



Multidimensional Poverty Index 2011: Brief Methodological Note

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INTRODUCTION

This note i) introduces the methodology used to construct the MPI 2011, ii) shares the main updates that have taken place since 2011, and iii) presents initial robustness results. The 2011 MPI uses the same dimensions, indicators, cutoffs, and weights in as in 2010, and the functional form has not changed. The construction of the MPI is explained in a non-technical fashion in Part 1 of this note. Part 2 outlines the updates to the MPI and the innovative analyses conducted this year. The updates are as follows: this year the MPI has been constructed for five additional countries. A new MPI has been released drawing on updated data for 20 countries. Innovative analyses include decomposition by sub-national region, time series comparisons, the calculation of standard errors, and the construction of MPI-related environmental indicators. The methodologies used to generate the tables on the MPI and the country briefs and maps on OPHI's website, as well as the results published in the 2011 *Human Development Report*, are presented in this note. The tables are presented as appendices.

1. MPI METHODOLOGY

The MPI is an index designed to measure acute poverty. It follows the Alkire and Foster (2007, 2011a,b) methodology. This section presents the methodology and innovations in 2011 (for a detailed description of the MPI methodology please see: Alkire and Santos 2010).

Data

For the MPI, all the information for each country must come from the same survey. Three main datasets were used to compute the MPI: the Demographic and Health Survey (DHS), the Multiple Indicators Cluster Survey (MICS), and the World Health Survey (WHS). Additionally, a few country-specific surveys were used. The MPI 2011 uses DHS surveys for 54 countries, MICS surveys for 32 countries, and WHS for 17 countries. Country-specific surveys were used for Argentina: *National Survey of Nutrition and Health* (ENNyS) 2005; Brazil: *National Survey of Demographic and Health* (PNDS) 2006; Mexico: *National Health and Nutrition Survey* (ENSANUT) 2006; Morocco: *National Study on Household Living Standards* (ENNVN) 2007; Occupied Palestinian Territory: *Pan Arab Population and Family Health Project* (PAPFAM) 2007; and South Africa: *National Income Dynamics Study* (NIDS) 2008.¹

The MPI estimation for each country relies on the most recent and reliable data having the required indicators which is available since 2000. However surveys are taken in different years, and some countries do not have recent data. The year of the survey is reported in the MPI 2011 tables. Eighty-two countries' data come from 2005 or later; twenty one countries' data are from 2003 or 2004, and six countries from 2000-2002. The difference in dates limits direct cross-country comparisons, as circumstances may have improved or deteriorated in the intervening years.

Unit of Analysis

¹ The original names of each survey are: Encuesta Nacional de Nutrición y Salud (ENNyS), Pesquisa Nacional de Demografia e Saúde da Mulher e da Criança (PNDS), Encuesta Nacional de Salud y Nutrición (ENSANUT) and Enquête Nationale sur les Niveaux de Vie des Ménages (ENNVN).

The MPI identifies each person as deprived or not deprived using any available information for household members. The MPI then aggregates across all poor people. This approach is followed in large part because of data constraints, and in part because it has a clear logic.² Some variables reflect the sharing which occurs among household members – for example when educated household members read for others. Other variables such as sanitation or electricity are usually common across household members. In terms of data constraints, large scale internationally comparable surveys do not have individual-level information for all indicators in the MPI where this might be relevant – such as malnutrition. For example, if any household member for whom data exists is malnourished, all household members are considered deprived in nutrition. Also, some indicators, such as school attendance for children up to class eight, do not apply to all household members.

Dimensions, indicators and deprivation cutoffs

MPI 2011 uses the same dimensions, indicators, and deprivation cutoffs as the MPI 2010. The MPI uses ten indicators belonging to three dimensions which mirror the HDI. Their intrinsic and instrumental value has been presented in Alkire and Santos (2010). Ten indicators compose the MPI: two for health, two for education and six for living standards. These indicators were selected in 2010 in consultation with experts in all three dimensions. During this process, the ideal set of indicators had to be reconciled with the data that were available and were appropriate for cross-country comparison. The ten indicators selected are almost the only set of indicators that could be used to compare over 100 countries using the chosen datasets. Figure 1 summarizes the dimensions, indicators, thresholds and weights used in the MPI. Eight of the ten indicators are connected to MDG indicators. The other two (flooring and electricity) provide some rudimentary indication of the quality of housing.

Missing indicators

The 10 MPI indicators are not always present in DHS, MICS, or WHS surveys, which is an important data constraint. The inclusion of more recent surveys in the MPI 2011 in most cases means better data for that country. For example the new dataset for Suriname includes all indicators while the dataset used for the MPI in 2010 lacked three indicators. Improvements in the number of indicators considered for the MPI calculation were also observed in Brazil (it now includes school attendance and child mortality), and South Africa (it now includes school attendance). As a result, 66 countries have all 10 indicators, 34 countries have nine indicators, 7 countries lack two indicators, and 2 countries lack three indicators. The missing indicators affect comparability, and so the MPI 2011 tables show the number of indicators available for each country, and names any indicator(s) that are missing.

Weights

In the MPI the three dimensions are equally weighted, so that each receives a 1/3 weight. The indicators within each dimension are also equally weighted. Thus, each indicator within the health and education dimension receives a 1/6 weight and each indicator within the living standards dimension receives a 1/18 weight ($1/3 \div 6$).

If there are fewer than 10 indicators, the principle of equal weights across dimensions and across indicators within a dimension still applies. For example, suppose there is a country whose dataset

² If data on all household members become available, complementary measures could easily be developed which take the individual as the unit of analysis. These would be very useful in order to study intra-household disparities.

is missing one of the living standard indicators (i.e. no information was collected on that variable). Thus, the total number of indicators is nine in this case. Then each of the four health and education indicators receive a 1/6 weight but each of the standard of living indicators receive a 1/15 weight ($1/3 \div 5$). Similarly, if there is one missing indicator in the education dimension, then each of the health indicators receives a 1/6 weight, each of the standard of living indicators receives a 1/18 weight but the one education indicator receives a 1/3 weight.

Figure 1: The dimensions, indicators, deprivation thresholds and weights of the MPI

Dimension	Indicator	Deprived if...	Related to...	Relative Weight
Education	Years of Schooling	No household member has completed five years of schooling.	MDG2	1/6
	Child School Attendance	Any school-aged child is not attending school up to class 8.+	MDG2	1/6
Health	Child Mortality	Any child has died in the family.	MDG4	1/6
	Nutrition	Any adult or child for whom there is nutritional information is malnourished.*	MDG1	1/6
Living Standard	Electricity	The household has no electricity.		1/18
	Improved Sanitation	The household's sanitation facility is not improved (according to MDG guidelines), or it is improved but shared with other households.**	MDG7	1/18
	Safe Drinking Water	The household does not have access to safe drinking water (according to MDG guidelines) or safe drinking water is more than a 30-minute walk from home roundtrip.***	MDG7	1/18
	Flooring	The household has a dirt, sand or dung floor.		1/18
	Cooking Fuel	The household cooks with dung, wood or charcoal.	MDG7	1/18
	Assets ownership	The household does not own more than one radio, TV, telephone, bike, motorbike or refrigerator and does not own a car or truck.	MDG7	1/18

Note: MDG1 is Eradicate Extreme Poverty and Hunger; MDG2 is Achieve Universal Primary Education; MDG4 is Reduce Child Mortality; MDG7 is Ensure Environmental Sustainability.

+ Data Source for age children start school: United Nations Educational, Scientific and Cultural Organization, Institute for Statistics database, Table 1. Education systems [UIS, <http://stats.uis.unesco.org/unesco/TableViewer/tableView.aspx?ReportId=163>].

*Adults are considered malnourished if their BMI is below 18.5 m/kg². Children are considered malnourished if their z-score of weight-for-age is below minus two standard deviations from the median of the reference population.

**A household is considered to have access to improved sanitation if it has some type of flush toilet or latrine, or ventilated improved pit or composting toilet, provided that they are not shared.

***A household has access to clean drinking water if the water source is any of the following types: piped water, public tap, borehole or pump, protected well, protected spring or rainwater, and it is within a distance of 30 minutes' walk (roundtrip).

Source: Alkire and Santos (2010) For details on the rationale behind each indicator please see Alkire and Santos (2010)

The poverty cutoff (identification of the MPI poor)

Each person is assigned a deprivation score according to his or her deprivations in the component indicators. The deprivation score of each person is calculated by taking a weighted sum of the deprivations experienced, so that the deprivation score for each person lies between 0 and 1. The score increases as the number of deprivations of the person increases and reaches its maximum of 1 when the person is deprived in all ten indicators. A person, who is not deprived in any indicator, receives a score equal to 0. Formally:

$$c_i = w_1 I_1 + w_2 I_2 + \dots + w_d I_d$$

where $I_i = 1$ if the household is deprived in indicator i and $I_i = 0$ otherwise, and w_i is the weight attached to indicator i with $\sum_{i=1}^d w_i = 1$.³

A second cutoff or threshold is used to identify the multidimensionally poor, which in the Alkire-Foster methodology is called the poverty cutoff. The poverty cutoff is the share of (weighted) deprivations a household must have in order to be considered poor, and we will denote it by k .⁴ Someone is considered poor if her deprivation score is equal to or greater than the poverty cutoff, that is, if $c_i \geq k$. In the MPI, a person is identified as poor if he or she has a deprivation score higher than or equal to $1/3$. In other words, a person's deprivation must be at least a third of the (weighted) considered indicators to be considered MPI poor.⁵ For those whose deprivation score is below the poverty cutoff, even if it is non-zero, their score is replaced by a '0' and any existing deprivations are not considered in the 'censored headcounts'. We refer to this important step as *censoring* the deprivations of the non-poor (see Alkire and Foster 2011b, Alkire Foster and Santos, 2011). To differentiate the original deprivation score from the censored one, we use the notation $c_i(k)$ for the censored deprivation score. Note that when $c_i \geq k$, then $c_i(k) = c_i$, but if $c_i < k$, then $c_i(k) = 0$. $c_i(k)$ is the deprivation score of the poor.

Computing the MPI (aggregation)

Following the structure of the Adjusted Headcount (M_0) measure of Alkire and Foster (2011a), the MPI combines two key pieces of information: (1) the **proportion** or **incidence** of people (within a given population) whose share of weighted deprivations is k or more and (2) the **intensity** of their deprivation: the average proportion of (weighted) deprivations they experience. Formally, the first component is called the **multidimensional headcount ratio** (H):

$$H = \frac{q}{n}$$

Here q is the number of people who are multidimensionally poor and n is the total population. The second component is called the **intensity** (or breadth) of poverty (A). It is the average deprivation score of multidimensionally poor people and can be expressed as:

$$A = \frac{\sum_{i=1}^n c_i(k)}{q}$$

where $c_i(k)$ is the censored deprivation score of individual i and q is the number of people who are multidimensionally poor.⁶

The MPI is the product of both: $MPI = H \times A$.

Population vulnerable to poverty and population in severe poverty

³ Note that in the notation of this methodological note, the indicators' weights add up to one. This differs from the notation used in Alkire and Foster (2007, 2011), where the indicators' weights add up to the total number of indicators considered, there denoted d . However, the identification step here is equivalent to the original paper.

⁴ Again, this notation differs from Alkire and Foster's papers (2007, 2011a), where k is defined as the *number* of deprivations someone must experience in order to be considered poor. But notation is consistent throughout this methodological note and equivalent to the original paper.

⁵ Households with a deprivation score between $1/5$ and $1/3$ are denoted 'vulnerable' due to their proximity to the poverty cutoff.

⁶ Note that the formula of A differs from Alkire and Foster (2007, 2011a) in that it does not contain the number of indicators d in its denominator. This is because d is already included in the deprivation score $c_i(k)$, since it is a weighted sum of the deprivations of each poor person, where the indicators' weights add up to 1.

The 2011 *Human Development Report* included a further two figures (Table 5). The first refers to people who are ‘vulnerable’ to poverty. This is defined as the people whose a deprivation score is between 20 and 33 percent ($20\% \leq c_i < 33\%$). The second refers to people in severe poverty. This is defined as people whose deprivation score is 50 percent or more ($c_i \geq 50\%$).

Table 1.1 reports the MPI value, Headcount ratio (H), Intensity of poverty (A), Population ‘vulnerable’ to poverty, and Population in severe poverty for all 109 countries included in the 2011 MPI. Table 2.1 presents the MPI value, Headcount ratio (H), and Intensity of poverty (A) for a different poverty cutoff, k=20 percent. Table 1.4 presents the MPI results in comparison with other estimates of inequality, poverty and wellbeing.⁷

Decomposing by population sub-groups

One key feature of the MPI is that it can be decomposed by population sub-groups such as regions or ethnic groups, depending upon the sample design. For example, if there are two sub-groups by which the survey is representative, rural and urban, the formula for their decomposition is:

$$MPI_{country} = \frac{n_U}{n} MPI_U + \frac{n_R}{n} MPI_R$$

where U denotes ‘urban’ and R denotes ‘rural’, and n_U/n is the population of urban areas divided by the total population, and similarly for n_R/n (and $n_U + n_R = n$). This relationship can be extended for any number of groups, as long as their respective populations add up to the total population.

The contribution of each group to overall poverty can be computed using the following formula:

$$\text{Contribution of urban areas to MPI} = \frac{\frac{n_U}{n} MPI_U}{MPI_{country}} * 100$$

Whenever the contribution to poverty of a region or some other group widely exceeds its population share, this suggests that some regions or groups may bear a disproportionate share of poverty.

Breaking MPI down by dimensions and indicators

Another key feature of the MPI is that, once the poor have been identified (in other words, once the MPI has been computed), one can decompose the MPI into its component-censored indicators to reveal *how* people are poor – the composition of deprivations they experience.

To decompose by indicators, compute the censored headcount ratio in each indicator. The censored headcount ratio for a particular indicator is obtained adding up the number of poor people who are deprived in that indicator and dividing by the total population. Once all the censored headcount ratios have been computed, it can be verified that the weighted sum of the censored headcount ratios also generates the country’s MPI. That is, if the MPI is constructed from all ten indicators:

⁷ Tables are available on <http://www.ophi.org.uk/policy/multidimensional-poverty-index/>

$$MPI_{country} = w_1CH_1 + w_2CH_2 + \dots + w_{10}CH_{10}$$

Here w_1 is the weight of indicator 1 and CH_1 is the censored headcount ratio of indicator 1, and so on for the other nine indicators, with $\sum_{i=1}^d w_i = 1$.

The percentage contribution of each indicator to overall poverty is computed as follows:

$$\text{Contribution of indicator } i \text{ to MPI} = \frac{w_i CH_i}{MPI_{country}} * 100$$

Whenever the contribution to poverty of a certain indicator widely exceeds its weight, this suggests that there is a relative high deprivation in this indicator in the country. The poor are more deprived in this indicator than in others. The contributions of all indicators will sum to 100 per cent.

Tables 1.2 and 2.2 report the censored headcount ratios for each of the ten MPI indicators in each country at different poverty k cutoff values, while tables 1.3 and 2.3 show the aggregate contribution by dimension and indicator.⁸

Counting the poor; analysing MPI internationally using population data

Because the MPI is drawn from different survey years, in order to identify the number of MPI poor in any given country or across countries it is necessary to multiply the MPI incidence or headcount ratio (H) calculated from the sample survey by the population of the country.

$$\text{Number of MPI poor} = H * \text{Total Population}$$

Despite its apparent simplicity, this is not a straightforward exercise. It entails selecting and justifying a particular year for the population figures. There are two basic alternatives, each of which might be appropriate to different exercises:

1. Use population data that correspond to the year of the survey
2. Use population data from a given single year, which may not be the survey year.

As those working with the MPI figures might reasonably adopt either approach, we note briefly the considerations that might inform this choice. It is necessary to be very clear, to prevent confusion.

Population data corresponding to the year of the survey

In this approach, the 'number' of MPI poor is calculated by multiplying the MPI Headcount ratio by the total population from the year of the survey. This is the approach that was used in the 2011 *Human Development Report*, in Table 5 (on MPI), under the title Headcount (thousands). So, for example, for India, whose DHS is dated at 2005, the number of MPI poor in India is calculated using 2005 population data, whereas for Colombia, whose MICS is dated 2010, the number of MPI poor is calculated using 2010 population data.

⁸ The tables are available at <http://www.ophi.org.uk/policy/multidimensional-poverty-index/> Note that when overall MPI is very low, the censored headcount ratios are also low, and contributions may be misleading. When this happens, one indicator can have a 90 per cent contribution, not because there is a massive deprivation in that indicator but because it is one of the few indicators that has a non-zero censored headcount ratio, explaining most of the (very low) MPI.

In this approach, the MPI values and the number of MPI poor all refer to the date of the survey. This has the significant advantage of consistency: no assumptions are made regarding poverty trends subsequent to the survey. This approach also has limitations: the number of MPI poor cannot be aggregated by regions or other groupings if the surveys for the countries considered differ. This limits the possibility of international comparisons, which are one of the motivations for creating internationally comparable poverty measures. A non-technical but possibly relevant additional consideration refers to the incentive to update poverty data. If population growth rates are strong, there may be a disincentive to update the data or to release new data, because even if the incidence of poverty has declined, the absolute number of MPI poor may have increased.

Population data from a given year, which may not be the year of the survey

In this approach, the ‘number’ of MPI poor is calculated by multiplying the MPI Headcount ratio by the total population taken from a given year, which may not be the same year as the survey. This is the approach used in the 2011 HDR press release to state that there are 1.7 billion MPI poor people. So, for example, to use the countries mentioned above, India and Colombia’s headcount ratios would both be multiplied by the total population for a given year, for example the year 2011.

This approach has the important advantage of comparison: it is possible to aggregate across countries to develop regional ranks, to analyse country groupings such as low income countries, and to aggregate across regions even. For example, using this approach we can generate the figure that 31 percent of the inhabitants in the 109 countries are MPI poor. If the year of the survey chosen is after the year of the survey, this approach also provides an incentive to governments to update their poverty data, because the ‘number of poor’ will decline, if poverty rates have gone down, and will do so more steeply in countries having strong population growth. The approach also has limitations. In using a headcount that is older than (or more recent than) the reference year of the survey, the assumption is being made that the level of poverty in year of the survey and the year of population are identical. This is a strong assumption.

These alternatives point out yet again the importance of increasing the periodicity of data collection.

2. 2011 UPDATES TO THE MPI

New Countries and new MPIs from updated data

The MPI 2011 has completely new estimations for five countries for which data were not available in 2010, bringing the total to 109 countries. These new countries are Bhutan (MICS2010), Maldives (DHS2010), Timor-Leste (DHS2009), Uganda (DHS2006), and Vanuatu (MICS2007). The MPI 2011 for twenty countries was calculated using updated data. These countries are: Albania, Bolivia, Brazil, Colombia, Dominican Republic, Jordan, Kenya, Lesotho, Madagascar, Morocco, Mozambique, Nicaragua, Nigeria, Occupied Palestinian Territories, Philippines, Republic of Congo, Sao Tome and Principe, Sierra Leone, South Africa, and Suriname. MPI estimates for 18 out of these 20 countries were constructed using data that was collected before 2005. These are now updated with more recent data.

Decomposition of national MPI at sub-national level

Out of the 109 countries included in the 2011 MPI, decomposition results were produced for 66 countries at sub-national level (states, districts, regions, or provinces, depending on the country).

These results will be made available in December 2011 (Alkire, Roche and Seth, forthcoming). The 66 countries satisfy the following three criteria:

1. The survey of the country is representative at the sub-national level according to the survey metadata regarding the sample design and to basic tabulations in the country survey report.
2. The national incidence of poverty or headcount ratio (H) and the MPI are large enough (H more than 1.5 percent and MPI greater than 0.005) so that a meaningful sub-national analysis can be pursued. The first two criteria exclude 30 country surveys from our analysis.
3. The sample size after the treatment of missing data is reasonably high both at the national level and at the sub-national level. For borderline cases, we performed additional bias analyses to exclude those cases where the sample reduction leads to statistically significant bias.

We specify the third criterion in three ways. First, the national sample size must be at least 85 percent of the original sample after missing data are treated. This is because a lower sample size may affect accurate comparability across sub-national estimations. Second, every sub-national region in a country must have a retained sample size that is at least 75 percent of the original sample. A smaller sample generates a problem of representativeness for that particular sub-national region, which may distort the sub-national comparisons. Third, we conduct a bias analysis test for each region whose sample size is 75 and 85 percent of the original. We identify the major cause of the sample reduction and divide the entire sample into two groups based on this cause and check the headcount ratios of the other indicators across these two groups. If there is a systematic and statistically significant difference (at a significance level of one percent) between the headcount ratios across these two groups, then that region does not satisfy the bias analysis test. If a region with a large population share (more than 20 percent) within a country does not pass the test, we completely exclude the country from our analysis.

Although decompositions are theoretically possible for about 100 countries, 66 countries with 683 regions satisfy all three criteria and are thus used for our sub-national analysis. Out of these 66 country surveys, 48 are DHS, 17 are MICS, and the remaining one is the ENSANUT survey from Mexico.

Analysis of changes over time

For seven countries reported in the MPI 2011, the updated data were consistent with the 2010 MPI data in terms of the sampling frame and indicators, so the differences between 2010 and 2011 MPI values can be interpreted as real reductions in MPI. These seven countries are: Bolivia (2003-2008), Colombia (2005-2010), Jordan (2007-2009), Kenya (2003-2009), Lesotho (2004-2009), Madagascar (2004-2009), and Nigeria (2003-2008).

In Table 3.1, we report the changes over time and confidence intervals for each of these countries over the period indicated with respect to MPI, headcount ratio (H), intensity of poverty (A) and also the censored headcounts of each indicator. We suggest observing both the absolute and relative variation in each indicator during the analysis of these changes over time. The absolute variation is informative as it indicates the overall percentage of people who have been lifted out of or have fallen into poverty. The relative variation expressed these changes in relation to the initial level of poverty and so provides information about the magnitude of the reduction with respect to the overall poverty level in the country. Since the length of the period between both surveys under comparison varies, we have annualized the changes to allow comparability across the seven countries.

The average annual absolute change of each indicator X is computed following the formula:

$$\Delta X_{t-s} = (X_t - X_s)/(t - s)$$

The average annual percentage change of each indicator X is:

$$\Delta\%X_{t-s} = ((X_t - X_s)/X_s)/(t - s)$$

where X_t denotes the performance of a country in period t and X_s is the performance of a country in period s .

The MPI conveys simultaneously information about the incidence of poverty (H) and the intensity of poverty (A). Similarly, changes in MPI over time can be the effect of changes in incidence (H) or intensity (A) or the interaction between both. Thus the MPI provides an incentive to bring someone out of poverty – to reduce the headcount. It also provides an incentive to reduce the intensity of poor people's poverty – even if they remain MPI poor. Following Apablaza and Yalonetzky (2011), we decompose the change of MPI as follows:

$$\Delta\%MPI_{t-s} = \Delta\%H_{t-s} + \Delta\%A_{t-s} + (\Delta\%H_{t-s} * \Delta\%A_{t-s} * (t - s))$$

Looking at the magnitude of changes over time provides a general overview of poverty reduction – but little idea of how that was accomplished. So Table 3.1 also breaks down the MPI change to show how reductions in different indicators drove the overall reduction in poverty and presents the confidence intervals to allow assessments of the statistical significance of the results. This information is useful for a number of reasons. First, once again it provides incentives and feedback to different public and private sector actors on what drove the change in MPI. Second, at a national level and when the variables are appropriate, such information can be combined with 'natural' experiments where feasible to evaluate policy impacts. Third, it is possible to decompose changes over time at regional levels and for different population sub-groups, so as to track differences or consistency in poverty reduction within countries. Decomposition of changes over time at the sub-national level were also performed on these seven countries and will be available shortly (Alkire, Roche and Seth, forthcoming).

Refined estimates

As a new index, the MPI construction was closely scrutinised and reviewed in 2011 for possible improvements. Improvements to fine-tune the MPI using the same dataset as in 2010 were made consistently for all countries, if these changes were relevant. There were two main changes in this fine-tuning process. In the first place, there was an improvement in the coding used to create the school attendance, sanitation, water, and nutrition indicators.⁹ Second, for countries lacking two or more indicators we made the poverty cutoff precisely equivalent to that of those with 9 or 10 indicators.¹⁰ Changes in these instances reflect the improved methodology and not changes on the ground. In eleven countries, these changes affected the MPI in the second decimal point.

⁹ The coding affected the treatment of missing data for the distance to water variable and the BMI variable, the coding of composting toilets (non-deprived), and the year in which children's school attendance was assessed.

¹⁰ In the 2010 MPI, we were using a cutoff such that if a person's weighted deprivation score was greater than or equal to 3, they were poor. Given the weighting structure of the MPI, this is equivalent to being deprived in a third of the indicators when the country has 9 indicators and in 30% when it has 10, but in practice this makes no difference. However, for countries with 8 or 7 indicators, it meant in practice a higher poverty cutoff. By using $k=1/3$ for all calculations we have removed any inconsistencies in identification.

These countries are: Cambodia, Cameroon, Cote d'Ivoire, Czech Republic, Ethiopia, Hungary, India, Myanmar, Pakistan, Rwanda, and Turkey.

Environmental Indicators and the MPI

Given the prominence of the environment in the 2011 *Human Development Report*, a special analysis was undertaken of the three environmental indicators of the MPI: lack of improved cooking fuel, safe drinking water and improved sanitation. Table 1.5 presents these results. The table first presents the 'raw headcount ratios'. These reflect the total proportion of people who are deprived in these indicators, whether or not they have been identified as MPI poor. These numbers are similar to the familiar MDG statistics, showing the percentage of people without safe drinking water etc. It then presents the 'censored headcount ratios' computed as described above. These reflect the proportion of people who are both MPI poor and are deprived in each particular indicator. It also sums the percentage contribution. These three indicators are weighted at 1/18 each, so their proportional contribution to poverty for someone deprived in 10 indicators is 3/18 or 0.16667. A separate analysis was undertaken of the joint distribution of just these three indicators across the MPI poor population. The last columns shows what percentage of MPI poor people (only) are deprived in one or more of the environmental indicators, in any two or more, or in all three of the environmental indicators simultaneously. Similar analyses can be done for other subsets of variables in a multidimensional poverty index, depending upon the focus of a particular study.

3. ROBUSTNESS CHECKS

Robustness of country rankings to changes in the poverty cutoff

The MPI uses the poverty cutoff (k) equal to a third of the weighted indicators. The choice of the poverty cutoff in this case is normative, as in income poverty. A change in the poverty cutoff may identify the multidimensionally poor differently, which may alter the ranks of countries. For this reason, we check the robustness of country rankings for alternative poverty cutoffs: $k = 0.2$ and $k = 0.4$. The value $k = 0.2$ was used as the lower bound to identify household as 'vulnerable' to poverty, hence the incidence of poverty at $k = 0.2$ is also the proportion of people who are either vulnerable or acute poor; it is about 43 percent of people across 109 countries depending upon the population estimates used.¹¹ At $k = 0.4$ roughly 22 percent of people across the 109 countries are identified as multidimensionally poor, whereas for the MPI cutoff of $k=1/3$, roughly 31 percent of people are identified as multidimensionally poor. Thus, this range of k from 0.2 to 0.4 values captures a variety of interesting variation around the chosen k value. Moreover, if the poverty cutoff exceeds $k=0.4$, more than 32 countries have very low and bunched MPI values, so ranking comparisons are less meaningful.

Given that there are 109 countries, there are 5,886 possible pair-wise comparisons. A comparison is deemed robust if the comparison does not alter at alternative poverty cutoffs. Fully 94.7 percent of the 5,886 pair-wise comparisons are not altered for the MPI poverty cutoff and the two alternative cutoffs, meaning that one country is unambiguously less poor than another, independently of whether the poverty cutoff is set at 20 percent, 33.33 percent or 40 percent of

¹¹ We estimate the number of MPI poor using the population figure for both years 2008 and 2010.

the weighted indicators. The Kendall Tau rank correlation coefficient (referred as Tau-b) and Spearman's rank correlation coefficient between the MPI ranking and the ranking for each of the two alternative poverty cutoffs are also computed. The Spearman's coefficients are 0.99 for both cases; while the Kendall coefficients are 0.94 and 0.93 respectively, as evident from Figure 2, columns six and seven. These results show that the MPI ranking across 109 countries is highly robust to changes in the poverty cutoff. Rankings within geographic regions are also highly robust. Within Sub-Saharan Africa, 97.2 percent of country rankings are robust, whereas in South Asian countries, 100 percent of the total possible pairs remain unaltered for alternative poverty cutoffs. The percentage of robust comparison is slightly lower for the countries in the Arab region, Latin American and Caribbean region and East Asia and Pacific Region, where 94.5 percent, 92.2 percent, and 87.3 percent of pair-wise comparisons are robust, respectively. We also conduct the robustness analysis across countries for each of the three major surveys that we use as reported in Figure 2.

Figure 2: Robustness of Countries across Regions and Surveys with respect to the Alternative Cutoffs

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Countries in Category	Number of Countries	Total Comparisons	Total Robust Comparisons	Percentage of Robust Comparison	Tau-b k=0.33 Vs. k=0.2	Tau-b k=0.33 Vs. k=0.4	Spearman k=0.33 Vs. k=0.2	Spearman k=0.33 Vs. k=0.4
HDR 2011	109	5886	5572	94.7%	0.94	0.93	0.99	0.99
DHS Surveys Only	54	1431	1392	97.3%	0.97	0.96	1.00	1.00
MICS Surveys Only	32	496	467	94.2%	0.92	0.94	0.98	0.99
WHS Surveys Only	17	136	115	84.6%	0.88	0.72	0.97	0.84
Arab States	11	55	52	94.5%	0.93	0.93	0.97	0.98
Europe and Central Asia	24	276	195	70.7%	0.60	0.64	0.76	0.75
Latin America and Caribbean	18	153	141	92.2%	0.92	0.86	0.97	0.95
Sub-Saharan Africa	38	703	683	97.2%	0.97	0.97	0.99	1.00
South Asia	7	21	21	100.0%	1.00	1.00	1.00	1.00
East Asia and the Pacific	11	55	48	87.3%	0.89	0.82	0.97	0.94

Robustness of country rankings to changes in weights

In the MPI, each dimension is equally weighted at one third and each indicator within a dimension is also equally weighted. The decision to weight health, education, and standard of living dimensions equally arises in part from various discussions around and robustness tests of the Human Development Index, as well as both expert opinion and participatory analysis.¹² Also, choosing dimensions such that they are roughly equal helps make the resulting measure easy to understand and use (Atkinson et al. 2002). Then the question is – ‘is the MPI robust to a range of weights?’

To answer this question, as in the robustness tests released in 2010, first we estimate the MPI using three alternative weighting structures: (i) giving 50 percent weight to health and 25 percent weight each to education and standard of living, (ii) giving 50 percent weight to education and 25 percent weight each to health and standard of living, and finally (iii) giving 50 percent weight to

¹² Using the HDI data from the 2006 Human Development Report, Foster, McGillivray and Seth (2009) show that 70% of the HDI pair-wise country comparisons are robust for any combination of weights on the 3 HDI dimensions, and 92% of the pair-wise comparisons are robust if the weights freely alter between 25 percent and 50 percent on each dimension.

standard of living and 25 percent weight each to health and education. Then we check if the country rankings are robust using the correlation coefficients between each pair of rankings using three different methods: Pearson's correlation coefficient, Spearman's rank correlation coefficient and Kendall's rank correlation coefficient (Tau-b).

We find that MPI ranks are robust for 84.9 percent of all pair-wise comparisons when these three alternative weights are considered. In Figure 3, we report the three pair-wise correlation coefficients between the rankings under the equal weight structure and each of the three alternative weight structures for all 109 countries. Changing the indicators' weights indeed affects the poverty estimates. However, the country rankings thus generated remain quite robust. It is evident from Figure 3, where we compare the rankings across all countries that the minimum of the three Pearson correlation coefficients is 0.987, the minimum of the three Spearman coefficients is 0.979 and the minimum of the three Kendall Tau-b coefficients is 0.893, respectively. In sum, the correlations between the MPI and each of three alternative weighting structures is 0.89 or above.

Figure 3: Robustness of Countries Ranking for Alternative Weights

			MPI Weights
			Equal weights: 33% each
			(Selected Measure)
Alternative Weights 1	50% Education	Pearson	0.992
	25% Health	Spearman	0.979
	25% LS	Kendall (Tau-b)	0.893
Alternative Weights 2	50% Health	Pearson	0.995
	25% Education	Spearman	0.987
	25% LS	Kendall (Tau-b)	0.918
Alternative Weights 3	50% LS	Pearson	0.987
	25% Education	Spearman	0.985
	25% Health	Kendall (Tau-b)	0.904
Number of countries:		109	

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