over broad domains and union, intersection, or intermediate poverty domains. Again, given the well-known sensitivity of many poverty comparisons to the choice of poverty lines, and the difficulty of choosing the "right" poverty line, we feel that this is an important contribution.

Section 3 applies these methods to spatial poverty comparisons in Ghana, Madagascar, and Uganda. In particular, we compare poverty across region and area (urban/rural) in the dimensions of household expenditures per capita and nutritional status for children under the age of five. Univariate comparisons based on expenditures alone almost always show greater poverty in rural areas in any one region than in urban areas in any other. Bivariate comparisons, however, are less likely to draw this conclusion, for a variety of reasons that we discuss.

Previous work on multidimensional poverty comparisons has ignored sampling variability, yet this is fundamental if the study of multidimensional poverty comparisons is to have any practical application. This paper's poverty comparisons are all statistical, using consistent, distribution-free estimators of the sampling distributions of the statistics of each poverty comparison.

2. Methods to compare poverty with multiple indicators of well-being

2.1. Data

The data for this study come from the 1988 Ghana Living Standards Survey, the 1993 *Enquête Permanente auprès des Ménages* in Madagascar, and the 1999 National Household Survey in Uganda. All of these are nationally representative, multi-purpose household surveys. The first measure of well-being that we use is per capita household expenditures, the standard variable for empirical poverty analysis in developing countries. The second is children's height-for-age z-score (HAZ), which measures how a child's height compares to the median of the World Health Organization reference sample of healthy children (WHO 1983). In particular, the z-scores standardize a child's height by age and gender as follows:

$$z\text{-}score = \frac{x_i - x_{median}}{\sigma_x},$$

where x_i is a child's height, x_{median} is the median height of children in a healthy and well-nourished reference population of the same age and gender, and σ_x is the standard deviation from the mean of the reference population. Thus, the z-score measures the number of standard deviations that a child's height is above or below the median for a reference population of healthy children of her/his age and gender.

The nutrition literature includes a wealth of studies showing that in poor countries children's height is a particularly good summary measure of children's general health status (Cole and Parkin 1977; Mosley and Chen 1984; WHO 1995). As summarized by Beaton et al (1990), growth failure is

"…the best general proxy for constraints to human welfare of the poorest, including dietary inadequacy, infectious diseases and other environmental health risks." They go on to point out that the usefulness of stature is that it captures the "…multiple dimensions of individual health and development and their socio-economic and environmental determinants (p. 2)." In addition, HAZ is an interesting variable to consider with expenditures per capita because the two are, surprisingly, not highly correlated, so that they capture different dimensions of well-being (Appleton and Song 1999) .[8]

2.2. Univariate Poverty Dominance Methods

The theoretical and statistical bases for the methods that we use in this paper are developed in Duclos, Sahn, and Younger (2003). In this section, we give an intuitive presentation only. Even though our goal is to make multidimensional poverty comparisons, it is easier to grasp the intuition with a one-dimensional example. Consider, then, the question addressed in Appleton (2001): did poverty decline in Uganda in the 1990s? By far the most common way to answer this question is to:

1) choose a poverty line, often based on the expenditure needed to satisfy basic caloric requirements along the lines of Ravallion and Bidani (1994);
2) choose a poverty measure, usually a Foster-Greer-Thorbecke (FGT) measure, too often the headcount; and
3) calculate poverty at two or more points in time, and compare.

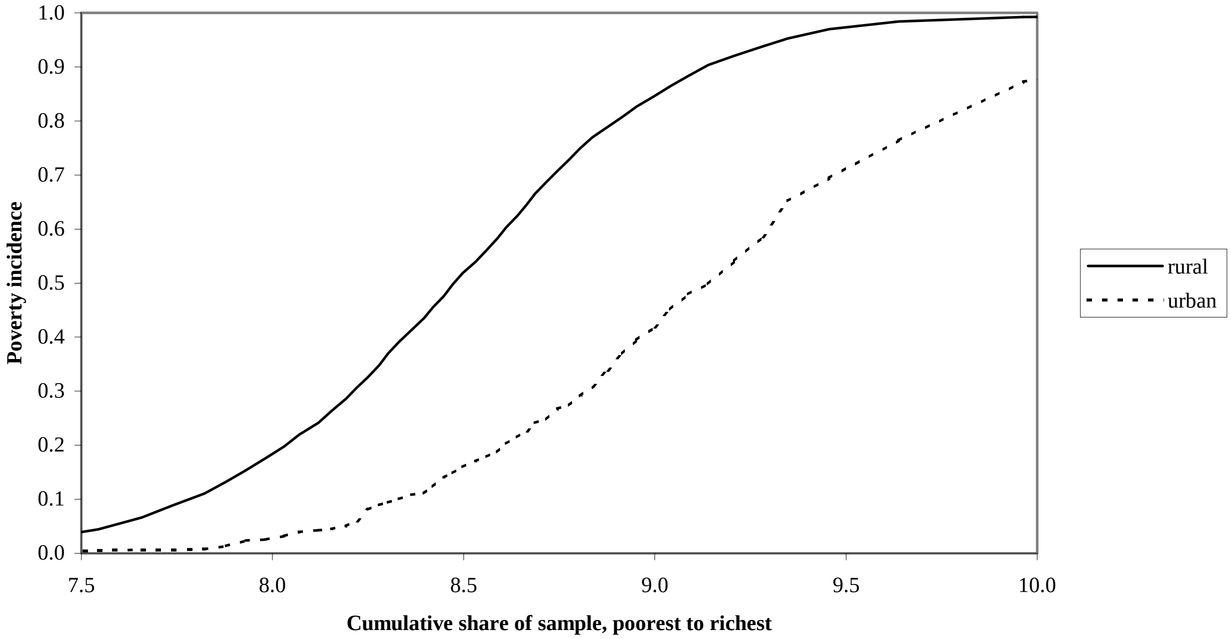
This approach has two weaknesses: it depends on the particular poverty line chosen, and it depends on the particular poverty measure chosen. Setting the poverty line is an imprecise art, and it is possible that choosing a different, equally defensible, poverty line will reverse one's conclusions. That is, using one poverty line, poverty is found to decline over time, while at another, it is found to increase. In addition, it is possible that one particular poverty measure will show poverty declining while another will show it increasing.

The dominance approach to poverty analysis aims to avoid these problems by making poverty comparisons that are robust to the poverty line selected and the poverty measure selected. Consider Figure 1, which displays the cumulative density functions (cdf) – or distribution functions [9] – for real household expenditures per capita in urban and rural areas of Uganda in 1999. The graph makes clear that no matter which poverty line one chooses, the headcount poverty index (the share of the sample that is poor) will always be lower for urban areas than for rural. Thus, this sort of poverty comparison is robust to the choice of a poverty line.

[8] Pradhan, Sahn, and Younger (2003) give a more thorough defense of using children's height as a welfare measure.

[9] The cumulative density function graphs the share of observations in a sample that fall below a given per capita expenditure level against that expenditure level itself. If we think of the values on the x-axis as potential poverty lines – the amount that a household has to spend per capita in order not to be poor – then the corresponding value on the y-axis would be the headcount poverty rate – the share of people whose expenditure is below that particular poverty line. Note that this particular cumulative density function is sometimes called a "poverty incidence curve."

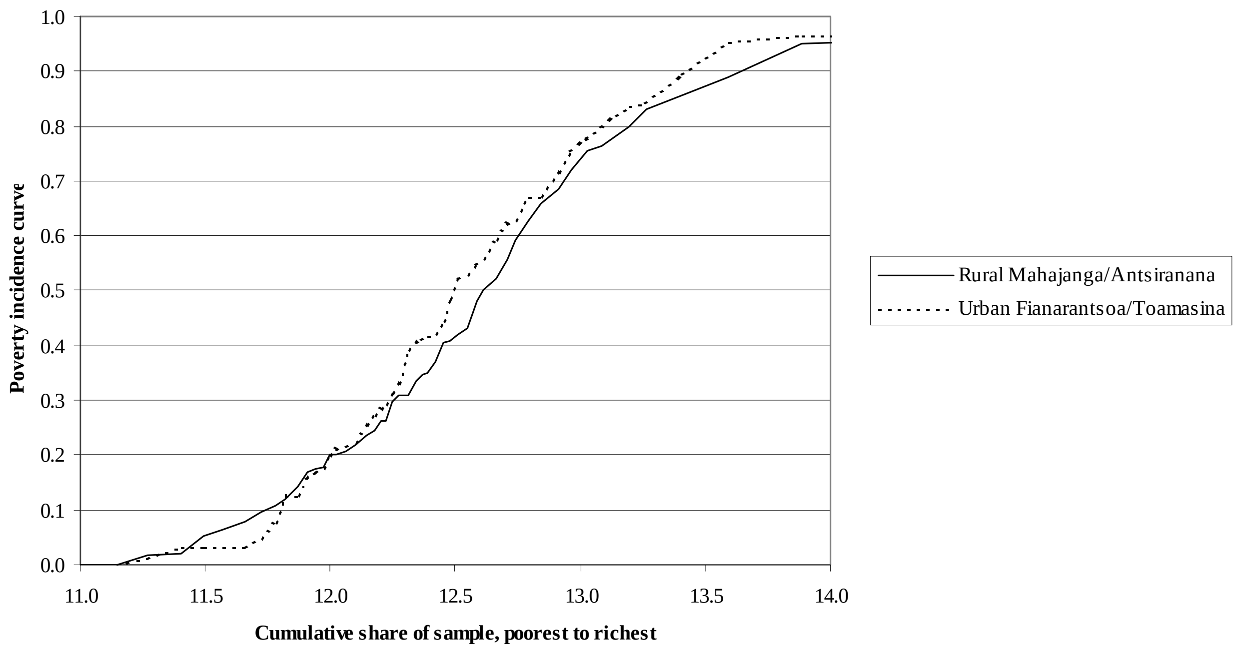
Figure 1 - Poverty Incidence Curves, Urban and Rural Areas of Uganda, 1999



What is less obvious is that this type of comparison also allows us to draw conclusions about poverty according to a very broad class of poverty measures. In particular, the work of Atkinson (1987) and Foster and Shorrocks (1988a,b,c) establishes that if the poverty incidence curve for one sample is everywhere below the poverty incidence curve for another over a bottom range of poverty lines, then poverty will be lower in the first sample for all those poverty lines and for all poverty measures that obey two conditions, that of being non-decreasing and anonymous. By non-decreasing, we mean that if any one person's income increases, then the poverty measure cannot increase as well. By anonymous, we mean that it does not matter which person occupies which position or rank in the income distribution. It is helpful to denote as Π^1 the class of all poverty measures that have these characteristics. Π^1 includes virtually every standard poverty measure. It should be clear that the latter two characteristics of the class Π^1 are entirely unobjectionable.

Comparing cumulative density curves as in Figure 1 thus allows us to make a very general statement about poverty in urban and rural Uganda: for any reasonable poverty line and for the class of poverty measures Π^1, poverty is lower in urban than rural areas. This is called "first-order poverty dominance." The generality of such conclusions makes poverty dominance methods attractive. However, such generality comes at a cost. If the cumulative density functions cross one or more times, then we do not have a clear ordering – we cannot say whether poverty is lower in one region or the other. This is the case in Figure 2, which graphs the cdf's rural Mahajanga/Antsiranana region and urban Fianarantsoa/Toamasina region in Madagascar in 1993. These curves cross at several points, including some that are well below a "reasonable" poverty line. In such cases, we cannot conclude that poverty was unambiguously lower in one region or the other.

Figure 2 - Poverty Incidence Curves for Rural Mahajanga/Antsiranana and Urban Fianarantsoa/Toamasina, Madagascar, 1993



There are two ways to deal with this problem, both of which being conceptually considerably more general than the traditional method of fixing the poverty line and focusing on a single poverty measure. First, it is possible to conclude that poverty in one sample is lower than in another for the same large class of poverty measures, but only for poverty lines up to the first point at which the cdf's cross (for a recent treatment of this, see Duclos and Makdissi, 1999). If reasonable people agree that this crossing point is at a level of well-being safely beyond any sensible poverty line, then this conclusion may be sufficient.[10] Second, it is possible to make comparisons over a smaller class of poverty measures. For example, if we add the condition that the poverty measure respect the Pigou-Dalton transfer principle,[11] then it turns out that we can compare the areas under the cdf's shown in Figure 2. If it is the case that the area under one curve is less than the area under another for a bottom range of reasonable poverty lines, then poverty will be lower for the first sample for all poverty measures that are non-decreasing, anonymous, and that obey the Pigou-Dalton transfer principle. This is called "second-order poverty dominance," and we can call the associated class of poverty measures Π^2. While not as general as first order dominance, it is still quite a general conclusion. Note that we can make this comparison by integrating the two curves in Figure 2, yielding "poverty depth curves," and comparing them to see if one is everywhere above the other.

If the poverty depth curves also cross, then we can proceed to a more restricted set of poverty measures, those that are non-decreasing, anonymous, and that obey the Pigou-Dalton transfer

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[10] In the case of Figure 2, that is not likely.

[11] The Pigou-Dalton transfer principle says that a marginal transfer from a richer person to a poorer person should decrease (or not increase) the poverty measure. Again, this seems entirely sensible, but note that it does not work for the headcount whenever a richer person located initially just above the poverty line falls below the poverty line due to the transfer to the poorer person.

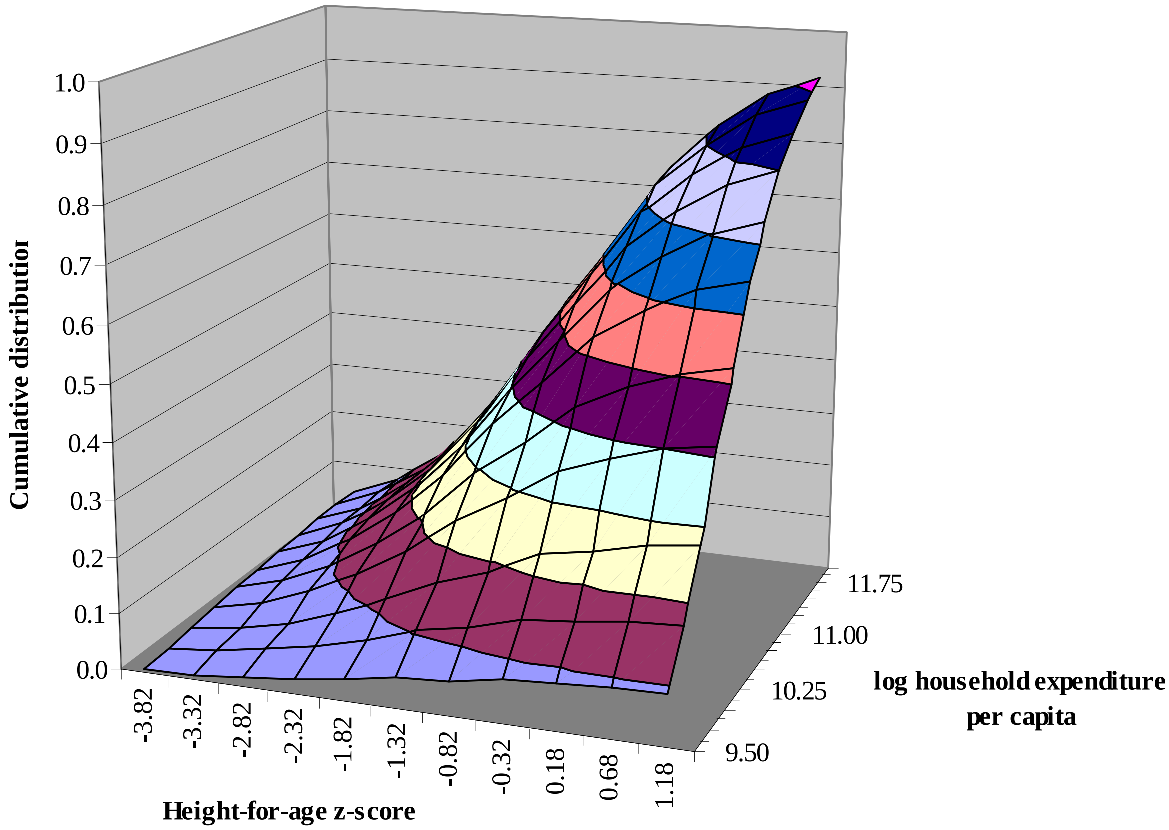
principle as well as the transfer sensitivity principle.[12] To make dominance comparisons for this class of poverty measures, called Π^3, we compare the area under the poverty depth curves by integrating them again and checking to see if one is entirely below the other. If so, then we have "third-order poverty dominance." It is possible to continue integrating the curves in this manner until one dominates the other, but the intuition for the associated classes of poverty measures decreases with the order of the comparisons.

2.3. Bivariate Poverty Dominance Methods

Bivariate poverty dominance comparisons extend the univariate methods discussed above. If we have two measures of well-being rather than one, then Figure 1 becomes a three-dimensional graph, with one measure of well-being on the x-axis, a second on the y-axis, and the bivariate cdf on the z-axis (vertical), as in **Figure 3**. Note that the bivariate cdf is now a surface rather than a line, and we compare one cdf surface to another, just as in Figure 1. If one such surface is everywhere below another, then poverty in the first sample is lower than poverty in the second for a broad class of poverty measures, just as in the univariate case.

[12] The transfer sensitivity principle says that if we make two symmetric but opposite transfers, one from a richer to a poorer person, and the other from a poorer to a richer person, with both of the latter being poorer than the participants in the first transfer, then poverty should decline (or not increase). The idea is that the social benefit of a transfer from a richer to a poorer person is larger the poorer are the two participants.

Figure 3 - Bidimensional Poverty Dominance Surface



That class, which we call $\Pi^{1,1}$ to indicate that it is first-order in both dimensions of well-being, has characteristics analogous to those of the univariate case –non-decreasing in each dimension, anonymous – and one more, that the two dimensions of well-being be substitutes (or more precisely, not be complements) in the poverty measure. This means, roughly, that an increase of well-being in one dimension should have a greater effect on poverty the lower the level of well-being in the other dimension.[13] In most cases, this restriction is sensible: if we are able to improve a child's health, for example, it seems ethically right that this should reduce overall poverty the most when the child is very poor in the income dimension. But there are some plausible exceptions. For example, suppose that only healthy children can learn in school. Then it might reduce poverty more if we concentrated health improvements on children who are in school (*better* off in the education dimension), because of the complementarity of health and education.

Practically, it is not easy to plot two surfaces such as the one in **Figure 3** on the same graph and see the differences between them, but we can plot the differences directly. If this difference always has the same sign. then we know that one or the other of the samples has lower poverty for a large class $\Pi^{1,1}$ of poverty measures. If the surfaces cross, we can compare the distributions at higher orders of dominance, just as we did in the univariate case. This can be done in one or both dimensions of

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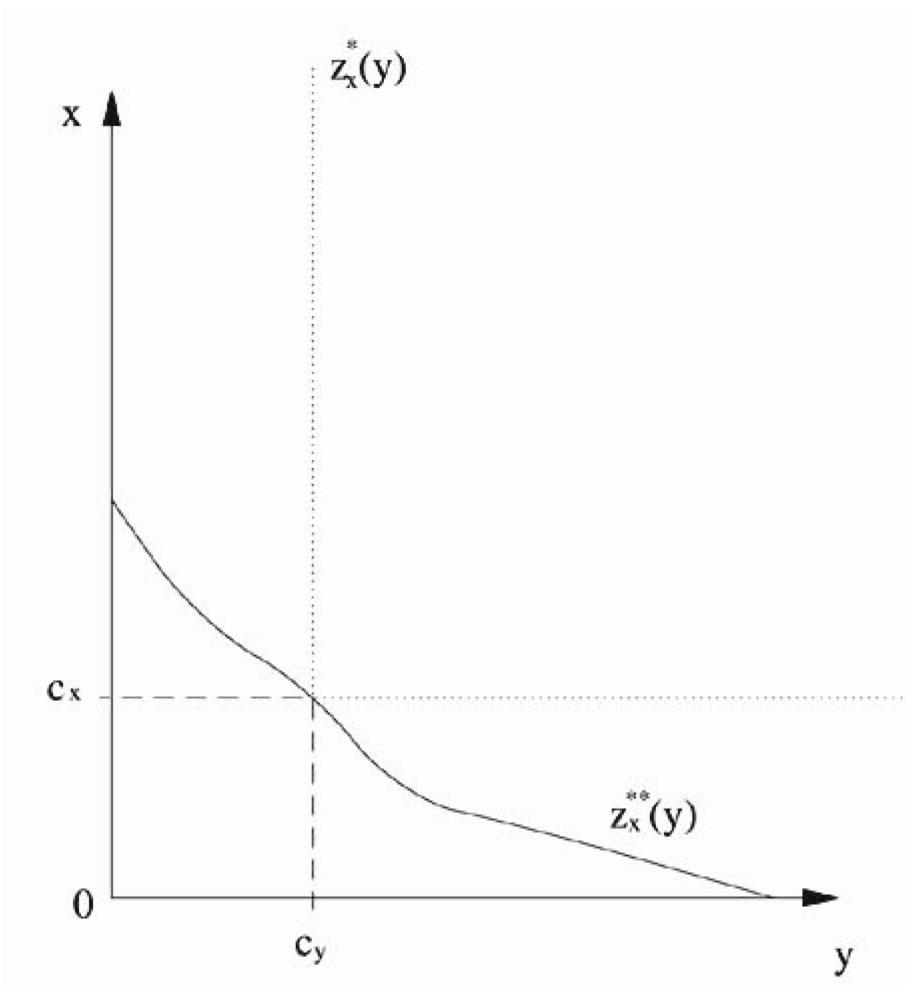
[13] Bourguignon and Chakravarty (2003) discuss this property in detail.

well-being, and the restrictions on the applicable classes of poverty measures are similar to the univariate case.

Intersection, Union, and "Intermediate" Poverty Definitions

In addition to the extra conditions on the class of poverty indices, multivariate dominance comparisons require us to distinguish between union, intersection, and intermediate poverty measures. We can do this with the help of Figure 4, which shows the domain of dominance surfaces – the (x,y) plane. The function $\lambda_1(x,y)$ defines an "intersection" poverty index: it considers someone to be in poverty only if she is poor in both of the dimensions x and y, and therefore if she lies within the dashed rectangle of Figure 4. The function $\lambda_2(x,y)$ (the L-shaped, dotted line) defines a union poverty index: it considers someone to be in poverty if she is poor in *either* of the two dimensions, and therefore if she lies below or to the right of the dotted line. Finally, $\lambda_3(x,y)$ provides an intermediate approach. Someone can be poor even if her y value is greater than the poverty line in the y dimension if her x value is sufficiently low to lie to the left of $\lambda_3(x,y)$.

Figure 4 - Intersection, Union, and Intermediate Dominance Test Domains



For one sample to have less intersection poverty than another, its dominance surface must be below the second sample's everywhere within an area like the one defined by $\lambda_1(x,y)$. To have less union poverty, its surface must be below the second sample's everywhere within an area like the one defined by $\lambda_2(x,y)$, and similarly for intermediate definitions and $\lambda_3(x,y)$. These are the sorts of comparisons that we will make in the applications that follow. Note, however, that if dominance is established for one of these areas, then it also necessarily obtains for any other sub-area, be it a union, intersection or intermediate one.

Multivariate vs. Human Development Index Poverty Comparisons

Figure 4 is also helpful to understand the difference between the general multivariate poverty comparisons that we use here and comparisons that rely on indices created with multiple indicators of well-being, the best known of which is the Human Development Index (UNDP, 1990). An individual-level index of the x and y measures of well-being in Figure 4 might be written as

$$I = a_x x + a_y y$$

where a_x and a_y are some weights assigned to each variable. This index is now a univariate measure of well-being, and could be used for poverty comparisons such as those in Figure 1.[14] The domain of this test for such an index would follow roughly a ray starting at the origin and extending into the (x,y) plane at an angle that depends on the relative size of the weights a_x and a_y. Testing for dominance at these points only is clearly less general than tests over the entire area defined, for instance, by $\lambda_1(x,y)$, $\lambda_2(x,y)$, or $\lambda_3(x,y)$ in Figure 4.

Table 1 - $\Pi^{1,1}$ Dominance Tests for Rural and Urban areas in Toliara, Madagascar (differences between rural and urban dominance surfaces)

	16.51	-8.841	-16.320	-16.580	-11.430	-8.068	-6.658	-4.174	-2.208	0.022	-0.239
	13.19	-9.286	-16.780	-16.090	-11.080	-7.815	-6.221	-3.662	-0.933	2.005	2.118
	12.84	-9.845	-15.690	-15.930	-10.720	-7.053	-5.253	-2.017	1.018	3.969	4.288
	12.60	-3.307	-11.960	-9.174	-3.734	-0.638	1.677	5.642	8.312	11.250	11.090
	12.44	1.646	-10.230	-7.667	-2.467	0.711	3.174	7.454	10.100	13.360	13.260
ln(y)	12.29	1.263	-6.159	-3.925	1.479	5.464	7.136	10.410	12.260	16.550	15.620
	12.16	0.628	-3.287	-2.195	2.421	5.733	7.625	12.410	14.220	18.720	17.440
	12.00	6.766	4.360	6.195	10.920	14.140	15.600	19.430	21.820	26.530	27.180
	11.82	7.153	4.561	4.882	8.766	12.440	13.510	15.620	17.350	22.040	22.570
	11.48	5.048	1.268	1.683	7.348	10.780	11.660	13.610	14.920	16.750	17.340
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						Haz					

[14] The Human Development Index is actually cruder than this, as it first aggregates across individuals each dimension of well-being to generate a single scalar measure, and then constructs a weighted average of those scalars to generate the HDI, which is also a scalar.

Table 1 gives an example of why our generalization of HDI-type univariate indices is important, comparing poverty in rural Toliara and urban Mahajanga/Antsiranana in Madagascar. The table shows the value of the t-statistic for a test of the difference in the two areas' poverty surfaces at a 10x10 grid of test points in a domain similar to Figure 4. We have highlighted the significantly negative differences in yellow (lighter in black-and-white) and the significantly positive differences in blue (darker in black-and-white). It is evidently possible to choose weights for an index composed of log household expenditures per capita and children's heights such that they ensure that we conclude that poverty is lower in urban Mahajanga/Antsiranana – this would take advantage of the test points that fit below the significantly negative tests in the upper left of the test domain. However, another set of weights would not permit the same conclusion and, in particular, more weight for expenditures would imply a significant crossing of the index's poverty incidence curves.

Multivariate vs. Multiple Univariate Poverty Comparisons

Suppose that one conducts a univariate comparison between expenditures per capita in two samples, as in Figure 1, and children's heights in two samples, and finds that for both variables, one sample shows lower poverty for all poverty lines and a large class of poverty measures. Is that not sufficient to conclude that poverty differs in the two samples? Unfortunately, no. The complication comes from the "hump" in the middle of the dominance surface shown in **Figure 3**. How sharply the hump rises depends on the correlation between the two measures of well-being. If they are highly correlated, the surface rises rapidly in the center, and vice-versa. Thus, it is possible for one surface to be lower than another at both extremes (the edges of the surface farthest from the origin) and yet higher in the middle if the correlation between the welfare variables is higher. The far edges of each surface integrate out one variable, and so are the univariate cdf's depicted in Figure 1. Thus, in this case, one surface would have lower univariate cdf's, and thus lower poverty, for both measures of well-being independently, but it would not have lower bivariate poverty. Intuitively, samples with higher correlation of deprivation in multiple dimensions have higher poverty than samples with lower correlation because lower well-being in one dimension contributes more to poverty if well-being is also low in the other dimension.

Table 2 - $\Pi^{1,1}$ Dominance Tests for Rural Central *vs.* Urban Eastern Regions, Uganda

	11.660	2.637	12.510	8.720	7.938	9.993	7.941	11.170	4.484	1.109	0.000
	9.276	3.458	13.930	9.712	12.030	15.540	15.410	20.020	13.550	14.130	16.400
	8.996	5.519	14.940	10.590	13.920	17.110	17.110	22.360	18.330	18.410	20.250
	8.803	2.559	11.910	7.156	10.320	13.760	14.730	21.160	18.730	19.030	21.460
	8.664	0.610	8.643	4.224	7.651	9.988	9.820	15.270	15.010	16.430	19.950
ln(y)	8.527	0.062	8.763	5.016	8.366	9.201	12.340	17.300	15.860	17.390	19.570
	8.395	-2.842	5.754	-0.025	2.692	4.249	6.958	10.650	12.260	13.580	15.240
	8.249	-1.582	5.582	-0.307	2.743	2.801	5.305	8.590	11.310	13.020	13.520
	8.068	-4.756	1.731	-4.960	-1.046	0.140	2.003	4.765	6.872	9.221	8.636
	7.824	4.698	8.001	8.184	9.695	7.846	10.090	12.120	12.850	13.900	12.290
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						Haz					

Table **2** provides an example. Univariate poverty is unambiguously higher in rural Central region than urban Eastern region in *both* dimensions, yet bivariate poverty is not, because of the statistically significant reversal of the dominance surfaces in the interior. Even at higher orders up to s_x=3 and s_y=3 we find that the dominance surfaces cross for these two areas.

It is also possible that two samples with different correlations between measures of well-being have univariate comparisons that are inconclusive – they cross at the extreme edges of the dominance surfaces – but have bivariate surfaces that are different for a large part of the interior of the dominance surface. (The sample with lower correlation would have a lower dominance surface). This would establish different intersection multivariate poverty even though either one or both of the univariate comparisons is inconclusive. It could not, however, establish union poverty dominance, since that requires difference in the surfaces at the extremes as well as in the middle.

Table 3 - $\Pi^{2,2}$ Dominance Tests for Rural Central and Urban Northern Regions, Uganda

	11.660	-0.824	0.263	1.863	1.217	0.048	-1.722	-2.680	-3.454	-3.200	-0.497
	9.276	-6.401	-5.347	-4.431	-4.999	-5.578	-6.354	-6.607	-6.573	-5.397	-0.773
	8.996	-7.860	-6.909	-6.315	-6.911	-7.340	-7.700	-7.669	-7.393	-6.083	-1.396
	8.803	-9.091	-8.169	-7.775	-8.286	-8.554	-8.556	-8.240	-7.784	-6.395	-1.564
	8.664	-10.090	-9.240	-8.997	-9.437	-9.571	-9.347	-8.833	-8.222	-6.765	-1.849
ln(y)	8.527	-10.750	-10.000	-9.823	-10.120	-10.080	-9.603	-8.851	-8.014	-6.456	-1.365
	8.395	-11.190	-10.360	-10.100	-10.310	-10.300	-9.793	-8.981	-8.069	-6.595	-1.725
	8.249	-11.820	-11.280	-10.990	-11.140	-11.190	-10.810	-10.140	-9.274	-7.970	-3.535
	8.068	-12.150	-11.680	-11.270	-11.130	-11.010	-10.610	-9.910	-8.959	-7.705	-3.469
	7.824	-12.240	-11.870	-11.450	-11.040	-10.650	-10.210	-9.528	-8.628	-7.559	-4.168
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						Haz					

Table 3 gives an example. Here, there is no statistically significant univariate dominance in the expenditure dimension of well-being, but there is a sizeable domain – up to the ninth decile in each dimension – over which poverty is lower in rural Central region than in urban Northern region for all intersection poverty indices in the $\Pi^{2,2}$ class.

3. Bivariate Spatial Poverty Comparisons in Africa

In this section, we apply bivariate dominance tests to the question of spatial poverty comparisons in Ghana, Madagascar, and Uganda. We compare poverty in urban and rural areas, nationally and by region, measured in terms of household expenditures per capita and children's height-for-age z-scores. The tests produce a large amount of output in the form of tables such as

Table **1**, which we relegate to appendices. Here, we report summaries of the dominance results.

Table 4 gives descriptive statistics for height-for-age z-scores (HAZ) and the log of household expenditures per capita (ln(y)). As one would expect, poverty measured by expenditures per capita and also stunting[15] are higher in rural than urban areas in each country. The same is true within each region of each country, except for Toliara region in Madagascar, where stunting is higher in urban than in rural areas. In fact, with a few exceptions in Madagascar, both expenditure and height poverty are lower in urban areas in any region than in rural areas in any other.

In addition to the means and poverty rates, Table 4 also reports the correlation between the log of expenditures per capita and height-for-age z-scores. Note that in Uganda and Madagascar expenditures and heights are more highly correlated in urban than rural areas, while both expenditures and heights tend to be higher in urban areas. As noted above, this combination can cause bivariate poverty comparisons to differ from univariate comparisons carried out separately in each dimension of well-being.

[15] Stunting usually is defined as a height-for-age z-score of less than –2.

Table 4- Descriptive Statistics for Poverty and Stunting

		Mean		Percent			Correlation
		HAZ	ln(y)	Stunted	Poor	N	ln(y),HAZ
Region	Area	**Ghana**					
Coast		-0.98	11.90	0.22	0.41	911	0.15
	Rural	-1.12	11.76	0.27	0.51	488	0.10
	Urban	-0.82	12.06	0.16	0.30	423	0.15
Forest		-1.38	11.81	0.32	0.46	1074	0.12
	Rural	-1.48	11.79	0.35	0.48	793	0.11
	Urban	-1.10	11.88	0.24	0.39	281	0.10
Savannah		-1.30	11.66	0.32	0.55	683	0.11
	Rural	-1.37	11.63	0.33	0.56	591	0.13
	Urban	-0.86	11.85	0.23	0.48	92	-0.08
National		-1.22	11.80	0.28	0.47	2668	0.14
	Rural	-1.35	11.73	0.32	0.51	1872	0.11
	Urban	-0.92	11.97	0.19	0.35	796	0.11
		Madagascar					
Tana		-2.24	12.32	0.57	0.73	928	0.26
	Rural	-2.33	12.26	0.60	0.78	534	0.25
	Urban	-1.80	12.65	0.40	0.48	394	0.20
Fian/Toa		-2.15	12.26	0.53	0.77	975	0.03
	Rural	-2.19	12.22	0.54	0.80	705	0.00
	Urban	-1.74	12.56	0.48	0.56	270	0.17
Maha/Antsi		-1.35	12.62	0.34	0.55	561	-0.02
	Rural	-1.32	12.61	0.34	0.56	346	-0.04
	Urban	-1.44	12.71	0.34	0.50	215	0.14
Toliara		-1.91	12.06	0.48	0.78	457	-0.18
	Rural	-1.82	11.98	0.45	0.82	302	-0.19
	Urban	-2.36	12.46	0.60	0.57	155	0.02
National		-1.97	12.33	0.50	0.71	2921	0.07
	Rural	-2.01	12.27	0.51	0.75	1887	0.05
	Urban	-1.79	12.61	0.44	0.52	1034	0.17
		Uganda					
Central		-1.00	8.80	0.25	0.19	1806	0.07
	Rural	-1.08	8.65	0.27	0.23	1390	0.04
	Urban	-0.77	9.22	0.18	0.08	416	0.03
Eastern		-1.22	8.48	0.28	0.38	2349	0.09
	Rural	-1.25	8.45	0.28	0.39	2010	0.06
	Urban	-0.75	8.99	0.21	0.14	339	0.21
Western		-1.42	8.63	0.34	0.28	2096	0.12
	Rural	-1.46	8.60	0.35	0.29	1860	0.07
	Urban	-0.59	9.35	0.15	0.06	236	0.25
Northern		-1.24	8.16	0.30	0.60	1230	0.09
	Rural	-1.24	8.13	0.30	0.62	1008	0.08
	Urban	-1.23	8.72	0.26	0.19	222	0.36
National		-1.22	8.54	0.29	0.35	7481	0.10
	Rural	-1.27	8.47	0.30	0.37	6268	0.06
	Urban	-0.79	9.15	0.19	0.10	1213	0.12

Table 5 through Table 7 summarize the dominance results for tests across urban and rural areas in Ghana, Madagascar, and Uganda. For each country as a whole, poverty is higher in rural than urban areas for each univariate poverty comparison (columns 3 and 4) and for both intersection and union bivariate comparisons (columns 5 and 6). These results are entirely consistent with virtually every poverty comparison that we know of based on incomes or expenditures alone – poverty is lower in urban areas.

In the regional comparisons, however, a significant number of exceptions to this widely held belief emerge, especially for the bivariate comparisons. Ghana has the fewest of these, with two of nine urban-rural comparisons being statistically insignificant for both intersection and union bivariate poverty comparisons. In Uganda, four of sixteen intersection and union comparisons cannot reject the null of non dominance, and two of these – rural areas in Eastern and Western region vs. urban areas in Northern region – actually have somewhat limited domains over which bivariate poverty is lower in the rural area for intersection poverty measures. In Madagascar, seven of sixteen intersection comparisons and ten of sixteen union comparisons cannot reject the null that bivariate poverty is the same in urban and rural areas, though none of these reject the null in favor of rural areas. Overall, then, the proposition that poverty is always higher in rural areas than urban areas does not get the same overwhelming support in these results that it almost always does in univariate poverty comparisons in Africa.

One immediate concern with these results is that the interesting cases are ones in which we are not rejecting the null of non-dominance, so they may be driven by a lack of power in the statistical tests. This concern is reinforced by the relatively few observations that are available in some urban areas. Review of the appendices shows, however, that in most of the cases in which we do not find bivariate dominance, the dominance surfaces actually cross significantly. That is, there are points in the test domain where the rural surface is significantly above the urban surface and vice-versa. We have noted these cases in the last column of Table 5 through Table 7 for first-order comparisons in both dimensions. Thus, the lack of bivariate dominance is typically not due to a lack of power.

To gain a better understanding of how bivariate and univariate dominance methods can differ, we classify the results into five types. For type 1, we have dominance (usually first-order) for both univariate comparisons and for intersection and union bivariate comparisons. This is the most common result, accounting for 25 of the 41 comparisons. This is also the least interesting type of result for our methods, because one could ask "why bother with the more complicated bivariate comparisons if, in the end, they produce the same results as simpler univariate dominance tests, or even scalar comparisons?"

Type 2 is equally uninteresting for our methods. This occurs when neither the univariate nor the bivariate methods finds dominance. Fortunately, there is only one such case, for urban and rural Mahajanga/Antsiranana region in Madagascar.

Type 3 is a case in which urban areas dominate rural for both univariate comparisons but not for the bivariate comparisons. There are six of these cases. There is also one case, rural Mahajanga/Antsirana vs. urban Toliara, in which the *rural* area dominates on both univariate comparisons, but not in the bivariate comparisons. For cases in which the bivariate comparisons are inconsistent with the univariate comparisons, a type 3 result is the most common. The bivariate comparisons are more demanding than univariate comparisons, so it makes sense that they reject the null of non-dominance less often, and this happens in five of the seven cases. In two, both involving urban areas in the Northern region of Uganda, the dominance result is actually reversed for intersection poverty measures over a limited domain. This is quite surprising, but understandable once we observe the very high correlation (0.36) between expenditures and heights in urban Northern region compared to rural Western and Eastern regions (0.07 and 0.06, respectively. See Table 4.)

Type 4 occurs when the univariate results are contradictory in the sense that we find univariate dominance in one dimension but not the other. There are six such occurrences, and in all but one we find that the urban area dominates in one dimension, usually expenditures, although there is one case, rural Central vs. urban Northern regions in Uganda, in which the rural area dominates, albeit only for the Π^3 class. Of these six cases, we find intersection dominance for four bivariate tests. That is, the bivariate tests are able to "resolve" the conflicting univariate results for at least some classes of poverty measures[16] and areas of poverty lines.

Type 5 is similar to type 4 except that the contradictory univariate results are statistically significant in each univariate comparison. There are only two of these cases, rural vs. urban Toliara, and rural Coast vs. urban Forest in Ghana. Unlike the type 4 results, in neither case are any of the bivariate poverty comparisons statistically significant, so the bivariate comparisons cannot resolve the univariate conflict.

Overall, we certainly have not amassed sufficient evidence to overturn the standard presumption that poverty is lower in urban than in rural areas, but enough of our results are at odds with this idea to give us pause. Further, we have seen that the reasons that we do not find this for bivariate poverty comparisons vary. For the type 4 and 5 cases, we find no univariate dominance in one dimension or another, and the bivariate results follow from that. But this is relatively rare, and in about half of these cases the bivariate tests for intersection poverty measures do actually find that poverty is lower in urban areas despite the contradictory univariate results. Most of the differences, though, come from the fact that our two measures of well-being are often more highly correlated in urban areas than in rural areas. As noted above, this correlation causes the poverty incidence surface to rise more rapidly near the origin of the distribution, raising it above the rural surface in the center even though it is below it at the extremes where we find the univariate poverty incidence curves. In most cases, this gives us results in which an urban area dominates a rural area in each dimension individually, but not jointly, because multiple deprivation is more common in urban areas. There are two cases, however, in which the dominance is actually reversed, so that for some intersection poverty measures, the rural area actually dominates the urban.

[16] As noted in the methods discussion, bivariate dominance for union poverty measures requires univariate dominance in each dimension, so it is impossible for this type of result.

Table 5 - Summary of Dominance Tests for Ghana

Rural	Urban	Univariate ln(y)	HAZ	Bivariate Intersection	Union	Crossing?
	National	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
Region:	vs. Region:					
Coast	Coast	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Forest	U d. R (1)	R d. U (2)	none	none	yes
	Savannah	U d. R (2)	U d. R (2)	U d. R (2,2)	U d. R (2,2)	
Forest	Coast	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Forest	U d. R (1) [1/]	U d. R (1)	none	none	no
	Savannah	U d. R (1)	U d. R (2)	U d. R (1,1)	U d. R (2,2)	
Savannah	Coast	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Forest	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1) [2/]	
	Savannah	U d. R (1)	U d. R (2)	U d. R (1,1)	U d. R (2,2)	

Notes: "A d. B" means that poverty in A is lower than in B for all reasonable poverty lines. The order of dominance is given in parentheses. For the bivariate comparisons, the first entry is for the height-for-age z-score, and the second is for the dimension of log of household expenditures per capita.

[1/] One test point is significant only at the 10% level.

[2/] Two test points are significant only at the 10% level.

Table 6 - Summary of Dominance Tests for Madagascar

Rural	Urban	Univariate ln(y)	HAZ	Bivariate Intersection	Union	Crossing?
	National	U d. R (1)	U d. R (1)	U d. R (1,1) [1/]	U d. R (1,1) [1/]	
Rural:	vs. Urban:					
Tana	Tana	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Fian/Tao	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1) 1/	
	Maha/Antsi	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Toliara	U d. R (1)	none	U d. R (2,2)	none	yes
Fian/Tao	Tana	U d. R (1)	U d. R (1)	none	none	no
	Fian/Tao	U d. R (1)	U d. R (1)	none	none	no
	Maha/Antsi	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1) [2/]	
	Toliara	U d. R (1)	none	U d. R (2,2)	none	yes
Maha/Antsi	Tana	U d. R (2)	U d. R (1)	U d. R (2,2) [1/]	U d. R (2,2) [1/]	
	Fian/Tao	none	U d. R (1)	U d. R (2,2)	none	yes
	Maha/Antsi	none	none	none	none	yes
	Toliara	R d. U (1)	R d. U (2)	none	none	yes
Toliara	Tana	U d. R (1)	none	none	none	no
	Fian/Tao	U d. R (1)	none	none	none	yes
	Maha/Antsi	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Toliara	R d. U (1)	U d. R (1)	none	none	yes

Notes: "A d. B" means that poverty in A is lower than in B for all reasonable poverty lines. The order of dominance is given in parentheses. For the bivariate comparisons, the first entry is for the height-for-age z-score, and the second is for the dimension of log of household expenditures per capita.

[1/]One test point is significant only at the 10% level.

[2/]One test point is significant only at the 10% level, and one is insignificant.

Table 7 - Summary of Dominance Tests for Uganda

Rural	Urban	Univariate ln(y)	HAZ	Bivariate Intersection	Union	Crossing?
	National	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
Region:	vs. Region:					
Central	Central	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Eastern	U d. R (1)	U d. R (1)	none	none	yes
	Western	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Northern	R d. U (3)	none	R d. U (2,2)	none	yes
Eastern	Central	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Eastern	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Western	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Northern	U d. R (1)	U d. R (2)	R d. U (ltd) [1/]	none	yes
Western	Central	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Eastern	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Western	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Northern	U d. R (1)	U d. R (2)	R d. U (ltd) [1/]	none	yes
Northern	Central	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Eastern	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Western	U d. R (1)	U d. R (1)	U d. R (1,1)	U d. R (1,1)	
	Northern	U d. R (1)	U d. R (2)	U d. R (1,1)	U d. R (2,2)	

Notes: "A d. B" means that poverty in A is lower than in B for all reasonable poverty lines. The order of dominance is given in parentheses. For the bivariate comparisons, the first entry is for the dimension of log of household expenditures per capita, and the second is for the height-for-age z-score.

[1/]Dominance is limited to a relatively small domain of poverty frontiers in $\Pi^{2,2}$, and a larger one in $\Pi^{3,3}$.

Conclusions

This paper has used bivariate stochastic dominance techniques to compare poverty in urban *vs.* rural areas in three African countries, where poverty is measured in terms of expenditures per capita and children's standardized heights, a good measure of children's health status. We have shown that our comparisons are more general than either a comparison of a Human Development-type index or "one-at-a-time" comparisons of multiple measures of well-being. More importantly, we find that our more general methods are at odds with simpler univariate poverty comparisons in a non-trivial number of cases.

Expenditure-based urban-rural poverty comparisons almost always find that rural areas are poorer than urban. Our results are consistent with that finding whether we use univariate or bivariate comparisons. However, differences emerge when we compare urban areas in one region of a country with rural areas in another region. We find several cases in which univariate poverty is lower in urban areas in both dimensions, but bivariate poverty is not. This happens because the correlation between expenditures per capita and children's heights is higher in the urban areas, so that urban residents who are expenditure poor are more likely also to be health poor. This correlation yields a higher density of observations in the poorest part of the bivariate welfare domain for urban areas, even though there are fewer observations for urban residents at the lower end of the density for each individual measure of well-being. We believe that taking such a correlation into account is important for welfare comparisons because the social cost of poverty in one dimension, say health, is higher if the person affected is also poor in the other dimension (expenditures).

It is interesting to note that the share of cases in which urban areas do not dominate rural is much higher in our bivariate comparisons than it is for expenditure- or income-based comparisons in the existing literature. In addition, we hasten to add that with two exceptions, both in Madagascar, the urban area in the region where the capital is located always dominates every rural area in both univariate and bivariate comparisons.

There are other instances in which our bivariate comparisons are at odds with univariate comparisons. Perhaps the most interesting are cases in which univariate results are inconclusive because one or the other univariate comparison is inconclusive, yet the bivariate results find dominance for a large domain of intersection poverty indices. This arises in about 10 percent of our examples and occurs again when the correlation between expenditures per capita and children's heights differs significantly across areas. These results are interesting because they show that bivariate comparisons may actually provide statistically significant results when univariate comparisons do not.

Hence, the finding that bivariate results often differs from the standard perception of greater rural poverty is typically not because children are taller in rural areas, but rather because the correlation between expenditures and heights is lower there than in urban areas. This, however, is based on only three countries: pursuing similar research in other countries will yield insight as to whether these results are anomalous. Why this should be is also an interesting question for future research. But a clear implication of these results for researchers and policy makers interested in multiple dimensions of poverty is that, at a minimum, one should check the correlations between measures of well-being in the groups of interest. Large differences in these correlations may lead to unexpected multivariate dominance comparisons.

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Table A. 1 - $\Pi^{1,1}$ Dominance Tests for Rural and Urban Areas in Ghana

	13.66	6.49	9.41	9.16	6.26	5.55	6.00	4.87	2.60	1.21	0.12
	12.51	6.73	9.61	10.17	7.66	6.94	7.78	7.31	5.31	4.43	4.02
	12.27	6.15	9.08	9.79	7.46	7.16	7.98	7.62	6.37	5.75	5.29
	12.09	6.48	10.29	11.06	8.48	8.44	9.73	9.59	9.00	8.65	8.42
	11.96	7.42	10.40	11.18	9.13	8.84	9.99	9.92	9.90	9.45	8.98
ln(y)	11.81	8.37	10.93	12.02	10.06	9.97	11.01	11.13	11.22	10.45	9.77
	11.67	7.85	9.35	11.34	9.58	10.25	10.82	11.11	11.01	10.58	10.25
	11.51	7.18	8.53	10.48	9.17	9.52	10.56	10.96	11.06	10.83	10.38
	11.31	5.02	5.94	8.12	7.20	6.91	7.10	7.44	7.44	7.39	7.30
	11.07	5.22	4.91	6.61	6.00	6.74	6.70	7.58	6.83	6.94	7.39
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Table A. 2 - $\Pi^{1,1}$ Dominance Tests for Rural Coast vs. Urban Areas in Ghana

Urban Coast

	13.66	6.47	8.03	8.19	5.97	4.91	5.58	5.02	2.08	-0.84	0.17
	12.51	5.16	7.60	8.30	6.91	6.11	7.23	7.46	4.94	2.77	4.55
	12.27	5.20	8.65	8.93	7.92	8.52	9.76	10.15	8.64	6.86	8.69
	12.09	5.37	9.41	10.52	9.27	9.83	11.53	12.40	11.64	10.31	12.35
	11.96	6.53	10.05	11.19	10.19	10.52	11.64	13.13	13.00	11.38	13.20
ln(y)	11.81	8.13	10.14	11.23	9.27	9.97	11.11	12.10	12.57	10.90	12.02
	11.67	7.25	8.51	10.12	9.18	10.16	10.71	12.34	12.70	11.82	13.22
	11.51	6.99	9.18	10.58	9.96	11.06	11.92	13.15	12.90	12.17	13.26
	11.31	3.79	5.71	7.37	7.39	7.81	7.39	8.71	8.30	7.95	9.03
	11.07	3.61	2.99	4.45	4.18	4.58	3.87	6.12	5.32	5.02	5.77
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Urban Forest

	13.66	0.27	2.25	1.56	-2.04	-1.74	-0.45	0.01	-0.36	-1.05	0.13
	12.51	0.35	1.99	2.64	-0.70	-0.52	1.11	1.81	1.17	0.75	2.47
	12.27	-0.49	1.58	2.10	-1.34	-1.44	-0.10	0.51	0.20	0.02	1.41
	12.09	1.28	2.60	2.73	-0.88	0.10	1.94	3.63	3.57	3.14	5.06
	11.96	3.31	3.82	4.68	1.91	1.79	2.59	4.54	5.08	4.67	6.35
ln(y)	11.81	4.70	4.10	4.36	2.57	2.83	3.02	5.17	5.69	5.28	6.52
	11.67	3.85	2.45	4.22	2.58	4.02	4.08	5.65	6.16	5.66	7.30
	11.51	4.60	2.68	4.10	2.42	3.98	4.33	5.58	5.84	5.52	6.44
	11.31	1.22	0.15	2.40	0.78	1.06	-0.23	1.36	1.11	1.22	2.38
	11.07	4.18	-0.56	1.70	-0.82	1.41	-0.11	2.69	2.13	1.63	2.19
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Urban Savannah

	13.66	-1.67	-0.91	2.56	0.12	2.88	4.45	4.76	2.85	2.34	0.00
	12.51	-0.31	-0.29	3.48	1.92	4.06	5.07	5.95	4.38	3.40	1.29
	12.27	-1.15	-1.05	1.80	0.66	2.62	3.97	5.71	4.25	3.46	1.12
	12.09	-1.44	-0.60	1.83	-0.23	1.53	4.52	6.20	4.58	3.16	0.37
	11.96	-1.74	-1.42	1.43	-0.30	0.47	2.21	3.91	3.25	1.77	-1.67
ln(y)	11.81	-0.85	-0.01	4.13	2.61	4.22	6.47	7.59	6.72	5.10	1.57
	11.67	5.35	4.89	9.77	7.64	7.85	9.57	10.68	10.80	8.89	5.77
	11.51	3.62	4.86	8.75	9.97	10.69	11.39	10.88	10.76	11.16	7.49
	11.31	0.20	0.63	4.03	4.64	4.37	3.64	2.60	1.56	1.63	-0.63
	11.07	1.13	3.31	5.45	5.83	5.02	5.35	3.75	0.91	1.46	3.03
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Table A. 3 - $\Pi^{1,1}$ Dominance Tests for Rural Forest vs. Urban Areas in Ghana

Urban Coast

	13.66	11.26	14.92	14.56	12.12	9.99	10.29	7.69	4.12	1.59	0.13
	12.51	10.49	14.74	14.81	12.72	10.84	11.54	9.80	6.70	5.09	4.52
	12.27	9.99	14.59	14.74	13.18	12.47	13.06	11.47	9.46	8.06	7.66
	12.09	9.59	15.79	16.69	15.07	13.98	15.05	13.25	12.23	11.49	11.25
	11.96	10.40	15.86	16.31	15.00	14.17	15.53	13.95	13.40	12.54	12.05
ln(y)	11.81	11.59	15.74	16.73	14.65	13.62	14.90	13.58	13.39	12.10	11.29
	11.67	9.39	12.63	14.27	12.45	12.22	12.80	12.14	11.56	10.92	10.29
	11.51	7.63	10.97	12.76	11.42	10.80	11.82	11.45	11.03	10.15	9.78
	11.31	5.90	7.71	9.68	8.87	8.17	8.78	9.03	8.86	8.19	8.33
	11.07	4.16	5.62	6.46	6.63	6.44	6.49	7.51	7.11	6.88	7.41
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Urban Forest

	13.66	5.17	9.04	7.74	3.93	3.23	4.15	2.64	1.67	1.38	0.08
	12.51	5.78	9.06	8.98	4.93	4.08	5.27	4.09	2.90	3.05	2.43
	12.27	4.42	7.48	7.75	3.74	2.36	3.04	1.77	0.99	1.18	0.40
	12.09	5.61	8.98	8.72	4.69	4.06	5.25	4.43	4.13	4.27	4.02
	11.96	7.30	9.67	9.71	6.57	5.29	6.26	5.31	5.46	5.79	5.26
ln(y)	11.81	8.34	9.82	9.81	7.84	6.37	6.65	6.59	6.47	6.44	5.82
	11.67	6.12	6.69	8.39	5.83	6.05	6.12	5.47	5.06	4.79	4.48
	11.51	5.29	4.57	6.35	3.88	3.72	4.24	3.91	4.00	3.56	3.07
	11.31	3.45	2.26	4.81	2.30	1.41	1.17	1.67	1.67	1.46	1.69
	11.07	4.71	2.19	3.79	1.75	3.32	2.58	4.11	3.95	3.52	3.85
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Urban Savannah

	13.66	3.22	5.85	8.75	6.11	7.90	9.13	7.43	4.89	4.78	-0.05
	12.51	5.13	6.75	9.84	7.59	8.74	9.31	8.26	6.13	5.72	1.26
	12.27	3.76	4.83	7.45	5.75	6.44	7.14	7.00	5.04	4.63	0.11
	12.09	2.91	5.77	7.81	5.34	5.50	7.87	7.02	5.14	4.29	-0.65
	11.96	2.31	4.42	6.43	4.34	3.96	5.87	4.69	3.62	2.88	-2.74
ln(y)	11.81	2.89	5.72	9.59	7.88	7.78	10.15	9.03	7.50	6.26	0.87
	11.67	7.58	9.11	13.91	10.92	9.90	11.65	10.49	9.68	8.01	2.96
	11.51	4.31	6.73	10.96	11.42	10.43	11.30	9.19	8.90	9.15	4.10
	11.31	2.45	2.74	6.42	6.14	4.73	5.04	2.92	2.12	1.87	-1.32
	11.07	1.73	5.91	7.40	8.18	6.87	7.92	5.17	2.73	3.35	4.68
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Table A. 4 - $\Pi^{1,1}$ Dominance Tests for Rural Savannah vs. Urban Areas in Ghana

Urban Coast

	13.66	10.53	13.44	12.76	10.38	8.66	8.05	6.87	3.48	1.46	0.17
	12.51	10.35	13.91	13.99	12.48	11.01	11.25	11.05	8.29	6.94	6.48
	12.27	10.65	14.26	14.79	13.46	13.31	13.91	13.68	12.03	11.03	10.67
	12.09	10.36	15.62	16.82	15.22	15.03	15.58	15.31	14.84	14.75	14.71
	11.96	10.99	15.35	15.99	14.67	14.95	16.05	15.87	15.97	15.48	15.53
ln(y)	11.81	11.70	16.13	17.25	15.09	15.85	17.36	17.07	17.69	16.75	16.49
	11.67	10.68	13.94	15.48	14.47	15.79	16.63	17.30	17.34	17.44	17.49
	11.51	10.43	13.91	15.65	14.70	15.21	17.09	18.35	18.69	18.75	18.88
	11.31	8.57	11.74	13.29	13.42	13.59	14.85	15.17	15.73	15.90	15.98
	11.07	7.74	8.87	10.68	11.31	11.66	12.49	13.06	12.45	13.10	13.27
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Urban Forest

	13.66	4.42	7.59	6.01	2.26	1.94	1.98	1.83	1.03	1.25	0.13
	12.51	5.64	8.25	8.20	4.70	4.24	5.00	5.29	4.46	4.89	4.38
	12.27	5.10	7.15	7.79	4.01	3.15	3.84	3.85	3.44	4.05	3.31
	12.09	6.39	8.81	8.85	4.82	5.05	5.75	6.35	6.58	7.34	7.27
	11.96	7.91	9.16	9.39	6.25	6.02	6.74	7.10	7.85	8.56	8.53
ln(y)	11.81	8.45	10.22	10.32	8.26	8.50	8.95	9.88	10.52	10.86	10.77
	11.67	7.48	8.03	9.60	7.81	9.52	9.79	10.39	10.57	11.01	11.35
	11.51	8.27	7.67	9.30	7.16	8.08	9.37	10.58	11.37	11.81	11.76
	11.31	6.29	6.53	8.56	6.96	6.89	7.25	7.78	8.44	9.04	9.17
	11.07	8.19	5.66	8.22	6.73	8.71	8.76	9.81	9.39	9.82	9.78
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Urban Savannah

	13.66	2.47	4.41	7.02	4.43	6.59	6.91	6.61	4.25	4.65	0.00
	12.51	4.98	5.95	9.05	7.35	8.91	9.03	9.49	7.71	7.58	3.20
	12.27	4.44	4.51	7.49	6.02	7.25	7.96	9.13	7.53	7.54	3.01
	12.09	3.70	5.60	7.94	5.48	6.49	8.37	8.96	7.60	7.36	2.55
	11.96	2.93	3.91	6.11	4.02	4.69	6.36	6.47	6.00	5.61	0.47
ln(y)	11.81	3.01	6.12	10.09	8.30	9.92	12.51	12.38	11.57	10.67	5.70
	11.67	8.91	10.44	15.13	12.92	13.43	15.45	15.57	15.36	14.37	9.77
	11.51	7.34	9.79	13.88	14.70	14.84	16.55	16.01	16.46	17.68	12.84
	11.31	5.33	6.99	10.14	10.76	10.19	11.12	9.04	8.89	9.46	6.12
	11.07	5.65	9.13	11.52	12.69	12.05	13.81	10.83	8.19	9.66	10.60
	0.00	-3.09	-2.41	-1.93	-1.56	-1.20	-0.84	-0.50	-0.07	0.60	5.05
						HAZ					

Table A. 5 - $\Pi^{1,1}$ Dominance Tests for Rural and Urban Areas in Madagascar

	16.51	3.259	2.949	3.145	3.257	3.913	4.167	2.588	1.153	0.292	-0.079
	13.19	3.687	3.171	4.066	4.623	5.541	6.504	5.412	4.839	4.627	4.821
	12.84	3.484	4.453	5.105	6.525	7.979	9.151	8.523	8.430	8.343	8.698
	12.60	5.292	5.470	6.317	8.224	10.020	11.630	10.930	10.820	11.090	11.360
	12.44	5.221	5.663	6.294	8.150	10.350	12.500	12.310	12.310	12.970	12.750
ln(y)	12.29	5.073	6.592	6.468	8.577	10.300	12.000	11.690	11.660	12.380	12.320
	12.16	3.876	5.762	5.602	7.566	8.466	10.410	10.650	10.490	11.470	11.240
	12.00	3.563	6.439	5.626	7.593	9.052	10.530	10.830	11.170	12.000	12.540
	11.82	3.466	5.865	4.413	5.684	6.488	7.695	7.811	8.012	8.739	8.920
	11.48	2.052	3.102	1.728	2.724	3.284	4.498	5.387	5.529	6.426	7.551
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Table A. 6 - $\Pi^{1,1}$ Dominance Tests for Rural Antananarivo vs. Urban Areas in Madagascar

Urban Antananarivo

	16.51	3.154	6.363	7.837	9.405	10.940	10.290	6.959	3.581	1.588	0.000
	13.19	4.785	7.602	9.615	11.940	14.720	14.680	11.490	8.881	7.933	7.248
	12.84	6.338	11.820	13.210	16.750	19.820	20.440	17.610	15.640	14.800	14.270
	12.60	7.723	12.460	12.600	16.500	18.310	19.590	17.260	15.950	15.170	14.490
	12.44	8.387	13.230	13.630	17.130	18.910	21.750	19.510	18.240	17.970	16.600
ln(y)	12.29	8.149	13.590	13.200	16.710	17.630	19.610	17.400	15.820	15.300	14.300
	12.16	6.834	11.180	11.470	14.410	13.890	15.140	13.520	11.380	10.760	10.230
	12.00	5.162	8.562	8.396	10.540	11.060	11.890	10.650	9.516	8.793	9.012
	11.82	5.113	7.359	7.405	9.297	8.843	9.364	8.167	6.638	6.265	5.949
	11.48	3.553	3.404	3.627	4.172	3.763	4.526	4.146	3.631	3.527	3.760
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Fianarantsoa/Toamasina

	16.51	2.106	2.428	6.446	6.273	6.262	9.066	8.314	6.290	3.529	0.000
	13.19	1.409	1.984	6.472	7.246	7.127	10.540	9.651	8.686	6.570	3.550
	12.84	2.370	3.034	7.464	8.607	9.410	13.310	12.180	11.960	10.630	7.689
	12.60	4.246	5.497	9.127	10.620	11.130	15.040	14.640	15.170	13.980	10.900
	12.44	4.176	5.669	9.549	10.670	12.420	16.090	15.220	16.000	14.260	10.490
ln(y)	12.29	5.671	6.274	8.983	9.736	10.850	13.800	13.320	13.890	11.740	8.487
	12.16	4.867	5.794	8.998	10.220	10.740	13.570	13.090	14.660	12.590	9.205
	12.00	2.845	6.403	7.495	9.909	11.090	13.720	13.610	14.800	12.430	10.010
	11.82	4.489	9.217	8.933	9.535	10.140	11.880	11.480	11.910	9.359	5.946
	11.48	3.770	5.577	6.521	5.935	6.268	7.321	8.667	8.323	8.536	8.763
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Mahajanga/Antsiranana

	16.51	14.210	15.050	18.070	17.130	15.210	13.230	7.546	6.791	3.026	0.000
	13.19	14.410	15.230	19.150	19.060	17.920	17.680	12.640	12.730	8.742	6.758
	12.84	14.410	16.010	19.510	21.280	21.330	20.620	16.490	16.990	12.540	11.350
	12.60	14.280	15.460	19.170	23.510	27.120	26.570	20.930	21.420	16.800	16.350
	12.44	13.640	18.010	21.090	26.460	30.730	29.350	25.240	25.690	22.470	21.840
ln(y)	12.29	12.450	16.700	19.140	24.790	27.970	26.600	22.930	23.910	20.990	21.290
	12.16	11.920	14.750	15.990	20.540	22.200	23.240	20.620	20.940	20.140	20.480
	12.00	9.061	13.170	13.040	16.540	18.000	19.150	17.620	17.610	16.790	16.880
	11.82	8.900	12.250	11.830	13.930	14.550	15.060	13.740	13.330	12.110	11.350
	11.48	5.364	7.045	4.937	4.659	4.856	5.257	6.629	5.386	4.883	5.116
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Toliara

	16.51	-5.614	-9.693	-9.164	-3.390	-0.148	2.859	1.683	2.302	2.324	0.000
	13.19	-4.391	-9.085	-7.892	-2.117	0.818	4.131	2.215	2.989	3.255	1.149
	12.84	-4.391	-6.766	-6.419	-0.958	2.653	6.021	4.326	5.505	6.060	4.405
	12.60	3.182	-1.986	0.484	6.088	8.402	11.940	10.980	11.880	11.690	9.382
	12.44	7.361	-1.111	1.040	6.074	8.391	11.780	10.710	11.360	11.200	8.572
ln(y)	12.29	6.803	3.115	4.168	9.193	11.360	13.850	12.550	12.590	13.030	10.070
	12.16	4.859	4.084	3.795	7.917	8.773	10.870	10.420	9.881	10.220	6.841
	12.00	9.356	9.943	9.561	12.940	13.900	15.850	15.150	14.560	14.360	12.650
	11.82	10.600	9.165	9.140	11.090	11.970	13.700	12.150	10.560	10.530	9.297
	11.48	7.546	3.865	3.070	3.572	4.648	5.718	5.467	4.719	4.135	3.833
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Table A. 7 - $\Pi^{1,1}$ Dominance Tests for Rural Fianarantsoa/Toamasina vs. Urban Areas in Madagascar

Urban Antananarivo

	16.51	7.198	10.440	8.607	6.840	7.968	6.849	4.194	0.252	-0.352	-0.045
	13.19	8.944	11.720	10.480	9.473	11.520	10.910	9.079	6.192	6.864	7.931
	12.84	9.165	14.770	13.320	13.670	15.760	15.780	14.330	11.660	12.890	13.820
	12.60	9.872	14.840	12.820	13.200	14.670	15.790	14.630	12.360	14.250	14.990
	12.44	8.096	13.740	11.580	11.820	13.310	16.220	15.560	13.500	15.920	16.400
ln(y)	12.29	7.009	13.270	10.620	11.510	12.200	14.850	13.930	11.860	13.830	14.570
	12.16	4.814	10.490	8.589	9.168	9.433	11.390	10.550	7.979	9.182	10.190
	12.00	3.847	7.867	5.833	6.076	7.441	8.533	7.917	6.756	7.945	9.620
	11.82	1.936	5.089	2.706	2.738	2.943	4.488	4.422	3.745	5.232	7.110
	11.48	0.117	2.651	0.830	0.851	0.635	2.827	2.439	2.744	3.952	5.921
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Fianarantsoa/Toamasina

	16.51	6.155	6.463	7.211	3.745	3.368	5.647	5.530	2.935	1.584	-0.045
	13.19	5.592	6.048	7.329	4.839	4.086	6.899	7.270	6.000	5.510	4.220
	12.84	5.227	5.928	7.574	5.700	5.696	8.977	9.068	8.109	8.796	7.260
	12.60	6.428	7.847	9.345	7.449	7.698	11.410	12.080	11.610	13.070	11.380
	12.44	3.878	6.176	7.535	5.560	7.091	10.870	11.440	11.360	12.290	10.300
ln(y)	12.29	4.507	5.954	6.426	4.703	5.634	9.267	9.967	10.010	10.320	8.745
	12.16	2.812	5.090	6.120	5.038	6.334	9.848	10.120	11.190	11.000	9.158
	12.00	1.501	5.697	4.928	5.447	7.471	10.340	10.840	11.980	11.570	10.620
	11.82	1.282	7.015	4.276	2.980	4.257	7.019	7.733	9.012	8.322	7.107
	11.48	0.350	4.867	3.824	2.661	3.191	5.660	7.013	7.461	8.949	10.860
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Mahajanga/Antsiranana

	16.51	17.970	19.250	18.890	14.410	12.140	9.703	4.774	3.429	1.083	-0.045
	13.19	18.240	19.440	20.090	16.430	14.620	13.790	10.200	9.965	7.668	7.438
	12.84	17.010	18.990	19.630	18.070	17.200	15.950	13.240	12.940	10.670	10.910
	12.60	16.270	17.860	19.400	19.980	23.080	22.410	18.190	17.590	15.870	16.860
	12.44	13.370	18.520	18.970	20.720	24.380	23.270	21.010	20.480	20.290	21.620
ln(y)	12.29	11.390	16.380	16.520	19.330	22.030	21.490	19.250	19.600	19.420	21.590
	12.16	10.120	14.080	13.110	15.200	17.550	19.270	17.490	17.290	18.440	20.430
	12.00	7.870	12.520	10.520	12.100	14.360	15.720	14.810	14.750	15.910	17.520
	11.82	6.126	10.230	7.312	7.536	8.781	10.250	10.000	10.430	11.070	12.520
	11.48	2.151	6.384	2.172	1.348	1.744	3.564	4.943	4.505	5.307	7.266
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Toliara

	16.51	-1.560	-5.611	-8.389	-5.916	-3.019	-0.488	-1.046	-1.023	0.383	-0.045
	13.19	-0.204	-4.982	-7.031	-4.503	-2.188	0.590	-0.098	0.360	2.208	1.815
	12.84	-1.530	-3.863	-6.309	-3.820	-0.983	1.869	1.339	1.787	4.278	3.983
	12.60	5.369	0.348	0.696	2.984	5.022	8.410	8.506	8.424	10.800	9.858
	12.44	7.067	-0.606	-0.941	1.047	3.173	6.728	7.064	6.894	9.284	8.383
ln(y)	12.29	5.648	2.795	1.634	4.169	6.124	9.312	9.217	8.742	11.590	10.330
	12.16	2.804	3.380	0.930	2.767	4.399	7.199	7.501	6.510	8.654	6.794
	12.00	8.180	9.257	7.006	8.478	10.260	12.450	12.360	11.740	13.490	13.270
	11.82	8.183	6.961	4.490	4.580	6.119	8.863	8.407	7.657	9.489	10.470
	11.48	5.018	3.118	0.265	0.242	1.533	4.031	3.769	3.835	4.559	5.993
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Table A. 8 - $\Pi^{1,1}$ Dominance Tests for Rural Mahajanga/Antsiranana vs. Urban Areas in Madagascar

Urban Antananarivo

	16.51	-3.434	-3.306	-6.104	-5.625	-4.052	-4.033	-4.128	-5.822	-4.624	-0.143
	13.19	-2.647	-2.835	-4.799	-4.747	-2.894	-2.708	-2.413	-3.765	-1.785	3.091
	12.84	-3.947	-1.045	-3.290	-2.245	-0.286	-0.096	0.959	0.514	1.711	6.764
	12.60	-6.668	-4.166	-7.532	-6.180	-4.204	-3.623	-3.435	-4.298	-2.226	2.354
	12.44	-7.125	-4.802	-8.739	-8.156	-6.047	-3.577	-2.983	-3.886	-1.888	1.362
ln(y)	12.29	-6.127	-2.246	-7.511	-6.629	-5.424	-3.854	-3.141	-3.836	-1.357	1.547
	12.16	-6.937	-3.922	-7.983	-6.639	-8.157	-6.329	-4.620	-5.842	-3.338	-1.309
	12.00	-6.713	-3.300	-7.326	-6.481	-6.738	-5.521	-4.281	-4.165	-2.103	0.381
	11.82	-5.356	-6.554	-9.495	-6.904	-8.085	-7.011	-6.205	-6.107	-4.656	-2.258
	11.48	-3.138	-3.753	-6.962	-5.021	-6.444	-5.215	-5.080	-4.279	-2.868	-0.913
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Fianarantsoa/Toamasina

	16.51	-4.477	-7.239	-7.489	-8.740	-8.663	-5.226	-2.798	-3.119	-2.677	-0.143
	13.19	-6.003	-8.447	-7.912	-9.370	-10.270	-6.635	-4.182	-3.955	-3.121	-0.563
	12.84	-7.849	-9.798	-8.923	-10.070	-10.060	-6.569	-4.042	-2.901	-2.195	0.468
	12.60	-9.933	-11.040	-10.940	-11.850	-11.010	-7.779	-5.841	-5.012	-3.327	-1.022
	12.44	-10.940	-12.200	-12.710	-14.400	-12.190	-8.691	-6.890	-5.929	-5.280	-4.349
ln(y)	12.29	-8.442	-9.563	-11.610	-13.380	-11.930	-9.274	-6.966	-5.637	-4.710	-4.011
	12.16	-8.681	-9.238	-10.380	-10.720	-11.220	-7.839	-5.033	-2.699	-1.574	-2.308
	12.00	-8.645	-5.481	-8.202	-7.102	-6.709	-3.724	-1.384	0.997	1.457	1.362
	11.82	-5.908	-4.744	-8.107	-6.670	-6.814	-4.507	-2.902	-0.841	-1.575	-2.261
	11.48	-2.927	-1.513	-4.275	-3.270	-4.005	-2.396	-0.456	0.514	2.263	4.203
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Mahajanga/Antsiranana

	16.51	8.146	5.343	3.746	1.689	-0.024	-1.246	-3.550	-2.625	-3.179	-0.143
	13.19	7.689	4.798	4.353	1.882	0.036	0.015	-1.327	-0.086	-0.999	2.608
	12.84	4.997	3.211	2.738	1.883	1.041	0.060	-0.051	1.729	-0.387	3.998
	12.60	0.644	-1.109	-1.199	0.219	3.480	2.308	-0.187	0.533	-0.742	4.052
	12.44	-1.392	0.310	-1.472	0.433	4.310	2.820	1.950	2.485	2.024	5.979
ln(y)	12.29	-1.392	1.197	-1.597	1.090	4.079	2.364	1.814	3.376	3.782	7.901
	12.16	-1.389	0.024	-3.463	-0.589	-0.127	1.329	2.069	3.143	5.481	8.325
	12.00	-2.881	1.931	-2.609	-0.378	0.256	1.685	2.549	3.721	5.677	8.027
	11.82	-1.200	-1.045	-5.280	-2.126	-2.281	-1.212	-0.597	0.593	1.183	3.129
	11.48	-1.200	0.309	-5.786	-4.546	-5.398	-4.496	-2.592	-2.522	-1.505	0.455
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Toliara

	16.51	-12.130	-19.800	-24.320	-19.060	-15.400	-11.510	-9.463	-7.120	-3.883	-0.143
	13.19	-11.710	-19.910	-23.310	-19.360	-16.970	-13.140	-11.700	-9.679	-6.434	-2.962
	12.84	-14.370	-19.910	-23.810	-20.280	-17.150	-13.860	-11.880	-9.253	-6.669	-2.767
	12.60	-10.910	-18.560	-19.880	-16.490	-13.770	-10.750	-9.350	-8.128	-5.487	-2.474
	12.44	-8.084	-18.850	-21.420	-19.140	-16.270	-12.850	-11.250	-10.350	-8.203	-6.218
ln(y)	12.29	-7.404	-12.620	-16.380	-13.920	-11.430	-9.230	-7.704	-6.879	-3.482	-2.470
	12.16	-8.688	-10.860	-15.410	-12.980	-13.160	-10.470	-7.624	-7.303	-3.855	-4.631
	12.00	-2.514	-1.838	-6.180	-4.091	-3.932	-1.623	0.121	0.759	3.323	3.931
	11.82	2.599	-4.797	-7.915	-5.111	-4.986	-2.642	-2.223	-2.203	-0.408	1.078
	11.48	2.599	-3.306	-7.448	-5.599	-5.599	-4.036	-3.769	-3.194	-2.259	-0.840
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Table A. 9 - $\Pi^{1,1}$ Dominance Tests for Rural Toliara vs. Urban Areas in Madagascar

Urban Antananarivo

	16.51	-0.085	-0.023	0.778	1.441	2.923	0.675	1.065	-0.932	-0.712	-0.239
	13.19	-0.142	0.146	1.711	2.955	5.791	3.978	5.443	4.882	6.658	8.242
	12.84	0.858	3.064	3.881	6.683	9.403	8.289	10.760	10.850	12.560	14.140
	12.60	1.293	2.517	2.856	6.296	8.768	8.761	11.640	12.240	14.710	16.290
	12.44	2.711	4.168	4.808	8.222	10.750	12.460	15.980	16.890	20.300	21.750
ln(y)	12.29	2.668	4.449	5.027	8.769	11.520	12.600	15.170	15.470	18.910	20.120
	12.16	2.665	3.936	5.464	8.819	10.790	11.820	15.560	15.770	19.300	21.190
	12.00	2.270	2.904	5.020	8.523	11.300	11.640	14.820	16.500	20.330	22.990
	11.82	0.529	2.623	3.101	6.952	9.312	9.167	11.610	13.350	17.530	18.980
	11.48	0.159	0.789	2.245	7.929	9.939	10.520	12.340	13.860	16.160	17.270
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Fianarantsoa/Toamasina

	16.51	-1.133	-3.948	-0.593	-1.625	-1.623	-0.509	2.390	1.748	1.224	-0.239
	13.19	-3.524	-5.461	-1.378	-1.603	-1.492	0.076	3.667	4.691	5.305	4.525
	12.84	-3.135	-5.698	-1.722	-1.087	-0.353	1.784	5.640	7.322	8.479	7.570
	12.60	-2.242	-4.435	-0.531	0.697	2.002	4.584	9.153	11.500	13.530	12.630
	12.44	-1.596	-3.442	0.813	2.032	4.605	7.247	11.850	14.680	16.480	15.270
ln(y)	12.29	0.100	-3.008	0.858	2.011	4.975	7.091	11.160	13.560	15.220	13.950
	12.16	0.636	-1.574	2.994	4.691	7.675	10.280	15.120	19.190	21.300	20.040
	12.00	-0.099	0.672	4.114	7.895	11.330	13.470	17.850	22.080	24.370	24.130
	11.82	-0.130	4.618	4.668	7.192	10.610	11.680	14.940	18.730	20.800	18.970
	11.48	0.392	3.094	5.193	9.621	12.310	13.170	16.630	18.330	20.920	22.040
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Mahajanga/Antsiranana

	16.51	11.240	8.615	10.680	8.802	6.980	3.459	1.641	2.241	0.723	-0.239
	13.19	9.971	7.762	10.910	9.650	8.770	6.728	6.544	8.625	7.461	7.748
	12.84	9.453	7.292	9.933	10.880	10.770	8.449	9.714	12.130	10.350	11.220
	12.60	8.423	5.568	9.203	12.790	16.740	14.930	15.080	17.470	16.340	18.190
	12.44	8.423	9.161	12.090	16.950	21.570	19.250	21.450	24.190	24.960	27.430
ln(y)	12.29	7.375	7.780	10.930	16.510	21.310	19.120	20.550	23.530	24.890	27.720
	12.16	8.204	7.762	10.010	14.850	18.950	19.720	22.800	25.810	29.750	33.120
	12.00	6.437	7.891	9.729	14.530	18.240	18.890	21.970	25.060	29.290	32.190
	11.82	4.885	8.049	7.693	11.640	15.020	14.870	17.210	20.180	23.720	24.790
	11.48	2.191	4.735	3.574	8.400	10.980	11.220	14.720	15.560	17.470	18.590
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Urban Toliara

	16.51	-8.841	-16.320	-16.580	-11.430	-8.068	-6.658	-4.174	-2.208	0.022	-0.239
	13.19	-9.286	-16.780	-16.090	-11.080	-7.815	-6.221	-3.662	-0.933	2.005	2.118
	12.84	-9.845	-15.690	-15.930	-10.720	-7.053	-5.253	-2.017	1.018	3.969	4.288
	12.60	-3.307	-11.960	-9.174	-3.734	-0.638	1.677	5.642	8.312	11.250	11.090
	12.44	1.646	-10.230	-7.667	-2.467	0.711	3.174	7.454	10.100	13.360	13.260
ln(y)	12.29	1.263	-6.159	-3.925	1.479	5.464	7.136	10.410	12.260	16.550	15.620
	12.16	0.628	-3.287	-2.195	2.421	5.733	7.625	12.410	14.220	18.720	17.440
	12.00	6.766	4.360	6.195	10.920	14.140	15.600	19.430	21.820	26.530	27.180
	11.82	7.153	4.561	4.882	8.766	12.440	13.510	15.620	17.350	22.040	22.570
	11.48	5.048	1.268	1.683	7.348	10.780	11.660	13.610	14.920	16.750	17.340
	0.000	-4.01	-3.33	-2.84	-2.39	-1.98	-1.63	-1.21	-0.71	0.12	4.85
						HAZ					

Table A. 10 - $\Pi^{1,1}$ Dominance Tests for Rural and Urban Areas in Uganda

	11.660	13.600	16.660	14.920	15.060	12.410	8.983	8.863	7.301	2.382	0.023
	9.276	14.340	20.740	22.210	25.370	23.980	23.510	24.900	25.220	24.210	25.460
	8.996	14.950	21.230	22.860	28.670	26.790	27.070	31.150	32.820	32.090	34.140
	8.803	16.610	23.260	25.680	30.690	32.420	33.130	37.380	39.530	40.910	42.910
	8.664	15.440	21.360	23.380	27.810	30.120	31.610	34.830	38.300	40.620	43.490
ln(y)	8.527	14.340	20.720	22.390	27.500	30.650	32.860	35.580	38.370	40.340	43.050
	8.395	13.390	21.030	22.510	26.720	30.920	33.620	35.930	38.280	39.870	42.230
	8.249	12.180	18.820	19.990	23.150	26.520	28.810	31.280	33.140	34.490	36.030
	8.068	9.106	15.410	16.730	19.730	22.550	25.010	27.170	29.930	31.040	33.400
	7.824	7.643	12.440	14.980	17.960	19.510	21.790	23.680	25.490	25.990	27.460
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						HAZ					

Table A. 11 - $\Pi^{1,1}$ Dominance Tests for Rural Central vs. Urban Areas in Uganda

Urban Central

	11.660	12.760	13.100	12.840	13.710	9.432	5.963	5.357	4.718	0.572	0.023
	9.276	12.960	17.960	22.720	26.110	23.090	22.510	22.680	24.320	24.900	27.770
	8.996	12.500	17.740	22.160	28.870	24.500	23.900	28.360	31.210	31.820	34.560
	8.803	15.220	20.370	26.060	31.410	32.120	31.720	35.410	37.910	41.590	43.530
	8.664	11.640	15.770	20.210	25.220	25.990	26.390	28.990	32.390	36.670	39.410
ln(y)	8.527	9.674	14.220	18.040	23.550	25.530	26.110	27.800	29.710	33.160	34.950
	8.395	7.385	14.410	16.980	21.230	24.020	25.000	25.790	27.030	29.260	30.280
	8.249	6.545	11.620	14.430	16.940	18.860	18.860	20.690	20.540	21.920	21.750
	8.068	3.557	9.455	12.730	15.580	16.630	17.640	19.740	21.380	21.440	22.700
	7.824	4.698	7.724	9.413	10.800	12.110	14.010	15.930	16.730	16.090	16.900
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						HAZ					

Urban Eastern

	11.660	2.637	12.510	8.720	7.938	9.993	7.941	11.170	4.484	1.109	0.000
	9.276	3.458	13.930	9.712	12.030	15.540	15.410	20.020	13.550	14.130	16.400
	8.996	5.519	14.940	10.590	13.920	17.110	17.110	22.360	18.330	18.410	20.250
	8.803	2.559	11.910	7.156	10.320	13.760	14.730	21.160	18.730	19.030	21.460
	8.664	0.610	8.643	4.224	7.651	9.988	9.820	15.270	15.010	16.430	19.950
ln(y)	8.527	0.062	8.763	5.016	8.366	9.201	12.340	17.300	15.860	17.390	19.570
	8.395	-2.842	5.754	-0.025	2.692	4.249	6.958	10.650	12.260	13.580	15.240
	8.249	-1.582	5.582	-0.307	2.743	2.801	5.305	8.590	11.310	13.020	13.520
	8.068	-4.756	1.731	-4.960	-1.046	0.140	2.003	4.765	6.872	9.221	8.636
	7.824	4.698	8.001	8.184	9.695	7.846	10.090	12.120	12.850	13.900	12.290
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						HAZ					

Urban Western

	11.660	7.881	10.700	17.210	15.520	14.030	10.990	11.270	10.440	5.947	0.167
	9.276	8.307	15.070	24.580	28.270	25.850	24.640	28.660	34.110	30.540	30.250
	8.996	8.272	14.840	23.080	27.160	25.870	27.190	30.100	36.320	34.660	39.630
	8.803	8.478	15.800	22.990	27.460	28.090	30.370	34.940	41.120	41.830	46.850
ln(y)	8.664	6.314	16.500	23.720	27.180	28.020	30.250	33.390	38.370	41.150	46.240
	8.527	6.429	15.730	22.070	26.120	25.370	26.910	29.410	32.860	34.600	37.110
	8.395	4.164	11.510	17.150	23.180	23.800	25.810	27.870	31.160	32.300	34.120
	8.249	4.245	8.491	13.760	19.610	21.630	22.310	23.440	25.160	26.790	27.890
	8.068	7.488	12.370	15.210	18.610	20.080	20.920	22.760	24.650	26.820	28.010
	7.824	4.698	8.001	9.646	11.000	12.980	14.790	16.640	17.410	18.540	19.270
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						HAZ					

Urban Northern

	11.660	-2.078	8.260	1.118	0.875	-8.225	-6.702	-5.046	-4.178	-1.944	0.000
	9.276	-3.019	6.890	-0.340	0.249	-8.063	-6.814	-4.963	-3.129	0.715	3.785
	8.996	-4.014	4.852	-3.787	-2.839	-10.300	-9.337	-8.146	-4.784	-1.764	0.788
	8.803	-3.698	4.300	-3.206	-2.787	-6.477	-6.524	-5.319	-2.051	0.400	2.425
	8.664	-5.033	1.988	-6.463	-6.171	-8.087	-8.878	-8.893	-6.401	-3.475	-0.626
ln(y)	8.527	-7.906	0.136	-9.609	-6.720	-6.885	-7.752	-6.152	-4.600	-0.948	0.039
	8.395	-1.872	1.605	-3.988	-1.914	1.728	3.549	3.473	4.507	7.883	9.095
	8.249	-5.686	-4.736	-10.610	-9.483	-6.670	-3.696	-1.952	-2.388	0.348	1.345
	8.068	-8.670	-6.032	-8.345	-10.410	-7.781	-5.557	-4.831	-4.195	-1.707	-1.636
	7.824	-10.520	-6.723	-4.552	-2.706	-0.172	2.293	4.761	5.295	6.767	7.456
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						HAZ					

Table A. 12 - $\Pi^{1,1}$ Dominance Tests for Rural Eastern vs. Urban Areas in Uganda

Urban Central

	11.660	17.010	15.740	13.760	14.930	12.370	8.695	8.636	8.251	2.570	-0.009
	9.276	18.070	21.710	25.220	29.350	28.460	28.470	29.620	31.460	30.110	31.160
	8.996	18.270	22.340	26.690	35.020	32.870	33.410	39.490	42.530	41.420	42.790
	8.803	21.890	26.520	33.030	40.110	43.030	43.890	49.210	52.650	55.750	56.790
	8.664	20.380	24.090	29.390	35.670	39.260	42.040	46.420	51.940	55.810	58.080
ln(y)	8.527	18.530	22.750	27.360	33.830	39.060	41.610	44.990	49.520	52.240	54.790
	8.395	16.170	23.810	27.760	32.930	38.360	40.970	44.020	46.850	48.860	50.780
	8.249	15.140	21.560	25.040	27.970	32.200	33.720	36.860	38.500	39.930	40.690
	8.068	12.850	18.470	21.890	24.590	27.680	29.710	32.190	35.350	36.220	38.270
	7.824	10.100	13.140	14.760	16.910	18.870	21.010	22.700	25.040	25.410	26.570
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						HAZ					

Urban Eastern

	11.660	7.033	15.150	9.633	9.146	12.930	10.690	14.510	8.015	3.108	-0.032
	9.276	8.785	17.670	12.130	15.080	20.690	21.110	26.830	20.180	18.970	19.520
	8.996	11.550	19.560	15.020	19.690	25.140	26.220	32.960	28.470	26.940	27.450
	8.803	10.050	18.190	13.980	18.400	23.630	25.610	33.380	31.090	30.350	31.950
	8.664	10.360	17.170	13.400	17.690	22.450	24.180	31.130	32.010	32.370	35.290
ln(y)	8.527	10.000	17.580	14.540	18.550	22.220	27.030	33.520	33.920	34.270	36.930
	8.395	7.007	16.030	11.570	14.780	18.630	22.510	28.060	30.850	31.590	33.880
	8.249	8.414	16.640	11.640	14.580	16.850	20.480	24.780	29.100	30.690	32.000
	8.068	5.731	12.210	6.121	9.568	12.730	15.290	18.210	21.720	24.540	24.690
	7.824	10.100	13.310	13.910	16.150	15.590	17.940	19.620	21.990	23.640	22.780
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						HAZ					

Urban Western

	11.660	12.230	13.330	18.140	16.760	17.010	13.760	14.610	14.040	7.962	0.135
	9.276	13.560	18.810	27.100	31.560	31.320	30.690	35.950	41.940	36.030	33.720
	8.996	14.230	19.460	27.620	33.260	34.320	36.940	41.410	48.280	44.560	48.360
	8.803	15.730	22.040	29.950	36.030	38.730	42.420	48.680	56.400	56.030	60.700
ln(y)	8.664	15.720	24.780	32.840	37.660	41.410	46.280	51.470	59.130	61.300	66.580
	8.527	15.810	24.150	31.210	36.380	38.900	42.460	46.770	53.160	53.930	57.390
	8.395	13.500	21.300	27.910	34.770	38.150	41.780	46.200	51.360	52.280	55.200
	8.249	13.440	19.100	24.480	30.330	34.680	36.960	39.530	43.120	44.940	47.150
	8.068	15.200	20.460	23.690	26.950	30.420	32.440	34.810	38.210	41.060	43.100
	7.824	10.100	13.310	14.920	17.050	19.490	21.580	23.240	25.550	27.290	28.410
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						HAZ					

Urban Northern

	11.660	2.327	10.890	2.023	2.072	-5.318	-3.980	-1.786	-0.666	0.054	-0.032
	9.276	2.331	10.620	2.051	3.234	-3.114	-1.367	1.307	3.208	5.342	6.751
	8.996	2.091	9.473	0.586	2.751	-2.662	-0.767	1.374	4.544	6.115	7.378
	8.803	3.852	10.610	3.570	5.122	3.006	3.806	5.738	9.270	10.780	11.910
	8.664	4.792	10.580	2.684	3.735	4.042	5.005	5.930	9.383	11.210	13.200
ln(y)	8.527	2.090	9.130	-0.079	3.370	5.877	6.406	8.982	12.200	14.660	15.820
	8.395	7.952	12.070	7.623	10.160	16.080	19.020	20.570	22.620	25.470	27.200
	8.249	4.379	6.944	1.347	2.396	7.387	11.440	14.100	15.070	17.570	19.270
	8.068	1.615	4.746	2.698	0.182	4.861	7.806	8.691	10.730	13.640	14.390
	7.824	-3.933	0.459	2.634	5.474	8.455	11.080	13.110	15.430	17.470	18.520
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						HAZ					

Table A. 13 - $\Pi^{1,1}$ Dominance Tests for Rural Western vs. Urban Areas in Uganda

Urban Central

	11.660	20.570	21.990	22.390	23.130	19.630	13.880	11.400	9.372	3.245	0.023
	9.276	20.580	26.270	31.970	35.810	33.640	31.330	29.580	29.480	28.090	27.970
	8.996	20.590	25.980	31.940	39.620	35.750	33.910	37.060	37.870	36.670	37.010
	8.803	23.020	28.260	35.700	41.600	43.280	41.360	43.770	44.580	46.270	45.680
	8.664	20.960	24.890	31.180	35.380	37.500	37.520	38.590	40.680	42.990	43.550
ln(y)	8.527	18.830	23.370	28.750	33.420	37.260	37.410	37.290	38.970	40.790	41.980
	8.395	16.520	24.000	28.470	31.660	35.930	36.560	36.200	36.300	37.430	38.000
	8.249	14.220	21.170	25.200	26.300	28.870	29.220	29.580	29.310	29.290	29.000
	8.068	10.220	16.640	19.930	21.810	22.990	24.370	25.150	26.410	25.390	27.410
	7.824	7.087	10.400	12.300	14.070	14.310	15.350	16.110	16.590	15.380	16.180
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						haz					

Urban Eastern

	11.660	10.720	21.400	18.150	17.150	20.220	15.920	17.340	9.136	3.783	0.000
	9.276	11.400	22.210	18.550	21.030	25.610	23.820	26.790	18.360	17.100	16.590
	8.996	13.960	23.200	20.070	23.890	27.870	26.690	30.660	24.350	22.760	22.420
	8.803	11.300	19.950	16.530	19.730	23.850	23.400	28.650	24.460	22.890	23.230
	8.664	11.000	17.990	15.160	17.420	20.840	20.140	24.150	22.440	21.910	23.500
ln(y)	8.527	10.340	18.220	15.940	18.150	20.530	23.140	26.360	24.490	24.320	25.910
	8.395	7.405	16.240	12.320	13.490	16.270	18.340	20.760	21.150	21.280	22.460
	8.249	7.343	16.210	11.820	12.810	13.400	15.950	17.600	20.090	20.340	20.700
	8.068	2.642	10.110	3.759	6.335	7.454	9.488	10.690	12.320	13.390	13.600
	7.824	7.087	10.610	11.310	13.190	10.430	11.630	12.320	12.690	13.130	11.490
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						haz					

Urban Western

	11.660	15.870	19.560	26.930	25.030	24.460	19.060	17.450	15.190	8.643	0.167
	9.276	16.130	23.360	33.900	38.120	36.620	33.600	35.910	39.750	33.890	30.450
	8.996	16.610	23.100	32.890	37.800	37.230	37.450	38.930	43.330	39.650	42.210
	8.803	16.940	23.790	32.600	37.480	38.970	39.920	43.270	48.000	46.520	49.080
ln(y)	8.664	16.330	25.580	34.630	37.370	39.640	41.620	43.300	47.070	47.740	50.680
	8.527	16.130	24.760	32.590	35.960	37.100	38.240	38.980	42.300	42.300	44.270
	8.395	13.870	21.500	28.630	33.500	35.720	37.360	38.310	40.530	40.580	41.990
	8.249	12.470	18.680	24.650	28.690	31.400	32.480	32.250	33.860	34.150	35.180
	8.068	12.890	18.760	21.830	24.330	25.960	27.290	27.950	29.470	30.550	32.480
	7.824	7.087	10.610	12.490	14.240	15.080	16.080	16.810	17.270	17.880	18.620
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						haz					

Urban Northern

	11.660	6.026	17.090	10.400	9.926	1.684	1.108	0.937	0.440	0.728	0.000
	9.276	4.961	15.120	8.337	8.974	1.449	1.148	1.273	1.487	3.568	3.963
	8.996	4.551	13.090	5.502	6.744	-0.173	-0.338	-0.614	0.838	2.310	2.808
	8.803	5.125	12.370	6.080	6.413	3.208	1.760	1.586	3.306	4.016	4.061
	8.664	5.443	11.400	4.421	3.468	2.518	1.198	-0.397	0.700	1.727	2.698
ln(y)	8.527	2.436	9.777	1.311	2.975	4.255	2.752	2.490	3.639	5.633	5.988
	8.395	8.347	12.280	8.380	8.881	13.730	14.880	13.460	13.250	15.460	16.170
	8.249	3.273	6.477	1.536	0.620	3.949	6.952	7.031	6.331	7.580	8.409
	8.068	-1.524	2.535	0.324	-3.083	-0.469	1.955	1.128	1.292	2.492	3.349
	7.824	-7.871	-3.246	-0.675	1.715	2.677	4.016	4.981	5.118	5.921	6.609
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						haz					

Table A. 14 - $\Pi^{1,1}$ Dominance Tests for Rural Northern vs. Urban Areas in Uganda

Urban Central

	11.660	19.720	18.840	16.170	16.690	11.790	7.597	6.035	6.904	0.391	0.023
	9.276	21.280	25.590	28.750	32.190	28.870	28.590	28.300	31.410	29.330	33.140
	8.996	21.780	27.460	31.300	39.420	35.430	36.110	40.820	45.510	44.060	49.000
	8.803	26.170	33.100	39.110	46.940	48.670	50.600	55.650	61.370	64.140	69.890
	8.664	24.370	30.680	36.570	44.500	47.280	51.100	55.400	63.730	68.000	74.460
ln(y)	8.527	24.190	30.940	37.130	45.970	51.050	55.740	59.210	66.610	70.030	78.270
	8.395	23.440	32.790	38.570	46.070	52.330	57.590	61.310	67.130	69.920	77.660
	8.249	21.400	30.450	36.640	43.320	49.440	53.360	57.880	62.020	64.490	70.570
	8.068	17.160	25.550	33.000	39.910	44.450	49.020	53.480	59.330	60.190	68.530
	7.824	15.210	22.720	27.610	33.360	37.020	41.050	44.620	48.220	48.980	54.140
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						haz					

Urban Eastern

	11.660	9.834	18.250	12.020	10.870	12.360	9.584	11.860	6.669	0.927	0.000
	9.276	12.110	21.540	15.500	17.710	21.090	21.230	25.530	20.130	18.250	21.320
	8.996	15.200	24.680	19.460	23.720	27.560	28.770	34.200	31.050	29.220	32.690
	8.803	14.780	24.820	19.750	24.440	28.510	31.320	38.830	37.890	36.540	41.410
	8.664	14.750	23.850	20.370	25.790	29.610	32.000	38.850	41.390	41.540	47.330
ln(y)	8.527	16.280	25.940	24.240	30.020	33.080	39.630	46.240	48.250	48.590	55.310
	8.395	15.170	25.550	22.690	27.510	31.530	37.350	43.260	48.170	49.060	55.640
	8.249	15.570	26.120	24.090	30.180	33.730	39.190	44.440	51.040	53.370	59.320
	8.068	10.750	20.090	18.880	26.310	30.350	34.890	39.250	44.840	47.440	52.680
	7.824	15.210	22.830	27.070	32.880	34.720	38.810	42.300	45.800	47.500	50.830
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						haz					

Urban Western

	11.660	15.000	16.420	20.590	18.520	16.430	12.650	11.960	12.670	5.765	0.167
	9.276	16.840	22.680	30.650	34.430	31.740	30.810	34.550	41.890	35.200	35.760
	8.996	17.840	24.580	32.240	37.610	36.900	39.720	42.770	51.460	47.300	55.030
	8.803	20.310	28.660	35.970	42.680	44.170	49.030	55.080	65.570	64.460	74.610
ln(y)	8.664	19.940	31.360	40.060	46.590	49.570	55.720	60.980	72.090	74.470	85.300
	8.527	21.720	32.270	40.950	48.620	50.880	56.700	61.260	71.050	72.130	81.810
	8.395	21.110	30.490	38.720	47.920	52.110	58.490	63.830	72.660	74.220	83.800
	8.249	19.980	28.310	36.140	45.550	51.920	56.800	60.870	67.510	70.650	79.260
	8.068	19.130	27.190	34.450	41.860	46.860	51.580	56.050	62.310	65.420	74.170
	7.824	15.210	22.830	27.700	33.450	37.430	41.450	45.020	48.610	50.510	55.680
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						haz					

Urban Northern

	11.660	5.139	13.970	4.385	3.772	-5.883	-5.070	-4.368	-2.001	-2.125	0.000
	9.276	5.686	14.450	5.364	5.787	-2.739	-1.261	0.137	3.163	4.662	8.447
	8.996	5.817	14.550	4.910	6.578	-0.447	1.526	2.435	6.813	8.149	11.990
	8.803	8.658	17.220	9.218	10.910	7.505	8.951	10.330	15.130	16.170	19.940
	8.664	9.272	17.280	9.535	11.510	10.710	12.140	12.570	17.370	19.010	23.110
ln(y)	8.527	8.582	17.610	9.460	14.360	16.040	17.700	19.780	24.290	26.780	30.780
	8.395	16.060	21.740	18.730	22.770	28.860	33.580	35.030	38.820	42.000	47.480
	8.249	11.830	17.050	13.930	17.860	23.930	29.560	32.740	35.140	38.170	43.700
	8.068	6.808	13.120	15.570	17.100	22.510	27.260	29.330	33.020	35.550	40.860
	7.824	3.033	12.760	18.520	24.940	29.090	33.300	36.960	40.200	42.080	46.940
	0.000	-3.100	-2.450	-1.970	-1.580	-1.220	-0.880	-0.500	-0.010	0.690	5.820
						haz					