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Growth and Poverty Reduction in Uganda, 1992-1999: A Multidimensional Analysis of Changes in Living Standards

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Comments Welcome

Growth and Poverty Reduction in Uganda, 1992-1999: A Multidimensional Analysis of Changes in Living Standards*

by

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Abstract

This paper examines Uganda's progress on poverty reduction when poverty is measured in multiple dimensions. In particular, I consider poverty measures that are defined across household expenditures per capita or household assets, children's health status, and in some cases, mother's literacy. The comparisons are robust to the choice of poverty line, poverty measure, and sampling error. In general, I find that multidimensional poverty declined significantly in Uganda during the 1990s, although results for the latter half of the decade are more ambiguous. While there was clear progress in the dimension of expenditures and assets, improvement in children's height-for-age z-scores is less certain for the 1995-2000 period. I also make poverty comparisons for individual regions and urban and rural areas in the country. Rather surprisingly, progress on multivariate poverty reduction is less clear in Central region and in urban areas.

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1. Introduction

Since the pioneering work of Sen (1979, 1985, 1987), most poverty analysts accept, in theory, that poverty is a multi-dimensional phenomenon. Poverty is not just a problem of low incomes, which are only instrumentally significant, but deprivation with respect to a variety of basic capabilities or functionings. Health, literacy, security, political voice, etc., are all relevant measures of deprivation that poverty analysis should consider, in addition to the standard measures of income or expenditures.

Despite the widespread acceptance of this theory, most empirical work on poverty uses a one-dimensional yardstick to judge a person's well-being, usually expenditures or income per capita or per adult equivalent. If this measure were highly correlated with other capabilities of interest, then such univariate analysis would be acceptable. But it is not (Appleton and Song, 1999; Alderman et. al., 1999), so the standard practice of poverty analysis falls short of what poverty theory suggests that we study.

This limitation is especially important in Uganda during the 1990s. Much has been made of the fact that, unusually for an African economy, Uganda's growth has been rapid and sustained for an extended period of time. Further, this growth has clearly translated into substantial declines in poverty for all socio-economic groups and in all regions of the country (Appleton, 2001b). Even though this evidence is quite clear – I would say incontrovertible – there is concern in Uganda that living standards are not improving by anything like the quantitative analysis of household expenditures suggests. Both of Uganda's participatory poverty assessments found that focus group participants and key informants were only slightly more likely to say that poverty had declined rather than increased in their community (UPPAP, 2000, 2002). In addition, there is concern among policy makers and stakeholders that non-income measures of well-being such as infant mortality and children's nutritional status are not improving over time despite the substantial increases in income (Ministry of Finance, Planning, and Economic Development, 2002; Task Force on Infant and Maternal Mortality, 2003; Uganda Bureau of Statistics, 2001).

This paper begins to address these concerns by expanding the analysis of poverty trends to more than the income/expenditure dimension of poverty. In particular, I analyze changes in poverty in Uganda and in its individual regions, using as measures of well-being both household expenditures per capita, the standard variable, and children's standardized heights (their height-for-age z-score), a good measure of young children's overall health status. In broad terms, then, I analyze changes in well-being measured in the dimensions of purchasing power and children's health status. As noted, this combination is particularly relevant in Uganda, where incomes have surely improved considerably over the 1990s while there are more doubts about health status.

The poverty comparisons made here follow the stochastic dominance approach initially developed in Atkinson (1987) and Foster and Shorrocks (1988a,b,c). Duclos, Sahn, and Younger (2003) extend those methods to multidimensional comparisons. One important advantage of the poverty dominance 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 a multidimensional context, this also means robustness over the manner in which multidimensional indicators interact in generating overall individual well-being. In contrast to earlier work on multidimensional comparisons, our orderings are also "poverty-line robust" in the sense of being valid for the choice of any poverty line (or "frontier" in multiple dimensions). Given the well-known sensitivity of many poverty comparisons to the choice of poverty lines, and the difficulty of choosing the "right" poverty line, this is an important contribution.

2. Methods

2.1. Data

The data for this study come from two sources. First, I use two of the same household survey data sets that Appleton (2001a, 2001b, 1996) and Deininger and Okidi (2001) use to gauge poverty over time: the 1992/93 Integrated Household Survey and the 1999/2000 National Household Survey (Statistics Department, Ministry of Finance and Economic Planning, 1994; Uganda Bureau of Statistics, 2001). Both surveys are multipurpose living standards measurement surveys, carried out by the Uganda Bureau of Statistics. Second, I use the three Demographic and Health Surveys (DHS) conducted in 1988, 1995, and 2000, also conducted by UBoS, with Macro International (Kaijuka, et.al., 1989; Statistics Department, Ministry of Finance and Economic Planning, 1996; Uganda Bureau of Statistics and ORC Macro, 2001). All these surveys are nationally representative, although some did not survey in areas of civil conflict, a fact that I take into account in the analysis.

The first measure of well-being that I use is the log of per capita household expenditures, the standard variable for empirical poverty analysis in developing countries.[1] 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

[1] Appleton actually uses expenditures per adult equivalent rather than per capita, but my results using per capita expenditures are entirely consistent with his.

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; Alderman et al 1999) .[2]

The DHS surveys do not collect information on household expenditures, so it is impossible to use the same welfare variable in these data that we use in the IHS and NHS. However, Montgomery, Burk, and Paredes (2000), Filmer and Pritchett (2001), Sahn and Stifel (2000), and Stifel and Sahn (2002) have all shown that it is possible to construct a welfare variable from DHS data whose statistical properties are comparable to the standard household expenditure variable. All of these authors use either principal components or factor analysis to generate an index of household assets – including durable consumer goods, productive assets, and household education levels. In this paper, I use factor analysis create an index based on consumer durables that the household owns and the household head's years of education (Sahn and Stifel, 2000). Appendix 1 gives details of the index and its estimation.

2.2. Univariate Poverty Dominance Methods

The theoretical and statistical bases for the methods that I use in this paper are developed in Duclos, Sahn, and Younger (2003). In this section, I give an intuitive presentation only. Even though my 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 (2001b): 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 income needed to satisfy basic caloric requirements along the lines of Ravallion and Bidani;
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.

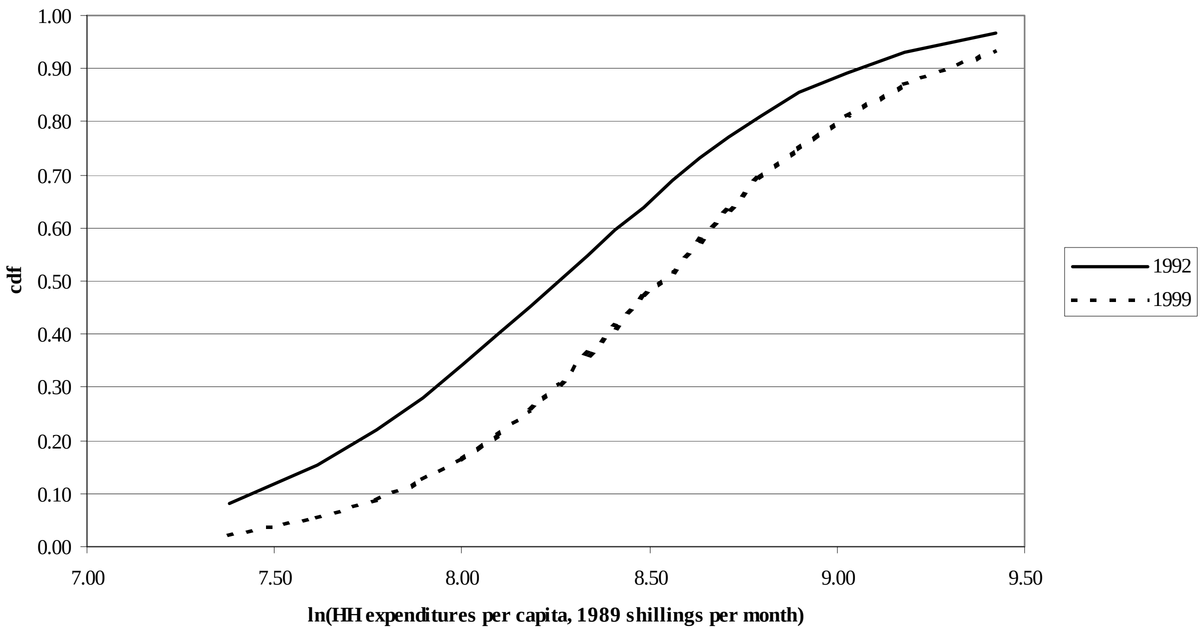
This approach has two weaknesses: it depends on the particular poverty line chosen, and it depends on the particular poverty measure chosen. Setting the poverty line is an imprecise art, and it is possible that choosing a different, equally defensible, poverty line will reverse one's conclusions. That 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[3] for real household

[2] Pradhan, Sahn, and Younger (2003) give a more thorough defense of using children's height as a welfare measure.
[3] 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

expenditures per capita in Uganda in 1992 and 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 in 1999 than it was in 1992. Thus, this sort of poverty comparison is robust to the choice of a poverty line.[4]

Figure 1 - Poverty Incidence Curves, Uganda, 1992 and 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 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, then poverty will be lower in the first sample for all poverty lines, and for all poverty measures that have four characteristics: they must be additively separable, non-decreasing, anonymous, and continuous at the poverty line. By additively separable we mean that the poverty measure can be expressed as a weighted sum of the poverty status of individuals. 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 doesn't matter which person occupies which position or rank in the income distribution. Continuous at the poverty line means that the poverty measure cannot change dramatically when someone crosses the poverty line. It is helpful to call all the poverty measures that have these characteristics the "class" Π^1. Π^1 includes virtually every standard poverty measure except the

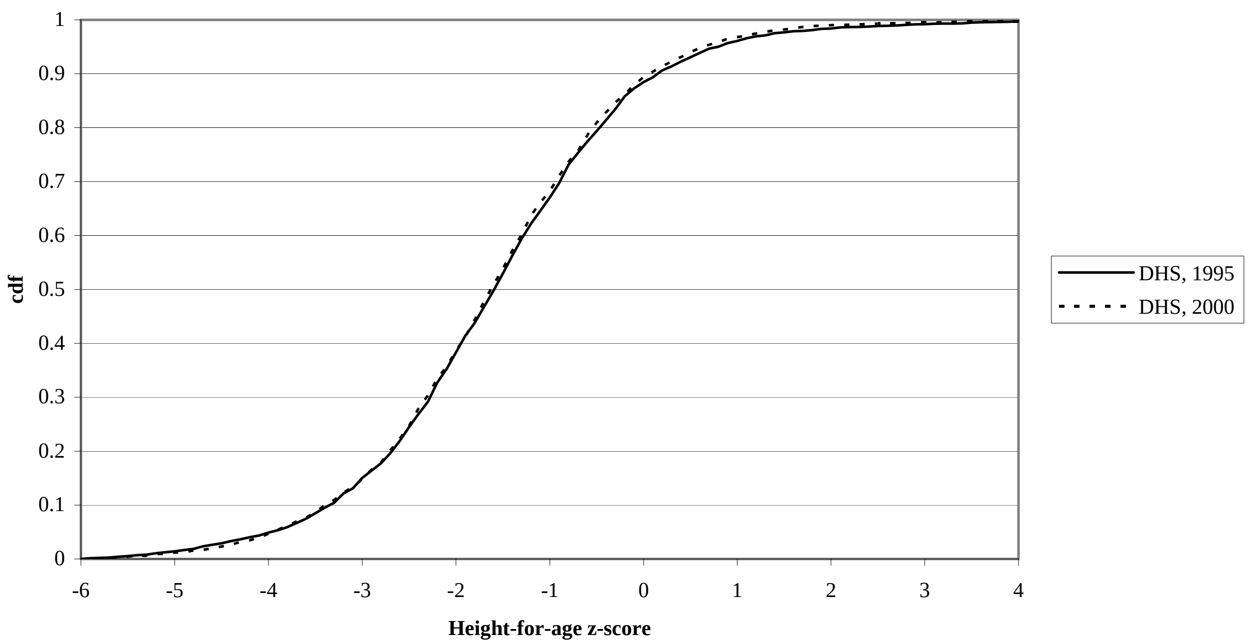
the y-axis would be the headcount poverty rate – the share of people whose expenditure is below that particular poverty line. Note that this particular cumulative density function is sometimes called a "poverty incidence curve."

[4] Appleton (2001b) uses this method to show that poverty in Uganda fell consistently over the 1990s, no matter where we set the poverty line.

headcount, but as we can see in the example, the headcount is also covered in this particular comparison because it is the poverty incidence curve's y-coordinate. It should be clear that the latter three characteristics of the class Π^1 are entirely unobjectionable. Additive separability is more restrictive theoretically, but is necessary for all of the standard measures of poverty.

Comparing cumulative density curves as in Figure 1 allows us to make a very general statement about poverty in 1992 and 1999 in Uganda: for any reasonable poverty line and for the very large class of poverty measures Π^1, poverty was lower in 1999 than it was in 1992. For reasons that will become clear shortly, this is called "first-order poverty dominance." The generality of this conclusion 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 year or the other. This is the case in Figure 2, which graphs the cdf's for children's height-for-age z-score in 1995 and 2000 in Uganda. These curves are quite close together, and they 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 year or the other.

Figure 2 - Poverty Incidence Curves for Children's Heights, Uganda, 1995 and 2000



There are two ways to deal with this problem, both which are still considerably more general than the traditional method of a fixed poverty line and 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 where the cdf's cross (Duclos and Makdissi, 2003). 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.[5] Second, it is possible to make comparisons for a smaller class of poverty measures. For example, if we add the condition that the poverty measure respect the Dalton transfer principle,[6] 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 all reasonable poverty lines, then poverty will be lower for the first sample for all poverty measures that are additively separable, non-decreasing, anonymous, continuous at the poverty line, and that respect the 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 additively separable, non-decreasing, anonymous, continuous at the poverty line, that respect the Dalton transfer principle, and that respect the principle of transfer sensitivity.[7] 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 intuition for the class of poverty measures generally ends at third-order 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 cdf on the z-axis (vertical), as in Figure 3. Note that the 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.

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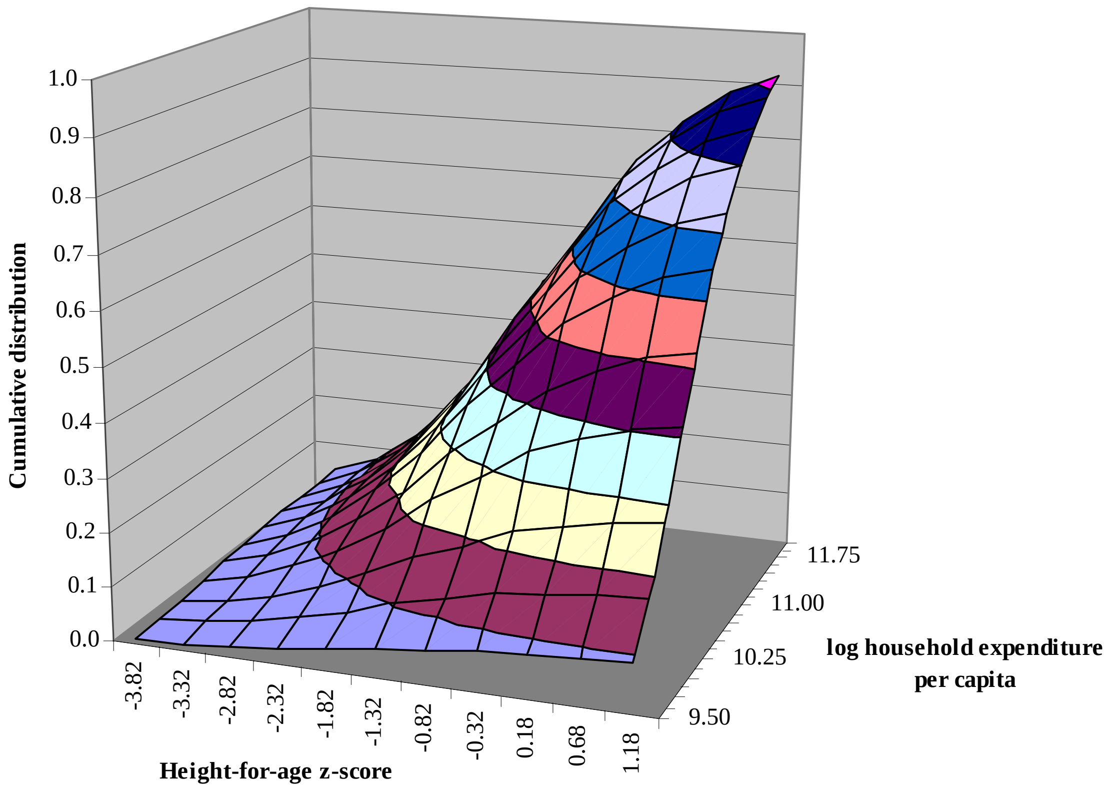
[5] In the case of Figure 2, that is not likely, since the standard cut-off for stunting is –2 z-scores.

[6] The Dalton transfer principle says that any transfer from a richer person to a poorer person should decrease the poverty measure. Again, this seems entirely sensible, but note that it does not work for the headcount if the transfer occurs between two poor people or two non-poor people. In fact, if the richer person were just above the poverty line ex ante, such a transfer could actually increase measured poverty if s/he fell below the poverty line, while the recipient did not rise above it.

[7] The principle of transfer sensitivity says that if we make two equal but offsetting transfers, one from a richer to a poorer person, and the other from a poorer to a richer person, but both of the latter being poorer than the participants in the first transfer, then poverty should decline. The idea is that the benefit of the transfer from a richer to a poorer person, or the cost of a transfer from a poorer to a richer 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 the same characteristics as the univariate case – additively separable, non-decreasing in each dimension, anonymous, and continuous at the poverty lines – 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 a transfer of well-being in one dimension from a person who is richer to one who is poorer in that dimension should have a greater effect on poverty if these two people are poorer in the other dimension of well-being.[8] In most cases, this restriction is sensible: if we want to improve a child's health, for example, it seems right that this should reduce overall poverty by more if the child is poorer 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

[8] Bourguignon and Chakravarty (2003) discuss this in detail, calling it a "correlation increasing switch.," as do Duclos, Sahn, and Younger (2002).

education. Thus, the bivariate comparisons that I make here are not so general as the univariate comparisons discuss in the previous section.

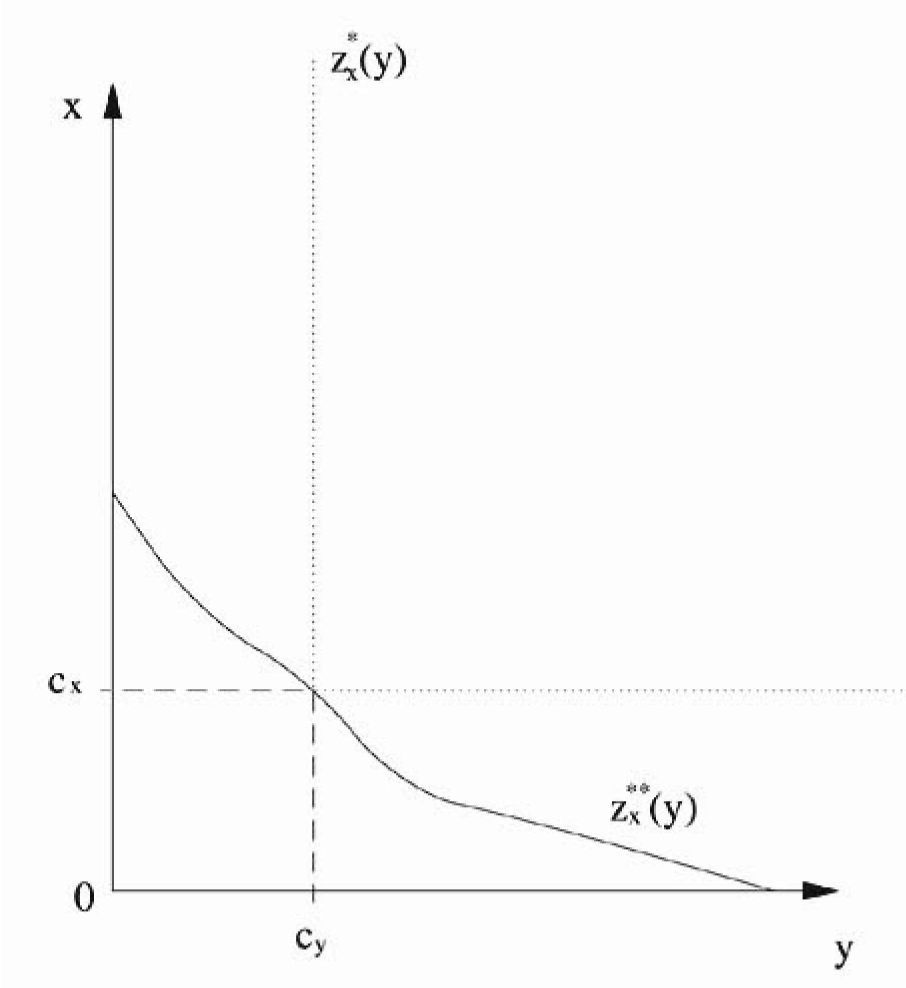
Practically, it is not easy to plot two surfaces such as the one in Figure 3 on the same graph and see the differences between them, but we can plot the differences directly. If this difference is always positive or always negative, then we know that one or the other of the samples has lower poverty for all poverty lines and for a large class of poverty measures $\Pi^{1,1}$.

If the surfaces cross, we can compare higher orders of dominance, just as we did in the univariate case. This can be done in one or both dimensions of well-being, and the restrictions on the applicable class of poverty measures are similar to the univariate case.

2.3.1. Intersection, Union, and "Intermediate" Poverty Definitions

In addition to the extra condition 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.

2.3.2. Multivariate vs. Human Development Index Poverty Comparisons

Figure 4 is also helpful to understand the difference between the general multivariate poverty comparisons that I 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 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 the 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.[9] The domain of this test would be a ray starting at the origin and extending into the (x,y) plane at an angle the 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 plane defined by $\lambda_1(x,y)$, $\lambda_2(x,y)$, or $\lambda_3(x,y)$.

2.3.3. 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 surfaces 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 are actually the univariate cdf's, as 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.

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 lower 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.

3. Results

3.1. Comparing Living Standards in the 1992/93 IHS and the 1999/2000 NHS

3.1.1. National Comparisons

Table 1 gives descriptive statistics for the headcount poverty rate and the stunting rate for 1992 and 1999 based on the IHS and NHS. These summary statistics show clear declines in the headcount and in stunting, for urban and rural areas and for all regions of the country. The poverty results are consistent with other work (Appleton, 2001b), even though this sample is of

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

children under five years old only. The stunting results, though, run counter to the consensus in Uganda (Uganda Bureau of Statistics, 2001), a point that I return to later. Note also that the correlation between the log of expenditures per capita and the height-for-age z-score, while variable across regions and areas, is reasonably stable across time for each region/area, except for Western region. Thus, we might expect that variable-by-variable poverty comparisons will produce results similar to bivariate comparisons.

Table 1 – Descriptive statistics for income poverty and stunting, 1992 and 1999

	Poverty[1/]		Stunting[2/]		N[3/]		corr(ln(y),HAZ)[4/]	
	1992	1999	1992	1999	1992	1999	1992	1999
National	0.56	0.35	0.38	0.29	6,816	7,481	0.06	0.10
Rural	0.60	0.30	0.40	0.37	4,666	6,268	0.01	0.06
Urban	0.28	0.19	0.27	0.10	2,150	1,213	0.19	0.12
Central	0.45	0.19	0.35	0.25	2,011	1,806	0.08	0.07
Eastern	0.58	0.38	0.40	0.28	1,647	2,349	0.08	0.09
Western	0.54	0.28	0.40	0.34	1,762	2,096	-0.01	0.12
Northern	0.72	0.60	0.39	0.30	1,396	1,230	0.09	0.09

Sources: 1992 IHS and 1999 NHS

Notes: 1/ Poverty is the headcount, or the share of the sample below the poverty line. I chose the poverty line such that the national headcount is equal to Appleton's for each survey.
2/ Stunting is the share of the sample below –2 z-scores.
3/ N is the sample size.
4/ The correlation is between the log of expenditures per capita and the height-for-age z-score.

Table 2 gives the dominance test results for poverty comparisons between the 1992/93 IHS and the 1999/2000 NHS. The table shows the domain for the dominance surfaces, similar to Figure 4. Each cell contains the t-statistic for the difference in the 1999 and 1992 surfaces at that point in the test domain. This is highlighted yellow (lighter in black and white) if the t-statistics is significantly negative – i.e. if the 1999 surface is below the 1992 surface – and green (darker in black and white) if the difference is significantly positive. Testing for differences at each point in the domain would be extremely time consuming, so we test only at each decile of the combined samples in each dimension, yielding the 10x10 table shown.[10]

Over almost the entire test domain, the 1999 surface is significantly below the 1992 surface, indicating that poverty was lower in 1999 than in 1992 using any union or intersection poverty measure in $\Pi^{1,1}$, and for any poverty line up to s/9700 per capita per month (in 1989 shillings) in the expenditure dimension and –0.54 z-scores in the height dimension. Since both of these values

[10] Given that cdf's are smoothly increasing functions, testing at only a few points should not have much effect on the results. It is unlikely that the surfaces would cross and cross again between two test points.

are quite high (the 90th and 70th percentiles, respectively), we have a very strong conclusion that bivariate poverty declined in Uganda during this period.

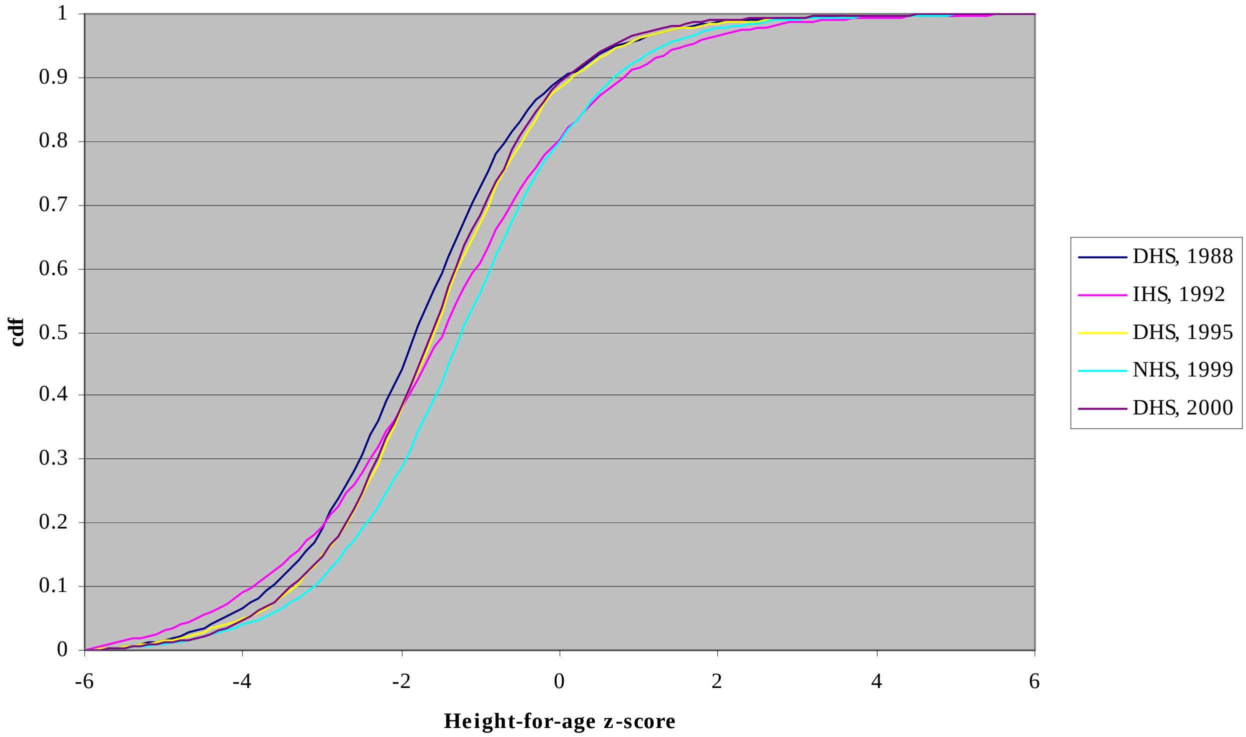
Table 2 – $\Pi^{1,1}$ dominance test results for 1992 IHS and 1999 NHS

	11.66	-13.16	-12.67	-11.50	-9.09	-7.65	-5.56	-3.31	-0.73	2.20	0.28
	9.18	-13.35	-13.12	-12.51	-10.74	-9.83	-8.48	-7.43	-6.19	-6.25	-11.42
	8.90	-13.00	-13.50	-13.23	-12.01	-11.50	-10.93	-10.48	-9.78	-10.63	-14.89
	8.72	-13.02	-13.83	-13.42	-12.36	-12.09	-12.28	-12.01	-11.95	-13.02	-16.63
	8.56	-13.76	-14.70	-14.64	-14.08	-14.15	-14.45	-14.29	-14.80	-15.98	-19.73
ln(y)	8.42	-13.33	-15.10	-15.40	-15.22	-15.66	-16.10	-16.18	-16.64	-17.80	-20.83
	8.27	-13.23	-15.59	-15.74	-15.87	-16.53	-17.18	-17.50	-18.49	-19.93	-22.61
	8.11	-12.71	-14.59	-15.53	-16.55	-17.25	-17.87	-18.34	-19.29	-21.06	-23.54
	7.91	-11.55	-14.32	-15.27	-16.34	-16.83	-17.40	-17.80	-18.77	-20.23	-21.71
	7.63	-9.14	-11.49	-12.01	-13.27	-13.74	-14.50	-14.96	-16.03	-17.07	-18.44
	0.00	-3.49	-2.68	-2.14	-1.72	-1.33	-0.95	-0.54	-0.02	0.72	5.99
						haz					

Further, Table A. 1 through Table A. 6 in Appendix 2 show essentially the same pattern for all regions in the country, and for urban and rural areas. Overall, then, we have very strong evidence that multivariate poverty measured in terms of expenditures per capita and children's heights declined between 1992 and 1999, in the country as a whole, in each region, and in rural and urban areas. Further, this conclusion does not depend on the poverty lines that we choose in each dimension (up to certainly reasonable limits), nor does it depend on the poverty measure that we choose, as long as it is in the class $\Pi^{1,1}$.

Given Appleton's (2001b) previous work, no one should be surprised about these results in the expenditures dimension, but what of the concern that children's health status has not been improving? The answer here appears to depend on differences in the data found in the NHS on the one hand, and the DHS surveys on the other. Consider Figure 5, which shows the cumulative density functions for height-for-age z-scores for the IHS, NHS, and all three DHS surveys in Uganda. Note that the curves for the 1995 and 2000 DHS surveys are quite close together, so that we cannot see any improvement in the distribution of children's heights in these two samples. These data (and similar data on infant mortality) are the source of the concern about lack of improvement children's health status in Uganda. Yet the cdf for the 1999 NHS is significantly below the DHS data. It seems implausible that children's heights would have improved significantly from 1995 to 1999 and then regressed from 1999 to 2000, especially since sampling for the 2000 DHS survey began only two months after the NHS finished.

Figure 5 – Cumulative density functions for height-for-age z-scores, all Uganda surveys



While we are unlikely to be able to resolve the disparity between the 1999 NHS and the 2000 DHS data for children's heights, recognizing this difference requires, at least, that we consider poverty comparisons with the DHS data as well as the household expenditure surveys.

3.2. Comparing Living Standards in the DHS Surveys

Table 3 gives descriptive statistics for poverty rates, based the household asset index, and children's stunting rates for the three DHS surveys in Uganda. All areas/regions of the country show declines in poverty as determined by household assets, a result that is comparable to the household expenditure results from the IHS/NHS data. In fact, these declines, and even the levels of poverty, are similar to poverty rates as determined by household expenditures per capita (Table 1). This supports the use of the asset index as a proxy for more standard measures of well-being.

Table 3 - Descriptive statistics for income poverty and stunting, 1988, 1995, and 2000 DHS surveys

	Poverty[1/]			Stunting[2/]			N[3/]			corr(asi,haz)[4/]		
	1988	1995	2000	1988	1995	2000	1988	1995	2000	1988	1995	2000
National	0.63	0.47	0.35	0.44	0.39	0.39	3,701	4,503	4,939	0.16	0.15	0.18
Rural	0.69	0.52	0.38	0.46	0.41	0.40	3,098	3,249	3,868	0.10	0.07	0.14
Urban	0.08	0.07	0.04	0.26	0.23	0.26	603	1,254	1,071	0.21	0.20	0.24
Central	0.41	0.24	0.19	0.33	0.34	0.35	1,378	1,306	1,377	0.12	0.19	0.26
Eastern	0.65	0.46	0.33	0.45	0.36	0.36	676	1,294	1,350	0.05	0.08	0.12
Western	0.75	0.55	0.39	0.53	0.43	0.48	1,520	1,196	1,437	0.14	0.04	0.07
Northern	0.93	0.65	0.56	0.45	0.42	0.37	127	707	775	0.07	0.05	0.12

Sources: 1988, 1995, and 2000 DHS surveys

Notes: 1/ Poverty is the headcount, or the share of the sample below the poverty line, based on an index of household assets. I chose the poverty line such that the national headcount is equal to Appleton's for the 2000 survey.

2/ Stunting is the share of the sample below –2 z-scores.

3/ N is the sample size.

4/ The correlation is between the household asset index and the height-for-age z-score.

5/ The 1988 DHS collected no data in urban areas in the Northern region.

The stunting data, however, are at odds with the IHS/NHS data. Here, we find only modest declines in stunting rates over time, most between 1988 and 1995. In fact, in urban areas, the stunting rate rises from 1995 to 2000, back to its 1988 level, so the national improvement over the entire period is due only to reductions in rural areas. In addition, the only region with steady improvement in children's heights is Northern region. Western region actually has a significant increase in stunting from 1995 to 2000.

3.2.1. Dominance Tests for the 1995 and 2000 DHS Data

Table 4 gives the dominance test results for all of Uganda comparing the 1995 and 2000 DHS data. Here, there is no dominance for any union or intersection poverty measure. If we examine the top and right edges of the test domain, we see that there is clear univariate dominance for the asset index (the right edge), i.e. poverty measured by assets declined significantly over the period. However, there is no statistically significant improvement in the dimension of children's heights (the top edge), though it is true that the 2000 surface is below that for 1995. Results for $\Pi^{2,2}$ are somewhat more positive, yielding dominance for intersection poverty lines up to the sixth decile for the asset index and for all poverty lines in the HAZ dimension, but this is still far less general than the IHS/NHS results (Table 1). Higher order tests, up to $\Pi^{1,3}$ and $\Pi^{3,3}$, yield results that are qualitatively similar to those in Table 4. Thus, we cannot make a robust conclusion that bivariate poverty declined between these two sample periods.

Table 4 – $\Pi^{1,1}$ dominance test results for 1995 and 2000 DHS

	4.89	-0.52	-0.43	-0.38	-0.33	-0.29	-0.26	-0.24	-0.21	-0.20	-0.41
	0.63	-0.63	-0.73	-0.81	-0.88	-0.99	-1.09	-1.23	-1.37	-1.57	-2.64
	0.07	-0.78	-1.01	-1.18	-1.34	-1.53	-1.72	-1.95	-2.19	-2.52	-4.07
	-0.12	-0.85	-1.15	-1.37	-1.57	-1.80	-2.02	-2.29	-2.56	-2.93	-4.63
	-0.22	-0.87	-1.22	-1.46	-1.68	-1.93	-2.16	-2.44	-2.72	-3.10	-4.82
asset index	-0.30	-0.88	-1.24	-1.50	-1.73	-1.99	-2.22	-2.50	-2.78	-3.15	-4.82
	-0.37	-0.87	-1.24	-1.51	-1.74	-1.99	-2.22	-2.49	-2.76	-3.12	-4.68
	-0.43	-0.83	-1.20	-1.46	-1.69	-1.94	-2.15	-2.40	-2.65	-2.97	-4.36
	-0.51	-0.76	-1.10	-1.33	-1.53	-1.74	-1.93	-2.14	-2.35	-2.62	-3.77
	-0.60	-0.55	-0.81	-0.99	-1.14	-1.30	-1.45	-1.62	-1.78	-2.00	-2.95
	0.00	-3.37	-2.69	-2.29	-1.95	-1.61	-1.30	-0.92	-0.51	0.10	5.71
						haz					

The results by region and area are surprising (Table A. 7 through Table A. 12). All regions except Central region show patterns that are similar to the national results in Table 4: there is clear univariate dominance in the asset dimension, but much more mixed results for heights. For Central region, the one that most analysts believe to have prospered most in recent years, there is not even dominance in the asset dimension, and the 2000 surface is actually above the 1995 surface over most of the test domain. At $\Pi^{2,2}$, Eastern region has lower bivariate poverty for all union and intersection poverty indices, and Northern region misses the same conclusion only at the lowest HAZ ordinate. Western region shows dominance for a broad range of intersection poverty measures, but not union measures. Central has mostly insignificant differences in bivariate poverty measures.

In sum, bivariate poverty comparisons of the 1995 and 2000 DHS data are rather inconclusive, the only exceptions being Eastern and perhaps Northern region, which show reductions in bivariate poverty for the $\Pi^{2,2}$ class, and rural areas, which show improvements for intersection poverty measures only for $\Pi^{2,2}$. The inability to find clear dominance results is due entirely to lack of progress in the dimension of children's heights, as univariate asset poverty does decline significantly over this period.

3.2.2. Dominance Tests for the 1988 and 2000 DHS Data

One limitation of the comparison between the IHS/NHS and DHS results is that the surveys did not take place at exactly the same time. It is possible, for example, that all the improvement we see between 1992 and 1999 in the IHS/NHS data occurred before 1995, although the large differences in children's heights between the 1999 NHS and the 2000 DHS argues against this. Nevertheless, this section extends the DHS analysis by comparing bivariate poverty in the 1988 and 2000 DHS surveys. Note that many more districts were not covered in the 1988 DHS for security reasons. I limit this analysis to districts that were covered in both 1988 and 2000, so the 2000 data are not the same as those in the previous section, which included all districts covered in the 2000 DHS.

Table 5 - $\Pi^{1,1}$ dominance test results for 1988 and 2000 DHS

	4.89	-4.43	-6.32	-5.75	-5.08	-5.48	-4.15	-4.07	-2.76	-0.02	1.19
	0.58	-4.55	-6.50	-6.24	-5.92	-6.60	-5.44	-5.62	-5.03	-4.24	-6.35
	0.03	-4.56	-6.96	-7.31	-7.20	-7.89	-7.20	-7.56	-6.81	-6.84	-8.60
	-0.16	-5.47	-8.65	-9.54	-10.76	-12.09	-12.24	-13.45	-13.62	-14.78	-17.33
	-0.26	-6.67	-9.96	-11.48	-12.76	-14.49	-15.22	-16.97	-17.67	-19.43	-22.38
asset index	-0.34	-7.68	-11.14	-13.07	-14.77	-16.93	-18.14	-20.23	-21.21	-23.35	-26.23
	-0.41	-7.96	-12.06	-13.61	-15.22	-17.91	-19.47	-21.54	-22.70	-24.56	-26.91
	-0.48	-8.84	-13.25	-15.53	-17.52	-20.30	-21.71	-23.86	-25.39	-27.13	-29.40
	-0.55	-9.21	-13.17	-15.07	-16.87	-19.13	-19.89	-21.67	-23.00	-24.12	-26.02
	-0.63	-7.81	-10.64	-12.31	-13.73	-14.77	-15.41	-16.77	-17.24	-17.80	-19.20
	0.00	-3.49	-2.82	-2.41	-2.04	-1.71	-1.38	-1.01	-0.59	0.03	5.76
						haz					

Here, there is unambiguously less bivariate poverty in 2000 than in 1988, for all union and intersection poverty measures and all reasonable poverty lines. When examining individual regions and areas (Table A. 13 through Table A. 18), the same is true for rural areas and Eastern, Western, and Northern regions. Central region does not show univariate dominance in the height dimension and so does not show bivariate dominance for union poverty measures. But it does have dominance for intersection poverty indices over poverty lines up to the fourth decile in the asset dimension. Further, for $\Pi^{2,2}$, Central region also shows unambiguous reductions in bivariate poverty for all reasonable intersection poverty measures and for union measures up to the third decile. For urban areas, there is no dominance result for $\Pi^{1,1}$ measures, even if we consider only univariate measures. But again, second-order tests finds dominance for all union and intersection poverty measures in $\Pi^{2,2}$. Overall, then, it is clear that poverty as measured by household assets and children's heights does fall unambiguously between 1988 and 2000, for the areas of the country covered in the 1988 DHS survey. As always, this is true for broad classes of poverty measures and for any reasonable poverty lines.

3.3. A Trivariate Dominance Test

Generalizing poverty comparisons from one to two measures of well-being is a desirable advance, but there are clearly more dimensions to poverty than income and children's health status. Testing for multivariate dominance quickly runs into two practical problems, however. First, large household surveys like the DHS typically interview a few thousand children under the age of five, the standard cut-off for anthropometric data. Bivariate comparisons such as those in the previous sections that test at every decile have 100 test points or cells, with an average number of observations in the 10s. A trivariate comparison would have 1000 test points, with only a few observations per test point on average, which is likely to produce very large standard errors at some test points, especially the critical ones at the poorest area of the distribution. The only alternative would be to reduce the number of test points to, say, every quintile, but that risks missing crossings such as those in Table A. 14.

Second, even multipurpose surveys like the IHS or NHS often do not have data on good welfare indicators in multiple dimensions of interest. If we think of income, health, and education as three key dimensions of well-being, then we have the problem that the best health indicator typically found in such surveys, children's anthropometrics, are only collected for children under five years-old. Those children obviously have no relevant education data. On the other hand, the health data collected for adults are typically self-reported and subject to considerable bias (Kroeger, 1985; Hill and Mamdani, 1989). In particular, households with higher incomes and better levels of education tend to report being sick more often, a result that is surely not due to lower living standards in any objective sense, but rather to differing senses of what it means to be sick (Over, et.al., 1992; Schultz and Tansel, 1997).

There is, however, one feasible option for a trivariate poverty comparison in the data that I use here. The DHS surveys include questions about the literacy of the mother of each child surveyed.[11] This is a good welfare variable for three reasons. First, it captures a distinct and important dimension of well-being, namely, education. Second, a child whose mother is literate benefits directly from that literacy in many ways. And third, a child whose mother is literate will probably be literate herself when she is grown. Thus, much as current height predicts future well-being (Strauss and Thomas, 1995), mother's literacy predicts future well-being in another dimension.

Literacy is also helpful for the sparse data problem because it is a discrete variable, taking only two values. This means that there are only two test points rather than ten in this third dimension: illiterate and literate. Duclos and Makdissi (1999) and Duclos, Sahn, and Younger (2003) discuss how to carry out dominance tests when one or more of the measures of well-being is discrete. The basic procedure is to first test for dominance in the non-discrete dimensions of well-being

[11] The IHS and NHS also collect literacy information, but they do not ask which person in the household is the mother of the children who are weighed and measured.

for the poorest discrete category – illiterate mother's in this case – and then test for dominance for the non-discrete dimensions for the poorest plus the second poorest discrete categories – illiterate plus literate mothers. If there are more than two categories the tests continue cumulatively for each progressively higher category until all are included. If we find that one sample has lower poverty in the continuous dimensions of well-being for each of these tests, then it also has lower poverty in all three dimensions, including the discrete one.

3.3.1. Trivariate Dominance Tests for the 1988 and 2000 DHS Surveys

The three measures of well-being that I consider are household assets, children's standardized heights, and mother's literacy. Since only the last variable is discrete, and because it has only two categories, illiterate and literate, we must first test for bivariate dominance for assets and heights for illiterate mothers only, and then test for bivariate dominance for assets and heights for illiterate and literate mothers, i.e., the entire sample. This second test, of course, is just what was reported in the previous section, where we found clear evidence that bivariate poverty had declined between 1988 and 2000. So here, we need only repeat the bivariate test for illiterate mothers to complete the trivariate comparison.

Table 6 gives the bivariate (assets, heights) dominance tests for children of illiterate mothers only in the 1988 and 2000 DHS data, for the entire country. As with the tests for all mothers (Table 5), there is clear dominance for both union and intersection poverty measures in $\Pi^{1,1}$ and for all reasonable poverty lines. Thus, we can conclude that trivariate poverty measured in the dimensions of assets, children's heights, and the mother's literacy, unambiguously declined between 1988 and 2000.

Table 6 - $\Pi^{1,1}$ dominance test results for 1988 and 2000 DHS, illiterate mothers only

	4.89	-3.63	-4.67	-3.86	-3.14	-3.29	-2.23	-2.20	-1.44	-1.24	-1.75
	0.58	-3.61	-4.71	-3.94	-3.29	-3.57	-2.64	-2.85	-2.19	-2.16	-2.69
	0.03	-3.53	-4.90	-4.43	-3.95	-4.18	-3.52	-3.70	-2.99	-3.17	-3.78
	-0.16	-3.92	-5.57	-5.22	-5.28	-5.63	-5.20	-5.48	-5.00	-5.34	-5.90
	-0.26	-4.47	-6.21	-6.35	-6.53	-7.11	-7.06	-7.65	-7.47	-8.11	-9.08
asset index	-0.34	-5.36	-7.49	-8.12	-8.69	-9.66	-9.92	-10.76	-10.99	-11.81	-13.07
	-0.41	-6.00	-8.75	-9.43	-10.16	-11.67	-12.28	-13.29	-13.77	-14.65	-15.85
	-0.48	-6.87	-10.02	-11.44	-12.50	-14.28	-15.01	-16.27	-17.12	-18.05	-19.39
	-0.55	-7.08	-10.05	-11.35	-12.52	-14.10	-14.49	-15.63	-16.40	-17.13	-18.35
	-0.63	-6.14	-8.23	-9.45	-10.47	-11.31	-11.72	-12.66	-12.97	-13.37	-14.43
	0.00	-3.49	-2.82	-2.41	-2.04	-1.71	-1.38	-1.01	-0.59	0.03	5.76
						haz					

Similar test for regions and areas show similar results for all regions in the country, including Northern region, and for rural areas. For urban areas, however, the same is not true. Table 7 shows the comparable bivariate test for urban areas for illiterate mothers only. Here, the 1988 surface is never significantly above the 2000 surface, and it is actually below the 2000 surface at higher values of assets and heights. This is at odds with the results for the entire sample (Table

6), so we do not have trivariate welfare dominance between 1988 and 2000 for urban areas. The reason for this result is that literacy rates of mothers fell substantially between 1988 and 2000 in urban areas, from 80 percent to 70 percent. The significantly larger share of illiterate mothers in 2000 means that the cumulative density is larger for that group – we are adding up 10 percent more observations – which pushes its cumulative density surface higher for this sub-group even though the surface for all mothers is significantly lower (Table 5). This decline in literacy is most likely due to the significant civil strife that Uganda suffered at the time that present day mothers should have been studying.

Table 7 - $\Pi^{1,1}$ dominance test results for 1988 and 2000 DHS, illiterate mothers only, urban areas

	4.89	0.03	0.35	1.11	0.95	1.90	2.64	2.96	3.79	4.23	4.38
	3.46	0.03	0.17	0.95	1.05	2.00	2.74	3.00	3.71	4.16	4.31
	2.76	0.16	0.26	1.17	1.11	1.65	2.41	2.64	3.34	3.80	3.83
	2.19	0.42	0.45	1.14	1.02	1.13	1.89	2.10	2.73	3.22	3.15
	1.70	0.59	0.57	1.31	1.04	1.10	1.90	2.09	2.81	3.27	3.14
asset index	1.16	0.77	1.21	1.73	1.49	1.44	2.17	2.55	3.10	3.59	3.43
	0.86	1.54	1.79	2.18	1.96	1.76	2.13	2.30	2.71	3.20	3.17
	0.50	0.81	0.99	1.74	1.62	1.18	1.39	1.57	1.94	2.67	2.87
	0.24	0.31	-0.41	0.18	0.04	-0.23	-0.14	0.05	0.15	0.92	0.69
	-0.21	-0.36	-0.74	-0.67	-0.64	-1.12	-1.13	-1.10	-1.18	-0.72	-1.05
	0.00	-2.82	-2.31	-1.86	-1.54	-1.22	-0.90	-0.51	-0.08	0.55	5.06
						haz					

4. Conclusions

Even though there is wide agreement that poverty is a multidimensional concept, empirical definitions of poverty in developing countries almost always rely on household expenditures per capita or per adult equivalent. This incongruity between theory and practice is especially important in Uganda. More than a decade of economic growth has ensured that poverty as measured by expenditures alone declined significantly during the 1990s. Yet there is concern on the part of analysts, service providers, and policy makers that similar progress is not being achieved in other dimensions of well-being, especially with respect to children's health. This paper tackles these issues by making poverty comparisons across time in multiple dimensions, using a method due to Duclos, Sahn, and Younger (2003). The method is quite general, providing poverty comparisons that are robust to the choice of poverty line and poverty measure.

Data from the 1992 IHS and the 1999 NHS give very clear results. Poverty defined in the dimensions of household expenditures per capita and children's height-for-age z-score, a good overall measure of children's health, declined significantly, regardless of the poverty line and measure that one might choose. Further, this is true for all regions and rural and urban areas in the country. Given Appleton's (2001b) previous work, no one should be surprised about these results in the expenditures dimension, but what of the concern that children's health status has not been improving? The answer is found in the fact that all analysis to date of children's nutritional status and mortality has relied on DHS data, which are noticeably different from the IHS/NHS data. This contrast between the 1999 NHS survey and the 2000 DHS survey is particularly striking given that these two surveys occurred within months of one another.

Comparisons of the 1995 and 2000 DHS surveys give a more mixed picture. Using an index of household assets devised by Sahn and Stifel (2000), national results do not find any significant improvement (or worsening) of poverty measures defined in the dimensions of assets and height-for-age z-scores. Individual regions and areas, however, do show improvement. Eastern and Northern region have reductions in bivariate poverty for the $\Pi^{2,2}$ class, and rural areas have improvements for intersection poverty measures only for $\Pi^{2,2}$. Overall, the inability to find clear dominance results is due entirely to lack of progress in the dimension of children's heights, as univariate asset poverty does decline significantly over this period.

Comparisons of the 1988 and 2000 DHS surveys are more in line with the IHS/NHS comparisons. There is unambiguously less bivariate poverty in 2000 than in 1988, for all union and intersection poverty measures and all reasonable poverty lines. When examining individual regions and areas, the same is true for rural areas and all regions of the country, though the results for Central region and for urban areas are only valid for the $\Pi^{2,2}$ class of poverty measures.

Extending the poverty comparison for the 1988 and 2000 DHS to a third dimension, mother's literacy, provides broadly similar results, suggesting that multidimensional methods may be useful beyond bivariate poverty measures, even though data are not often sufficient to support such tests. The one key difference for these three-dimensional comparisons is for urban areas, where we do not find a significant reduction in poverty as measured by assets, height-for-age z-scores, and mother's literacy between 1988 and 2000. This is due to the fact that mother's literacy actually fell in urban areas (but not in the entire country) during this period, from 80 to 70 percent. This decline in literacy is most likely due to the significant civil strife that Uganda suffered at the time that present day mothers should have been studying.

Overall, the data support the argument that multidimensional poverty fell significantly in Uganda during the 1990s, a conclusion that should ease concern about improvements in non-income dimensions of well-being. However, the results for the latter half of the decade are more ambiguous, depending on the significant differences in data on children's health status found in the 1999 NHS and the 2000 DHS. Resolving the very different results in these two surveys is an important task for future research on well-being and poverty in Uganda.

Appendix 1 – Constructing an Asset Index

The asset index is a linear combination of the household assets recorded in the DHS survey, i.e.

$$A_i = \sum_k \alpha_k a_{ik}$$

where A_i is the asset index for household i, the a_{ik}'s are the k individual assets recorded in the survey, and the α_k's are the weights. One logical approach to the weights would be to use the relative price of each asset, but such data are not available in the DHS, and some assets such education levels are difficult to price in any event. Another option is to use arbitrary weights as in Montgomery, Burk, and Paredes (2000), but that seems unattractive. Hammer (1998) and Filmer and Pritchett (1998) use the standardized first principal component of the variance-covariance matrix of the observed household assets as weights, allowing the data to determine the relative importance of each asset, based on its correlation with the other assets.

In this paper, however, I use factor analysis, a technique that is similar to principal components but which has certain statistical advantages (Lawley & Maxwell, 1971; Sahn and Stifel, 2000). In particular, I assume that the one common factor that best explains the variance in the ownership of the set of assets is a measure of economic well-being or "welfare."

The assets that I include in the analysis are ownership of a radio, TV, refrigerator, bicycle, and motorized transportation (a motorcycle or a car); the household’s source of drinking water (piped or surface water relative to well water); the household’s toilet facilities (flush or no facilities relative to pit or latrine facilities); the household’s floor material (low quality relative to higher quality); and the years of education of the household head to account for household's stock of human capital. Since I want to compare the assets over the three surveys, I pool all three datasets to estimate the scoring coefficients (asset weights), which I then apply to each household in each sample to estimate its wealth index. Table 8 gives the weights used.

Table 8 - Weights for the asset index

Asset	Weight
Radio	0.11230
Television	0.23083
Refrigerator	0.14224
Bicycle	0.00334
Motorized Transport	0.08843
Piped Water	0.20729
Surface Water	-0.06355
Flush Toilet	0.11616
No Toilet	-0.06625
Primitive Flooring	-0.29871
Household Head’s Years of Education	0.14231

Appendix 2 – Region- and Area-specific Dominance Results

Table A. 1 – $\Pi^{1,1}$ dominance test results for 1992 IHS and 1999 NHS, rural areas

	11.16	-13.38	-13.11	-11.87	-9.91	-8.07	-5.99	-3.69	-1.10	1.11	1.56
	9.05	-13.78	-13.83	-13.30	-11.81	-10.37	-9.26	-8.05	-7.02	-7.61	-12.70
	8.81	-13.32	-14.48	-14.17	-13.03	-12.02	-11.58	-11.09	-10.63	-11.65	-15.71
	8.65	-13.59	-15.05	-15.41	-14.64	-14.19	-14.38	-14.64	-14.91	-16.38	-20.44
	8.50	-13.59	-14.92	-15.20	-14.88	-14.65	-15.15	-15.11	-15.68	-16.93	-20.70
haz	8.36	-13.83	-15.74	-17.21	-16.53	-16.36	-17.09	-17.20	-18.28	-19.83	-22.95
	8.22	-13.94	-16.18	-17.04	-17.29	-17.49	-18.23	-18.69	-19.92	-21.76	-24.59
	8.06	-12.84	-14.63	-15.91	-16.71	-17.37	-18.42	-18.54	-19.64	-21.61	-23.87
	7.87	-11.93	-14.71	-16.08	-17.18	-17.60	-18.50	-18.76	-20.13	-21.65	-22.71
	7.59	-9.74	-12.10	-12.68	-13.50	-13.98	-15.06	-15.40	-16.59	-17.71	-19.27
	0.00	-3.56	-2.74	-2.21	-1.79	-1.38	-0.99	-0.60	-0.10	0.67	5.99
						haz					

Table A. 2 – P1,1 dominance test results for 1992 IHS and 1999 NHS, urban areas

	11.66	-12.47	-15.59	-9.49	-9.95	-5.03	-5.45	-3.44	0.13	-0.90	0.54
	9.89	-14.45	-16.66	-12.36	-13.82	-11.35	-12.07	-10.03	-10.88	-14.03	-19.98
	9.51	-14.23	-16.70	-13.19	-14.91	-14.07	-15.09	-14.05	-14.83	-18.16	-23.54
	9.29	-12.08	-16.18	-13.77	-16.46	-15.15	-16.86	-16.13	-15.97	-18.57	-21.76
	9.13	-13.56	-14.89	-14.65	-15.82	-15.34	-18.55	-17.80	-18.09	-20.84	-23.69
haz	8.93	-14.15	-15.90	-16.13	-16.01	-15.09	-19.18	-19.42	-19.90	-21.78	-24.07
	8.79	-14.37	-16.41	-16.41	-18.33	-18.16	-20.96	-20.90	-23.31	-24.85	-26.07
	8.63	-11.30	-10.77	-12.03	-13.65	-16.40	-17.82	-18.78	-20.96	-22.50	-23.88
	8.39	-11.54	-13.15	-15.54	-17.59	-20.33	-21.13	-21.79	-23.85	-24.73	-25.95
	8.16	-7.79	-10.38	-13.11	-14.01	-15.34	-16.91	-18.12	-19.98	-19.67	-21.37
	0.00	-2.89	-2.15	-1.61	-1.29	-0.97	-0.54	-0.07	0.37	1.00	5.90
						haz					

Table A. 3 – P1,1 dominance test results for 1992 IHS and 1999 NHS, Central region

	11.66	-16.97	-15.25	-14.01	-11.17	-11.24	-7.72	-6.27	-5.58	-2.74	2.10
	9.39	-17.04	-16.13	-15.83	-13.09	-13.81	-11.93	-11.24	-11.68	-10.75	-12.17
	9.12	-16.24	-15.08	-15.31	-14.12	-14.40	-13.41	-14.38	-14.03	-13.63	-15.30
	8.90	-16.79	-15.83	-17.66	-17.53	-18.30	-18.18	-19.79	-20.33	-20.81	-22.91
	8.74	-16.64	-16.06	-18.03	-17.55	-19.01	-19.58	-21.40	-22.84	-23.19	-25.01
ln(y)	8.60	-17.19	-17.23	-19.28	-18.08	-20.43	-22.35	-23.38	-24.98	-25.37	-28.34
	8.45	-16.99	-18.65	-21.35	-20.89	-22.93	-23.95	-25.02	-26.64	-26.99	-29.79
	8.28	-17.39	-19.65	-22.37	-21.47	-23.19	-25.06	-26.09	-27.96	-28.22	-30.70
	8.08	-15.93	-17.55	-20.66	-21.46	-22.82	-23.99	-25.38	-27.43	-28.43	-31.34
	7.77	-12.93	-15.08	-17.75	-19.93	-20.25	-21.55	-21.97	-24.09	-25.06	-27.12
	0.00	-3.26	-2.54	-2.02	-1.57	-1.20	-0.84	-0.44	0.10	0.81	5.80
						haz					

Table A. 4 – P1,1 dominance test results for 1992 IHS and 1999 NHS, Eastern region

	11.19	-14.89	-14.50	-15.02	-12.37	-9.73	-6.15	-2.99	-0.02	2.04	-2.56
	9.06	-15.88	-15.50	-16.04	-14.06	-12.17	-9.69	-7.86	-6.07	-7.87	-14.49
	8.82	-15.10	-15.41	-15.75	-13.36	-11.87	-9.38	-7.46	-6.06	-7.23	-10.06
	8.64	-15.36	-16.02	-16.75	-15.00	-14.30	-12.44	-11.62	-11.05	-13.21	-16.34
	8.52	-15.98	-15.79	-17.09	-16.35	-15.88	-15.10	-13.57	-13.21	-14.95	-18.26
ln(y)	8.37	-15.95	-16.68	-18.96	-17.56	-17.61	-17.94	-16.63	-17.16	-18.50	-21.03
	8.24	-16.36	-17.83	-19.57	-19.58	-20.30	-20.50	-20.22	-20.85	-22.55	-25.16
	8.09	-15.14	-15.28	-17.94	-20.13	-20.58	-21.32	-21.60	-21.85	-23.24	-25.88
	7.89	-14.42	-15.69	-18.69	-21.12	-21.01	-21.75	-22.60	-23.06	-24.54	-26.13
	7.66	-11.55	-13.44	-16.49	-18.70	-19.06	-20.31	-21.63	-22.10	-22.97	-24.57
	0.00	-3.47	-2.68	-2.14	-1.72	-1.31	-0.93	-0.56	-0.10	0.61	5.92
						haz					

Table A. 5 – P1,1 dominance test results for 1992 IHS and 1999 NHS, Western region

	10.89	-10.51	-9.56	-7.89	-4.12	-2.98	0.26	0.57	1.79	3.83	-0.47
	9.16	-10.88	-10.48	-10.38	-7.57	-7.29	-5.27	-6.89	-8.02	-9.25	-19.46
	8.91	-10.14	-10.90	-11.47	-9.64	-10.35	-9.65	-12.08	-14.21	-16.86	-24.26
	8.75	-10.88	-11.82	-12.59	-11.42	-11.90	-11.70	-14.57	-17.13	-19.20	-25.44
	8.61	-12.37	-14.18	-14.70	-14.60	-15.39	-15.16	-18.42	-20.35	-22.49	-28.24
ln(y)	8.47	-11.55	-13.18	-13.71	-13.80	-15.34	-14.82	-17.58	-19.98	-21.64	-26.46
	8.33	-11.95	-13.43	-13.86	-13.69	-15.50	-15.78	-18.13	-20.64	-22.68	-26.58
	8.19	-10.77	-12.30	-13.04	-13.90	-15.60	-16.72	-18.68	-21.31	-24.45	-27.85
	8.02	-10.96	-12.66	-13.73	-14.87	-17.54	-18.69	-19.66	-22.26	-25.10	-27.85
	7.75	-9.74	-12.87	-14.02	-15.22	-17.74	-19.61	-21.28	-23.88	-25.97	-28.02
	0.00	-3.57	-2.80	-2.28	-1.87	-1.49	-1.10	-0.69	-0.17	0.59	5.73
						haz					

Table A. 6 – P1,1 dominance test results for 1992 IHS and 1999 NHS, Northern region

	11.17	-12.76	-12.30	-12.10	-9.68	-10.04	-10.57	-4.06	2.78	2.59	3.12
	8.82	-12.03	-12.23	-12.03	-9.42	-9.59	-9.61	-3.94	0.25	-1.59	-5.05
	8.60	-12.26	-12.95	-13.25	-10.65	-10.75	-10.88	-6.63	-3.53	-5.49	-9.71
	8.42	-12.48	-13.50	-14.11	-11.94	-11.77	-12.59	-9.10	-6.91	-9.19	-12.23
	8.25	-13.71	-15.75	-15.43	-12.56	-12.42	-13.49	-10.43	-9.40	-11.97	-14.25
ln(y)	8.10	-13.04	-17.48	-16.16	-13.01	-12.78	-14.54	-11.49	-10.66	-14.58	-16.17
	7.96	-12.28	-15.05	-14.22	-11.17	-10.25	-10.11	-7.15	-7.09	-9.79	-10.14
	7.82	-11.16	-13.45	-11.54	-10.20	-8.70	-8.65	-5.83	-5.53	-7.25	-6.50
	7.59	-11.22	-12.68	-9.34	-7.96	-6.93	-6.33	-4.87	-5.05	-7.10	-6.97
	7.36	-8.59	-8.81	-5.84	-6.20	-7.30	-6.78	-5.07	-4.36	-4.50	-4.09
	0.00	-3.74	-2.75	-2.19	-1.70	-1.36	-0.96	-0.50	0.02	0.85	5.54
						haz					

Table A. 7 – P1,1 dominance test results for 1995 and 2000 DHS, rural areas

	4.63	0.40	0.04	1.35	0.16	1.10	1.02	1.53	2.32	2.16	1.22
	0.19	0.29	-0.29	0.57	-0.99	-0.23	-0.46	-0.61	-0.72	-2.38	-6.16
	-0.08	-0.12	-0.75	-0.22	-2.41	-2.11	-2.88	-3.18	-3.45	-5.31	-9.16
	-0.19	-0.62	-1.31	-1.12	-3.80	-3.62	-4.60	-4.77	-5.37	-7.31	-10.39
	-0.27	-1.41	-2.53	-2.73	-5.41	-5.51	-6.59	-6.90	-7.44	-9.49	-12.35
asset index	-0.33	-1.45	-3.19	-3.56	-6.12	-6.51	-7.77	-8.02	-8.81	-10.94	-13.53
	-0.40	-2.49	-4.38	-3.66	-6.23	-6.98	-8.29	-8.67	-9.26	-10.97	-13.64
	-0.45	-2.86	-4.71	-4.96	-7.19	-7.68	-9.04	-9.48	-10.37	-12.00	-14.52
	-0.52	-4.53	-6.66	-6.93	-8.91	-9.15	-9.88	-10.23	-10.74	-11.96	-13.80
	-0.60	-3.90	-6.11	-6.03	-7.30	-6.98	-7.00	-7.24	-7.75	-8.89	-10.25
	0.00	-3.43	-2.74	-2.35	-2.01	-1.66	-1.36	-0.98	-0.57	0.01	5.30
						haz					

Table A. 8 – P1,1 dominance test results for 1995 and 2000 DHS, urban areas

	4.89	-0.27	6.03	5.34	2.43	2.92	1.87	-0.22	-0.12	2.10	0.43
	3.08	-1.06	4.80	3.31	-0.11	-0.20	-1.62	-4.02	-5.02	-6.38	-10.89
	2.50	-0.82	4.27	2.15	-2.01	-2.24	-3.91	-6.13	-7.25	-9.55	-13.21
	2.02	-0.45	5.16	3.25	0.23	-0.07	-1.02	-2.93	-2.81	-3.05	-4.79
	1.49	-0.12	3.85	2.63	-0.15	-0.73	-1.01	-1.77	-1.77	-2.29	-4.20
asset index	1.00	-1.37	2.49	-0.21	-2.51	-3.24	-4.01	-4.92	-5.85	-6.39	-7.96
	0.60	-2.49	0.48	-2.83	-4.59	-5.93	-7.24	-8.51	-9.58	-9.78	-11.24
	0.41	-3.23	-0.61	-3.69	-5.72	-7.43	-7.55	-8.58	-9.57	-8.77	-9.98
	0.11	-2.31	-1.27	-4.53	-6.23	-7.58	-7.03	-7.97	-8.23	-7.42	-8.50
	-0.21	-0.20	1.54	-1.67	-3.27	-4.50	-3.85	-4.56	-5.01	-3.86	-3.97
	0.00	-2.74	-2.21	-1.78	-1.45	-1.09	-0.82	-0.48	-0.06	0.61	5.71
						haz					

Table A. 9 – P1,1 dominance test results for 1995 and 2000 DHS, Central region

	4.87	0.08	0.43	0.55	0.59	0.56	0.52	0.46	0.36	0.19	-0.74
	2.09	0.32	0.59	0.65	0.61	0.53	0.43	0.32	0.18	-0.05	-1.02
	0.99	0.66	0.80	0.78	0.66	0.51	0.33	0.16	-0.06	-0.37	-1.49
	0.47	1.02	1.05	0.95	0.75	0.53	0.29	0.05	-0.23	-0.62	-1.90
	0.10	1.44	1.31	1.11	0.81	0.52	0.20	-0.11	-0.47	-0.92	-2.35
asset index	-0.11	1.81	1.58	1.30	0.95	0.60	0.24	-0.11	-0.50	-0.98	-2.39
	-0.19	2.01	1.75	1.45	1.07	0.70	0.32	-0.04	-0.44	-0.92	-2.27
	-0.28	2.12	1.87	1.57	1.18	0.79	0.40	0.04	-0.36	-0.83	-2.07
	-0.38	1.95	1.74	1.46	1.07	0.69	0.31	-0.04	-0.41	-0.83	-1.80
	-0.50	1.22	1.00	0.73	0.35	-0.01	-0.36	-0.65	-0.93	-1.22	-1.60
	0.00	-3.18	-2.55	-2.15	-1.79	-1.48	-1.16	-0.84	-0.44	0.19	5.71

Table A. 10 – P1,1 dominance test results for 1995 and 2000 DHS, Eastern region

	4.89	-0.79	-1.15	-1.35	-1.45	-1.49	-1.50	-1.49	-1.46	-1.39	-0.85
	0.33	-0.91	-1.44	-1.76	-2.04	-2.24	-2.42	-2.63	-2.83	-3.03	-3.83
	-0.03	-0.96	-1.51	-1.86	-2.17	-2.41	-2.62	-2.89	-3.14	-3.43	-4.67
	-0.16	-1.00	-1.56	-1.91	-2.22	-2.47	-2.68	-2.95	-3.20	-3.51	-4.87
	-0.24	-1.03	-1.60	-1.95	-2.26	-2.50	-2.70	-2.96	-3.20	-3.50	-4.88
asset index	-0.31	-1.08	-1.65	-2.00	-2.31	-2.54	-2.73	-2.97	-3.20	-3.48	-4.79
	-0.36	-1.09	-1.67	-2.02	-2.32	-2.54	-2.72	-2.95	-3.16	-3.42	-4.62
	-0.42	-1.10	-1.67	-2.02	-2.32	-2.53	-2.69	-2.90	-3.08	-3.31	-4.36
	-0.48	-1.10	-1.62	-1.94	-2.22	-2.41	-2.56	-2.73	-2.89	-3.09	-4.00
	-0.57	-1.14	-1.50	-1.74	-1.93	-2.06	-2.17	-2.30	-2.43	-2.60	-3.48
	0.00	-3.21	-2.59	-2.22	-1.86	-1.54	-1.24	-0.84	-0.42	0.14	5.42
							haz				

Table A. 11 – P1,1 dominance test results for 1995 and 2000 DHS, Western region

	4.30	-0.90	-0.50	-0.13	0.23	0.50	0.75	0.97	1.13	1.23	0.46
	0.16	-1.50	-1.30	-1.20	-1.10	-1.05	-1.06	-1.12	-1.26	-1.55	-3.73
	-0.09	-1.70	-1.58	-1.59	-1.60	-1.63	-1.71	-1.86	-2.06	-2.44	-4.75
	-0.19	-1.77	-1.69	-1.74	-1.80	-1.86	-1.98	-2.15	-2.37	-2.76	-5.01
	-0.27	-1.77	-1.71	-1.80	-1.89	-1.99	-2.12	-2.31	-2.53	-2.92	-5.03
asset index	-0.34	-1.70	-1.66	-1.77	-1.88	-1.99	-2.13	-2.31	-2.53	-2.90	-4.81
	-0.41	-1.60	-1.56	-1.68	-1.79	-1.90	-2.03	-2.20	-2.40	-2.72	-4.34
	-0.45	-1.51	-1.47	-1.57	-1.68	-1.78	-1.89	-2.03	-2.19	-2.45	-3.74
	-0.51	-1.39	-1.32	-1.40	-1.48	-1.54	-1.61	-1.70	-1.80	-1.97	-2.76
	-0.60	-1.12	-0.99	-1.04	-1.08	-1.07	-1.05	-1.01	-0.97	-0.94	-0.89
	0.00	-3.61	-2.98	-2.54	-2.16	-1.85	-1.51	-1.13	-0.72	-0.10	5.24
							haz				

Table A. 12 – P1,1 dominance test results for 1995 and 2000 DHS, Northern region

	4.27	-0.11	-0.59	-0.79	-0.93	-1.08	-1.20	-1.27	-1.26	-1.18	-0.75
	-0.08	-0.99	-1.71	-2.06	-2.35	-2.70	-3.03	-3.38	-3.67	-4.06	-5.59
	-0.22	-1.08	-1.86	-2.24	-2.56	-2.95	-3.32	-3.71	-4.05	-4.51	-6.35
	-0.32	-1.05	-1.87	-2.28	-2.61	-3.02	-3.40	-3.81	-4.17	-4.66	-6.65
	-0.39	-0.95	-1.79	-2.21	-2.55	-2.97	-3.35	-3.76	-4.13	-4.63	-6.66
asset index	-0.44	-0.81	-1.65	-2.06	-2.40	-2.81	-3.18	-3.57	-3.94	-4.43	-6.44
	-0.50	-0.64	-1.43	-1.81	-2.12	-2.50	-2.84	-3.21	-3.55	-4.01	-5.95
	-0.54	-0.49	-1.21	-1.56	-1.84	-2.18	-2.50	-2.85	-3.18	-3.62	-5.51
	-0.60	-0.24	-0.88	-1.18	-1.42	-1.74	-2.03	-2.35	-2.68	-3.12	-4.97
	-0.68	0.24	-0.45	-0.77	-1.04	-1.36	-1.66	-1.99	-2.33	-2.79	-4.57
	0.00	-3.57	-2.73	-2.33	-2.00	-1.64	-1.31	-0.93	-0.53	0.10	4.55
							haz				

Table A. 13 – P1,1 dominance test results for 1988 and 2000 DHS, rural areas

	3.31	-3.43	-5.03	-4.75	-4.32	-4.50	-2.96	-2.71	-2.34	0.24	-0.18
	0.20	-3.50	-5.47	-5.61	-5.95	-6.48	-5.37	-5.65	-6.11	-5.55	-9.40
	-0.09	-3.96	-6.95	-7.97	-8.70	-9.63	-9.56	-10.71	-12.03	-12.90	-17.14
	-0.21	-5.73	-8.91	-10.33	-11.81	-13.61	-14.27	-16.04	-18.31	-20.23	-24.44
	-0.30	-6.62	-10.51	-12.36	-14.31	-16.24	-17.26	-19.79	-21.97	-24.64	-28.90
asset index	-0.37	-7.99	-12.46	-14.38	-15.98	-18.63	-19.91	-23.00	-25.17	-27.94	-31.94
	-0.43	-8.42	-13.19	-15.20	-16.99	-19.85	-21.62	-24.79	-27.56	-30.17	-33.73
	-0.50	-8.57	-13.49	-15.60	-17.60	-20.07	-21.50	-24.12	-26.25	-28.43	-31.13
	-0.57	-9.22	-13.27	-15.83	-17.50	-19.67	-21.10	-23.18	-24.99	-26.48	-28.48
	-0.64	-8.01	-10.00	-12.43	-13.14	-14.26	-15.17	-16.26	-17.52	-18.07	-19.33
	0.00	-3.56	-2.91	-2.48	-2.13	-1.81	-1.45	-1.10	-0.68	-0.07	5.76
						haz					

Table A. 14 – P1,1 dominance test results for 1988 and 2000 DHS, urban areas

	4.89	-5.07	-1.21	0.82	-2.93	-1.96	-2.75	-2.67	-2.24	-1.23	0.17
	3.46	-5.18	-2.14	-0.24	-3.41	-2.64	-2.67	-2.03	-2.31	-0.06	2.57
	2.76	-5.59	-2.98	-1.51	-5.42	-5.73	-5.41	-4.37	-4.42	-2.85	-3.19
	2.19	-4.92	-2.47	-1.87	-5.46	-6.03	-4.84	-3.81	-3.47	-2.15	-2.65
	1.70	-2.55	-0.53	0.68	-2.10	-2.64	-1.73	-1.17	-0.95	0.21	-1.29
asset index	1.16	-0.96	1.51	1.61	-0.70	-0.56	1.70	2.88	3.02	4.16	3.33
	0.86	-0.85	1.06	0.38	-1.66	-2.77	-2.15	-1.90	-2.13	-1.32	-1.70
	0.50	-3.08	-1.44	-1.38	-2.90	-3.68	-3.16	-3.20	-3.15	-2.13	-1.96
	0.24	-2.10	-3.19	-2.17	-4.33	-5.80	-5.55	-5.18	-5.50	-3.92	-4.77
	-0.21	-2.54	-3.49	-3.81	-6.11	-7.11	-6.63	-6.67	-7.07	-6.49	-7.00
	0.00	-2.82	-2.31	-1.86	-1.54	-1.22	-0.90	-0.51	-0.08	0.55	5.06
						haz					

Table A. 15 – P1,1 dominance test results for 1988 and 2000 DHS, Central region

	4.86	0.74	-0.73	1.11	0.21	1.26	1.48	0.47	1.41	1.16	-2.85
	2.03	0.84	-0.74	0.47	-0.61	-0.05	-0.07	-1.49	-1.02	-2.74	-6.59
	0.85	0.28	-0.69	-0.40	-1.43	-0.74	-1.48	-3.19	-2.91	-5.43	-7.88
	0.39	-0.72	-2.36	-2.62	-4.15	-3.24	-4.22	-5.67	-5.58	-7.82	-10.27
	0.01	-0.40	-1.90	-2.52	-3.35	-2.85	-3.93	-5.36	-5.02	-7.03	-8.90
asset index	-0.14	-1.89	-4.42	-5.92	-7.76	-8.07	-9.92	-10.92	-10.92	-13.27	-15.15
	-0.25	-3.90	-7.00	-8.90	-10.53	-11.35	-13.12	-14.71	-15.21	-17.86	-20.46
	-0.35	-5.39	-8.79	-10.81	-12.36	-13.06	-15.21	-16.46	-17.20	-19.04	-21.37
	-0.45	-3.49	-7.68	-9.01	-10.41	-11.24	-12.74	-14.53	-15.71	-17.74	-19.90
	-0.57	-5.62	-9.05	-9.78	-12.28	-12.27	-13.66	-14.66	-15.74	-17.07	-18.33
	0.00	-3.22	-2.56	-2.16	-1.80	-1.47	-1.15	-0.83	-0.38	0.37	5.13
						haz					

Table A. 16 – P1,1 dominance test results for 1988 and 2000 DHS, Eastern region

	4.89	-7.59	-9.46	-8.41	-9.28	-7.41	-6.31	-6.83	-5.08	-0.16	0.44
	0.29	-7.09	-9.39	-8.94	-10.07	-8.18	-6.73	-7.26	-6.64	-5.41	-8.11
	-0.06	-7.74	-11.23	-11.05	-12.63	-11.19	-10.28	-11.33	-11.38	-11.44	-14.44
	-0.21	-9.49	-12.26	-13.26	-16.28	-15.51	-15.64	-17.55	-18.70	-19.94	-23.71
	-0.28	-9.14	-12.81	-13.75	-16.05	-15.98	-16.68	-18.89	-20.06	-22.40	-26.03
asset index	-0.34	-10.37	-13.65	-14.88	-17.51	-18.11	-20.00	-22.32	-23.91	-26.92	-30.36
	-0.41	-11.34	-14.82	-16.69	-19.01	-20.93	-22.83	-25.42	-27.06	-29.77	-32.43
	-0.47	-10.55	-13.09	-15.21	-17.60	-20.45	-23.08	-25.21	-27.40	-29.68	-31.93
	-0.54	-10.58	-13.09	-14.94	-17.92	-18.84	-20.74	-22.43	-24.13	-25.50	-27.16
	-0.61	-9.10	-10.98	-11.53	-13.17	-13.71	-14.44	-15.30	-16.02	-16.80	-18.27
	0.00	-3.32	-2.68	-2.32	-1.98	-1.64	-1.30	-0.92	-0.52	0.05	5.03
						haz					

Table A. 17 – P1,1 dominance test results for 1988 and 2000 DHS, Western region

	4.29	-3.01	-4.02	-4.87	-4.71	-4.81	-5.16	-4.55	-5.21	-6.05	-0.05
	0.07	-3.66	-5.04	-6.21	-6.98	-8.22	-8.75	-9.54	-11.47	-14.24	-14.81
	-0.15	-4.69	-6.85	-8.97	-9.92	-11.71	-13.14	-15.63	-18.64	-23.00	-25.66
	-0.26	-6.66	-9.49	-12.42	-13.77	-15.77	-18.39	-21.23	-24.84	-29.66	-32.26
	-0.34	-7.08	-11.69	-14.27	-15.98	-18.45	-21.38	-25.00	-28.16	-32.94	-35.71
asset index	-0.41	-7.94	-13.07	-16.25	-17.48	-19.78	-23.21	-26.75	-29.80	-34.96	-36.92
	-0.47	-9.61	-14.83	-18.42	-20.36	-23.16	-26.62	-30.71	-33.89	-38.95	-41.10
	-0.54	-11.19	-15.59	-19.39	-20.69	-22.67	-26.28	-29.19	-31.66	-35.31	-37.71
	-0.60	-10.40	-15.32	-18.33	-20.72	-23.49	-26.08	-28.56	-30.12	-32.58	-33.87
	-0.68	-8.52	-11.57	-13.27	-14.67	-16.48	-17.24	-18.27	-19.26	-20.43	-20.91
	0.00	-3.77	-3.12	-2.72	-2.37	-2.03	-1.70	-1.34	-0.93	-0.34	5.08
						haz					

Table A. 18 – P1,1 dominance test results for 1988 and 2000 DHS, Northern region

	4.27	-4.93	-12.26	-9.68	-6.68	-7.78	-3.64	-0.54	4.79	9.09	7.16
	-0.05	-5.69	-13.17	-10.87	-8.07	-10.14	-6.99	-4.66	-2.04	-0.92	-10.29
	-0.23	-6.57	-14.43	-12.94	-11.45	-15.12	-13.13	-11.91	-10.58	-11.57	-23.74
	-0.31	-7.70	-15.54	-15.11	-14.84	-19.32	-18.64	-18.67	-18.16	-20.90	-33.96
	-0.38	-8.44	-16.29	-15.86	-16.50	-22.29	-22.39	-24.02	-23.82	-26.35	-36.86
asset index	-0.44	-7.64	-15.98	-17.25	-18.98	-24.09	-24.80	-27.48	-28.52	-31.63	-42.74
	-0.49	-7.34	-18.27	-20.69	-23.08	-27.52	-26.28	-29.69	-29.68	-32.21	-41.85
	-0.54	-6.50	-15.11	-18.19	-19.43	-22.74	-21.76	-24.22	-23.41	-23.70	-31.61
	-0.59	-6.52	-10.84	-13.55	-12.91	-16.06	-14.66	-17.24	-17.49	-18.57	-24.09
	-0.68	-10.58	-13.11	-10.97	-12.07	-14.77	-14.26	-14.88	-16.11	-16.40	-22.51
	0.00	-3.57	-2.79	-2.36	-1.97	-1.64	-1.33	-1.01	-0.56	0.05	5.36
						haz					

Table A. 19 – P1,1 dominance test results for 1988 and 2000 DHS, illiterate mother's only, rural areas

	3.31	-3.17	-4.80	-4.02	-3.39	-3.68	-2.63	-2.73	-2.92	-2.87	-3.72
	0.20	-3.10	-5.11	-4.54	-4.18	-4.52	-3.70	-3.87	-4.20	-4.23	-5.31
	-0.09	-3.32	-5.55	-5.18	-5.08	-5.31	-4.83	-5.09	-5.36	-5.48	-6.52
	-0.21	-3.95	-6.07	-5.76	-6.09	-6.61	-6.32	-6.88	-7.51	-7.95	-9.03
	-0.30	-4.76	-7.27	-7.61	-8.30	-8.96	-8.98	-10.04	-10.74	-11.53	-13.08
asset index	-0.37	-5.82	-8.85	-9.59	-10.31	-11.64	-12.06	-13.42	-14.36	-15.56	-17.38
	-0.43	-6.54	-10.07	-11.12	-11.96	-13.60	-14.38	-16.02	-17.54	-18.84	-20.72
	-0.50	-7.02	-10.72	-12.09	-13.28	-14.94	-15.74	-17.32	-18.64	-20.03	-21.68
	-0.57	-7.38	-10.62	-12.47	-13.65	-15.14	-16.16	-17.52	-18.75	-19.75	-21.07
	-0.64	-6.49	-8.02	-9.82	-10.29	-11.24	-11.92	-12.58	-13.60	-14.02	-15.02
	0.00	-3.56	-2.91	-2.48	-2.13	-1.81	-1.45	-1.10	-0.68	-0.07	5.76
						haz					

Table A. 20 – P1,1 dominance test results for 1988 and 2000 DHS, illiterate mother's only, urban areas

	4.89	0.03	0.35	1.11	0.95	1.90	2.64	2.96	3.79	4.23	4.38
	3.46	0.03	0.17	0.95	1.05	2.00	2.74	3.00	3.71	4.16	4.31
	2.76	0.16	0.26	1.17	1.11	1.65	2.41	2.64	3.34	3.80	3.83
	2.19	0.42	0.45	1.14	1.02	1.13	1.89	2.10	2.73	3.22	3.15
	1.70	0.59	0.57	1.31	1.04	1.10	1.90	2.09	2.81	3.27	3.14
asset index	1.16	0.77	1.21	1.73	1.49	1.44	2.17	2.55	3.10	3.59	3.43
	0.86	1.54	1.79	2.18	1.96	1.76	2.13	2.30	2.71	3.20	3.17
	0.50	0.81	0.99	1.74	1.62	1.18	1.39	1.57	1.94	2.67	2.87
	0.24	0.31	-0.41	0.18	0.04	-0.23	-0.14	0.05	0.15	0.92	0.69
	-0.21	-0.36	-0.74	-0.67	-0.64	-1.12	-1.13	-1.10	-1.18	-0.72	-1.05
	0.00	-2.82	-2.31	-1.86	-1.54	-1.22	-0.90	-0.51	-0.08	0.55	5.06
						haz					

Table A. 21 – P1,1 dominance test results for 1988 and 2000 DHS, illiterate mother's only, Central region

	4.86	-3.06	-5.48	-5.32	-6.48	-6.50	-7.04	-7.70	-7.90	-8.48	-9.59
	2.03	-2.95	-5.43	-5.43	-6.54	-6.65	-7.56	-8.22	-8.47	-9.07	-10.31
	0.85	-3.02	-5.39	-5.59	-6.72	-7.01	-8.24	-9.00	-9.08	-9.92	-11.03
	0.39	-3.81	-6.33	-6.80	-8.16	-8.46	-9.55	-10.38	-10.43	-11.44	-12.52
	0.01	-3.35	-5.69	-6.51	-7.62	-8.13	-9.09	-10.00	-9.90	-11.09	-12.02
asset index	-0.14	-3.37	-5.91	-6.94	-8.06	-8.54	-9.48	-10.16	-10.10	-11.21	-11.97
	-0.25	-3.49	-5.70	-6.53	-7.63	-8.18	-9.63	-10.49	-10.42	-11.74	-12.94
	-0.35	-4.44	-6.51	-6.99	-7.87	-8.25	-9.66	-10.46	-10.57	-11.59	-12.97
	-0.45	-3.69	-6.47	-6.99	-8.08	-8.55	-9.60	-10.82	-11.14	-12.32	-13.82
	-0.57	-4.33	-6.65	-7.02	-8.92	-8.68	-9.54	-10.32	-10.98	-11.83	-12.77
	0.00	-3.22	-2.56	-2.16	-1.80	-1.47	-1.15	-0.83	-0.38	0.37	5.13
						haz					

Table A. 22 – P1,1 dominance test results for 1988 and 2000 DHS, illiterate mother's only, Eastern region

	4.89	-5.44	-5.34	-3.12	-3.74	-2.00	-0.84	-0.77	0.29	1.36	0.95
	0.29	-5.21	-5.22	-3.52	-3.99	-2.23	-1.22	-1.67	-0.93	-0.34	-1.08
	-0.06	-5.71	-6.35	-4.90	-5.45	-3.94	-3.34	-3.66	-2.99	-2.74	-3.59
	-0.21	-6.79	-7.72	-6.77	-8.11	-6.80	-6.74	-7.19	-7.13	-7.44	-8.36
	-0.28	-7.47	-9.38	-8.92	-10.29	-9.49	-9.99	-10.73	-10.82	-11.78	-13.30
asset index	-0.34	-8.47	-10.63	-10.88	-12.65	-12.54	-13.46	-14.60	-15.14	-16.64	-18.53
	-0.41	-9.33	-12.29	-13.03	-14.68	-15.55	-16.52	-17.90	-18.86	-20.36	-21.82
	-0.47	-8.94	-11.04	-12.17	-13.68	-15.67	-17.46	-18.74	-20.20	-21.69	-23.23
	-0.54	-8.67	-10.67	-12.14	-14.16	-14.82	-16.14	-17.48	-18.70	-19.66	-20.79
	-0.61	-7.47	-8.99	-9.43	-10.73	-11.14	-11.72	-12.37	-12.94	-13.54	-14.66
	0.00	-3.32	-2.68	-2.32	-1.98	-1.64	-1.30	-0.92	-0.52	0.05	5.03
						haz					

Table A. 23 – P1,1 dominance test results for 1988 and 2000 DHS, illiterate mother's only, Western region

	4.29	-2.48	-3.79	-3.47	-2.68	-2.83	-2.98	-2.70	-2.46	-3.31	-2.47
	0.07	-2.81	-4.18	-3.81	-3.14	-3.50	-3.66	-3.67	-3.48	-4.45	-3.93
	-0.15	-3.41	-4.85	-4.80	-4.28	-4.67	-5.05	-5.42	-5.43	-6.59	-6.22
	-0.26	-4.01	-5.70	-5.92	-5.79	-6.10	-6.92	-7.34	-7.85	-9.43	-9.12
	-0.34	-4.69	-7.38	-7.80	-8.13	-8.85	-10.13	-11.24	-11.93	-13.66	-13.85
asset index	-0.41	-5.85	-9.39	-10.18	-10.56	-11.37	-13.06	-14.53	-15.62	-18.06	-18.22
	-0.47	-6.75	-10.50	-12.42	-13.46	-14.82	-16.71	-18.76	-20.22	-22.68	-23.34
	-0.54	-8.64	-11.72	-14.17	-15.03	-16.22	-18.44	-20.22	-21.58	-23.59	-24.75
	-0.60	-8.35	-12.02	-14.01	-15.70	-17.53	-19.32	-20.85	-21.68	-23.22	-23.97
	-0.68	-6.77	-8.99	-10.26	-11.34	-12.69	-13.27	-14.06	-14.60	-15.49	-15.84
	0.00	-3.77	-3.12	-2.72	-2.37	-2.03	-1.70	-1.34	-0.93	-0.34	5.08
						haz					

Table A. 24 – P1,1 dominance test results for 1988 and 2000 DHS, illiterate mother's only, Northern region

	4.27	-2.36	-9.30	-7.32	-3.64	-5.71	-2.47	-0.84	2.09	3.10	-1.79
	-0.05	-2.67	-9.86	-8.64	-5.27	-7.73	-4.71	-3.40	-1.12	-0.87	-5.95
	-0.23	-3.51	-10.87	-10.03	-7.73	-10.74	-8.54	-7.71	-6.18	-6.39	-12.48
	-0.31	-4.60	-12.16	-12.14	-10.84	-14.55	-13.25	-13.20	-11.89	-12.97	-19.93
	-0.38	-4.97	-12.48	-12.53	-12.11	-17.02	-16.41	-17.36	-16.35	-17.30	-23.54
asset index	-0.44	-6.27	-13.52	-14.80	-14.92	-19.29	-19.02	-20.45	-20.33	-21.64	-28.67
	-0.49	-5.95	-15.68	-18.02	-19.42	-23.18	-21.90	-24.08	-23.23	-24.35	-31.27
	-0.54	-6.01	-13.91	-16.66	-17.74	-20.64	-19.65	-21.90	-21.09	-21.27	-27.91
	-0.59	-6.04	-10.02	-12.49	-11.88	-14.73	-13.41	-15.72	-15.90	-16.85	-21.72
	-0.68	-9.83	-12.16	-10.16	-11.17	-13.65	-13.15	-13.71	-14.83	-15.08	-20.60
	0.00	-3.57	-2.79	-2.36	-1.97	-1.64	-1.33	-1.01	-0.56	0.05	5.36
						haz					

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