The Global Multidimensional Poverty Index (MPI): 5-year methodological note

OPHI Briefing 38

Sabina Alkire*, Adriana Conconi, Gisela Robles, José M. Roche, María Emma Santos, Suman Seth and Ana Vaz

January 2016

Acknowledgements

We warmly acknowledge the contribution of many colleagues and co-workers who participated in the definition of the Global Multidimensional Poverty Index (MPI) over the past five years. In particular, we are grateful to our colleagues at the UNDP Human Development Report Office for their substantive engagement, especially Milorad Kovacevic, Cecilia Calderon and Selim Jahan. We are grateful as well to Sunita Kishor, Shea Rutstein and Trevor Croft at DHS/ICFI, Attila Hancioglu at MICS. We are deeply appreciative of the competent support at some stages of new MPI calculations from various research assistants that are acknowledged in each of the methodological notes published. We also wish to thank other OPHI team members and associates, Miroslawa Alunowska, Lise Andersen, Paola Ballon, Adriana Conconi, Paddy Coulter, Heidi Fletcher, James Foster, Natasha Francis, John Hammock, Cai Heath, Bouba Housseini, Raggie Johansen, Felipe Roa, Jose Manuel Roche, Maria Emma Santos, Suman Seth, Yangyang Shen, Victoria Thornton, Ana Vaz, Claire Walkey, Diego Zavaleta, for their support and substantive input.

* The Oxford Poverty and Human Development Initiative (OPHI), Oxford Department of International Development, University of Oxford. Contact details: ophi@qeh.ox.ac.uk Tel +44 1865 271915 Fax +44 (0)1865 281801

This note has been prepared within the OPHI theme on [multidimensional poverty measurement.

OPHI gratefully acknowledges support from the UK Economic and Social Research Council (ESRC)/(DFID) Joint Scheme, Robertson Foundation, Praus, UNICEF N'Djamena Chad Country Office, German Federal Ministry for Economic Cooperation and Development (BMZ)**,** Georg-August-Universität Göttingen, International Food Policy Research Institute (IFPRI), John Fell Oxford University Press (OUP) Research Fund, United Nations Development Programme (UNDP) Human Development Report Office, national UNDP and UNICEF offices, and private benefactors. International Development Research Council (IDRC) of Canada, Canadian International Development Agency (CIDA), UK Department of International Development (DFID), and AusAID are also recognised for their past support.

Global Multidimensional Poverty Index (MPI):

Contents

I. Overview

Poverty has traditionally been measured in one dimension, usually monetary poverty using income or consumption-expenditure indicators. In this analysis, a basket of goods and services considered the minimum requirement to live a non-impoverished life is valued at the current prices. People who do not have sufficient monetary resources for that basket are deemed poor.

Monetary poverty certainly provides very useful information. Yet poor people themselves define their poverty much more broadly to include lack of education, health, housing, empowerment, employment, personal security and more. No one indicator, such as income, is uniquely able to capture the multiple aspects that contribute to poverty. For this reason, since 1997, *Human Development Reports* (*HDRs*) have measured poverty in ways different than

traditional income-based measures. The Human Poverty Index (HPI) was the first such measure; the Multidimensional Poverty Index (MPI) succeeded it in 2010.

In 2010, the UNDP Human Development Report Office, in collaboration with the Oxford Poverty & Human Development Initiative (OPHI), a research centre in the University of Oxford's Department of International Development, designed a new index of Multidimensional Poverty. OPHI has computed, and UNDP has published, this Global MPI in every subsequent *Human Development Report*. OPHI's website additionally includes the consistent sub and partial indices of the global MPI for all countries, rural-urban areas,[1] and subnational decompositions possible for each dataset[2] together with special studies including subnational disaggregation, changes over time for strictly harmonized datasets[3] ethnic decompositions,[4] destitution,[5] inequality among the poor,[6] child poverty,[7] gender analysis,[8] and robustness tests.[9]

This document: the Global MPI in 2015

This document synthesizes *all* foregoing studies, to provide under one cover a comprehensive guide to the methodology of estimating and reporting the global MPI in 2015.[10] Recall that the methodology for the first global MPI was first issued in a working paper co-published by OPHI and HDRO, by Alkire and Santos (2010). The underlying methodology, dimensions, indicators, and cutoffs have remained unchanged since 2010. Yet adjustments have been made by HDRO's and OPHI's mutual agreement. Each year a methodological document has accompanied the global MPI launch, and has transparently documented any agreed methodological adjustments included in that year's estimations. Previously published estimations were *not* changed. This document summarizes how the Global MPI 2015 is computed, drawing on *each* previous Methodological document sequentially. However before moving to the specifications we provide a brief intuitive introduction to the MPI and its linked partial and subindices, as well as clarifying how a Global MPI differs from official national poverty statistics.

II. THE MPI, ITS PARTIAL INDICES & SUBINDICES

1 Alkire, Chatterjee et al. 2014b

2 Alkire and Robles Aguilar 2015; Alkire, Roche and Seth 2011; Alkire, Roche et al. 2015

3 Alkire, Roche and Vaz 2014

4 Alkire, Roche and Vaz 2014

5 Alkire, Conconi, Robles and Vaz 2015; Alkire, Conconi and Seth 2014

6 Alkire and Seth 2015

7 Vaz 2014

8 Robles Aguilar 2015

9 Alkire and Santos 2014; Alkire, Santos et al. 2010; Alkire Foster et al. 2015

10 This document brings together the following: Alkire and Santos 2010, 2014; the 2010 UNDP Primer, and OPHI's methodological documents 2011-2015. This document is purely focused on communicating the structure and computations of the global MPI. Those looking for a more detailed discussion of the original 2010 MPI might wish to consult Alkire and Santos 2014.

The MPI is an index designed to measure acute poverty. Acute poverty refers to two main characteristics. First, it includes people living under conditions where they do not reach **the minimum internationally agreed standards in indicators of basic functionings,**[11] such as being well nourished, being educated or drinking clean water. Second, it refers to people living under conditions where they do not reach the minimum standards in **several** aspects **at the same time**. In other words, the MPI measures those experiencing **multiple deprivations,** people who, for example, are both undernourished and do not have safe drinking water, adequate sanitation and clean fuel.

The MPI is an overall headline indicator of poverty, which enables poverty levels to be compared across places, and over time, to see at a glance which groups are poorest, and whether poverty has been reduced or has increased. Having one at-a-glance indicator is tremendously useful for communicating poverty comparisons to policy actors and civil society.

The MPI also is a 'high resolution lens' because it can be broken down in different intuitive and policy relevant ways. The most important breakdowns are: **incidence/intensity**, and **dimensional** composition.

On incidence/intensity, the MPI combines two key pieces of information to measure acute poverty. The **incidence** of poverty is the proportion of people (within a given population) who are identified as poor based on the multiple deprivations they experience. It is denoted *H* for *Headcount ratio*. The **intensity** of poverty is the average proportion of (weighted) deprivations poor people experience – how *poor* people are, on average. It is denoted *A* for *Average deprivation share*. The MPI is the product of both: MPI = H x A.

Both the incidence and the intensity of these deprivations are highly relevant pieces of information for poverty measurement. To start with, the percentage of people who are poor is a necessary measure. It is intuitive and understandable by anyone. People always want to know how many poor people are in a society as a proportion of the whole population.

Yet, that's not enough. Imagine two countries: in both, 30 per cent of people are poor (incidence). Judged by this piece of information, these two countries are equally poor. However, imagine that in one of the two countries poor people are deprived—on average—in one-third of the dimensions, whereas in the other country, the poor are deprived—on average—in two-thirds. By combining the two pieces of information - the intensity of deprivations and the proportion of poor people - we know that these two countries are not equally poor, but rather that the second is poorer than the first because the intensity of poverty is higher.

On **dimensional** composition, the MPI can be consistently broken down by each of its indicators. One particular number that is of interest is what percentage of people are poor and are deprived in each component indicator (*j*). This is the censored headcount ratio h_j. The MPI

11 In Amartya Sen's capability approach, **functionings** are the valuable beings and doings that a person can achieve The Economic Commission for Latin America and the Carribbean are an example of an institution that has released a regional MPI for Latin America in their *Social Panoram 2014,* which covers 17 countries and measures moderate rather than acute poverty, in ways appropriate for that region.

is made by adding up the censored headcount ratios of each indicator, where before adding, each is multiplied by their proportional weight. MPI = sum $[w_j(h_j)]$ for all j, where w_j add up to 1 (e.g. 1/6 or 1/18 in the case of the global MPI).

Because of its robust functional form and direct measures of acute deprivation, insofar as the indicators are comparable,[12] the MPI can be used for **comparisons** across countries or regions of the world, as well as within-country comparisons between regions, ethnic groups, rural and urban areas, and other key household and community characteristics. Furthermore, it enables analysis of **patterns of poverty**: how much each indicator and each dimension contributes to overall poverty.

Before presenting the structure of the Global MPI as published in 2015, it may be useful to contrast it with national measures, and also with other potential specifications of regional or global MPI 2015+s that may arise in conjunction with the Sustainable Development Goals.

III. THE GLOBAL MPI AND NATIONAL MPIS

The MPI is based on a versatile methodology that can be readily adjusted to incorporate alternative indicators, cutoffs and weights that might be appropriate in regional, national, or subnational contexts.

It is desirable to have two kinds of MPI estimations. One kind are 'global' or at times regional estimations that can be **compared** to other countries to enable mutual learning and the sharing of best practices. The second are national MPIs, whose design reflects the policy priorities and cultural and climactic **particularities** of each country.

These are already in place for monetary measures. Global measures such as $1.25/day, $2/day, $4/day and $10/day income poverty measures enable comparisons, global monitoring, and so on. But most countries actually use their own national poverty measures, which are tailored to their own context, to guide policy. International documents such as *World Development Indicators* normally publish both national and global monetary poverty measures. One measure cannot *both* be compared to other countries *and* tailor-made for a given country context. So in the same way, we need two kinds of MPIs.

Each of these categories is explained below.

1. **Global Multidimensional Poverty Index**: A global assessment of multidimensional poverty would ideally cover all countries, using consistent datasets. Ideally it would include at least two different specifications: an MPI for **acute** poverty and one for **moderate** poverty, so as to have some relevance to countries with different levels of multidimensional poverty. From 2010-2015 there has been one MPI, which is called 'Global' in this and other documents but it does not cover all countries, and focuses on acute poverty only. Naturally, it is hoped

[12] The number of indicators, and their definition, have become more comparable in 2015; details are given in Alkire and Robles 2015.

that comparable data will be available for a wider set of countries in the near future, which would also enable estimations of a second measure of moderate poverty.

Comparable measures may also be designed at the **regional** level. The Economic Commission for Latin America and the Caribbean are an example of an institution that has released a regional MPI for Latin America in their *Social Panorama 2014,* which covers 17 countries and measures moderate rather than acute poverty, in ways appropriate for that region.

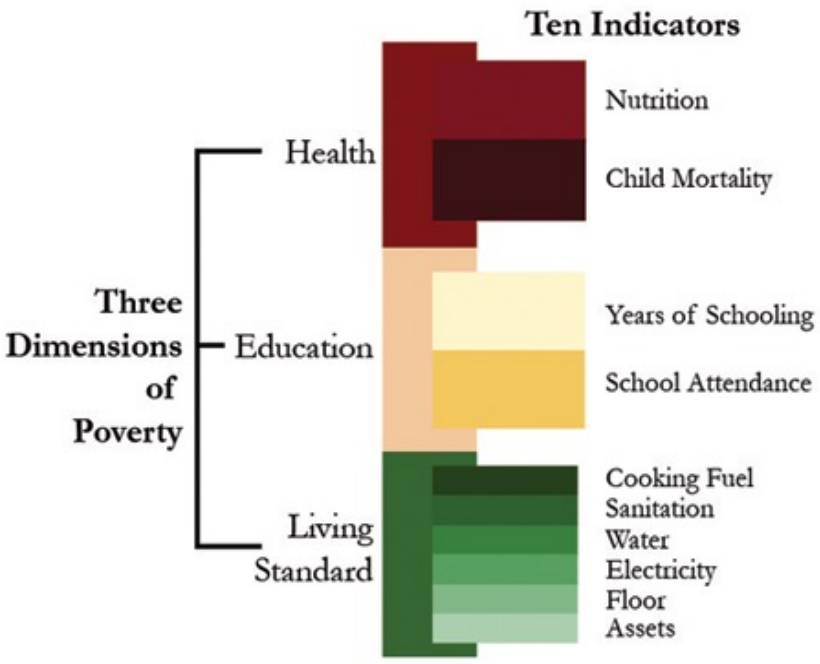
2. **National MPIs**: National MPIs are multidimensional poverty measures that have been created by adapting the Alkire-Foster method upon which the MPI is based to better address local realities, needs and the data available. It may have a different number and set of dimensions and indicators, and have different deprivation cutoffs and poverty cutoff. Their purpose is to assess multidimensional poverty levels in specific countries or regions in the components most relevant and feasible locally. Governments such as Mexico, Bhutan, Colombia, and Chile already publish official National MPIs and use them proactively for policy. The Multidimensional Poverty Peer Network (www.mppn.org) connects many countries who are in the process of considering or designing such official national poverty statistics.

IV. THE STRUCTURE OF THE GLOBAL MPI

The MPI is a measure of acute global poverty developed by the Oxford Poverty and Human Development Initiative (OPHI) with the United Nations Development Programme's *Human Development Report* (Alkire and Santos 2010, 2014; UNDP 2010 and previous methodological notes). The index belongs to the family of measures developed by Alkire and Foster (2007, 2011a; Alkire, Foster, Roche, Seth, Santos, Roche and Ballon (2015). In particular, it is an application of the adjusted headcount ratio, M_0. This methodology requires determining the unit of analysis (i.e. household), identifying the set of indicators in which they are deprived at the same time and summarizing their poverty profile in a weighted deprivation score. They are identified as multidimensionally poor if their deprivation score exceeds a cross-dimensional poverty cutoff. The proportion of poor people and their average deprivation score (i.e. the 'intensity' of poverty or percentage of simultaneous deprivations they experience) become part of the final poverty measure. A more formal explanation of the methodology is presented in Alkire and Santos (2014) and in Alkire and Foster (2011a).

The MPI uses information from 10 indicators which are organised into three equally weighted dimensions: health, education and living standards. These dimensions are the same as those used in the Human Development Index (HDI). The MPI has two indicators for health, two for education and six for living standards. The indicators of the MPI were selected after a thorough consultation process involving experts in all three dimensions. During this process, the ideal indicator definitions had to be reconciled with what was actually possible in terms of data availability and cross-country comparison. The ten indicators finally selected are almost the only set of indicators that could be used to compare over 100 countries.

Figure 1. Composition of the MPI – dimensions and indicators



The MPI begins by establishing a deprivation profile for each person, which shows which of the 10 indicators they are deprived in. Each person is identified as deprived or non-deprived in each indicator based on a deprivation cutoff (more details in Alkire and Santos 2014). Health and Education indicators reflect achievements of all household members. That is, each person is identified as deprived or not deprived using any available information for household members. For example, if any household member for whom data exists is malnourished, each person in that household is considered deprived in nutrition. Taking this approach – which was required by the data - does not reveal intra-household disparities, but it is intuitive and assumes shared positive (or negative) effects of achieving (or not achieving) certain outcomes. Ideally, the MPI would be complemented with individual-level MPIs for children, adults, and elders, which could compare individual level achievements gender and age groups, for example, and document intra-household inequalities. Yet because certain variables are not observed for all household members this is rarely feasible.

Next, looking across indicators, each person's **deprivation score** is constructed based on a weighted average of the deprivations they experience. The indicators use a nested weight structure: equal weight across dimension and equal weight for each indicator within dimensions. Finally, a poverty cutoff of 33.33% identifies as multidimensionally poor those people whose deprivation score meets or exceeds this threshold.

The MPI reflects both the **incidence** or headcount ratio (H) of poverty – the proportion of the population that is multidimensionally poor – and the average **intensity** (A) of their poverty – the average proportion of indicators in which poor people are deprived. The MPI is calculated by multiplying the incidence of poverty by the average intensity across the poor ($H \times A$). A person is identified as poor if he or she is deprived in at least one third of the weighted indicators. Those identified as 'Vulnerable to Poverty' are deprived in 20% – 33.33%

of weighted indicators and those identified as in 'Severe Poverty' are deprived in 50% or more of the dimensions.

Box 1 provides a more precise summary of the dimensions, indicators, thresholds and weights used in the MPI.

Dimension	Indicator	Deprived if…	Related to…	Relative Weight
Education	**Years of Schooling**	No household member aged 10 years or older has completed five years of schooling.	MDG2	1/6
	Child School Attendance	Any school-aged child is not attending school up to the age they'd finish class 8.[+]	MDG2	1/6
Health	**Child Mortality**	Any child has died in the household.	MDG4	1/6
	Nutrition	Any adult under 70 years of age or any 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 at least a 30-minute walk from home roundtrip.[***]	MDG7	1/18
	Flooring	The household has a dirt, sand, dung or other (unspecified) type of floor.		1/18
	Cooking Fuel	The household cooks with dung, wood, charcoal or other solid fuels	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.

[+] The range of eligible 'school-aged' children is determined using the age at which children start primary school, until the year in which they would complete class 8; households having children in this age range who are not attending school are considered deprived.

[*] Adults are considered malnourished if their BMI is below 18.5 m/kg^2. 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, 2014)

V. THE DATA USED TO UPDATE THE GLOBAL MPI

The MPI relies on datasets that are publicly available and comparable for developing countries. The two most widely used surveys are:

- The Demographic and Health Surveys http://www.measuredhs.com/aboutsurveys/dhs/start.cfm
- The Multiple Indicators Cluster Survey http://www.childinfo.org/mics.html
- The Pan Arab Project for Family Health (PAPFAM) Surveys http://www.papfam.org/

In 2010, estimations were also computed using The World Health Survey (WHS) which was conducted once in 2003.[13] These estimations were published for some years if no more recent data were available, and have now been dropped as the 2015 MPI estimations are based on data 2004-2014.

In the countries in which none of these internationally comparable surveys was available, country specific surveys that contained information on the MPI indicators were used if high quality survey with the same indicators were available, if country so requested and if the data were in the public domain. In 2010 for example, this was done for Mexico and for urban Argentina; subsequently national data have been used in other countries like Brazil and China.

Policies for updates

The following policies have governed the MPI updates since 2013.

1. **Data**
   The MPI will be updated when new data become available from the following sources:
   a. Full DHS (including Continuous DHS such as in Peru)
   b. Full MICS

   - A Malaria Indicators Survey (MIS) will not generally be used if a recent DHS or MICS is available, due to its exclusion of nutritional variables and school attendance, the fact that years of schooling may not be available for the household roster, and its sample size.

2. **Labelling of survey year**
   The survey will be dated according to the year in which the fieldwork took place, as detailed in the data report. If the fieldwork took place during two calendar years, the data will be labelled with both years, e.g. 2010/11.[14]

[13] http://www.who.int/healthinfo/survey/en/

[14] The labelling of some surveys' years, presented in previous rounds of the MPI, was modified following this criteria. These include Albania, China, the Czech Republic, Gambia, Haiti, Honduras, India, Kenya, Kyrgyzstan, Macedonia, Madagascar, Montenegro, Namibia, Nicaragua, Occupied Palestinian Territory, Pakistan, Paraguay, Sao Tome and Principe, Serbia, Thailand, Timor-Leste and Uruguay. The MPI estimations were not altered.

3. **Improvements in data sources or survey instruments**
   Naturally, survey instruments such as DHS and MICS improve over time, for example in the way in which improved water or improved sanitation is measured. OPHI's policy is to always use the maximum information that is available for the 10 indicators and incorporate improvement in the questionnaire in new years. For example, if nutritional information is available only for children in one survey round, for women and children in the next round, and in the third, for a male subsample as well, then each round of MPI calculations will take advantage of the maximum available information in the given survey. Similarly when data on mobile telephones or any hitherto missing assets becomes available, this will be incorporated into the asset indicator. As a result, **the MPI estimation for a given year will be the most accurate possible figure with the available data at hand** but may not be comparable across time. The potential comparability is clarified in each country-specific survey note published at the time of the update, and now gathered in the reference document (Alkire and Santos (2010 and 2014); Alkire, S., A. Conconi, and S. Seth (2014); Alkire, S., A. Conconi, and J.M. Roche (2013); Alkire, S., and G. Robles, G. (2015)

4. **Population-weighted global aggregates.**
   The population year used for aggregate estimates based on the global MPI are updated by one year annually. For example in 2015, the 2011 population figures are used. However, OPHI publishes data tables that include both the population during the year of the survey, and those for comparable years. The next section comments on the uses of each set of population data.

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.

Number of MPI poor = H * 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.

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. 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.

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 refer to different years. 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. 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 30 percent of the inhabitants in the 101 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 ratio 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.

VI. PRECISE INDICATOR DEFINITIONS

VII. MISSING HOUSEHOLDS AND MISSING INFORMATION

De Facto or De Jure:

A first issue is which household members' information should be considered for the MPI. Many surveys distinguish two types of household members**:**

- Whether the person is a ***de jure*** **household member**, i.e., whether the member is a **usual resident of the household**.
- Whether the person is **a *de facto* household member**, i.e., whether the member **slept in the household the previous night.**

The MPI uses data on de jure *and* de facto household members. In principle, one would think that only de jure members should be included, as de facto members can be any occasional visitor to the household (national household surveys many times only consider the de jure members). However, the MPI uses information on the de facto members because:

(1) Censuses usually use the de facto criterion (they consider household members those that spent the night in the house).
(2) Some surveys used only the *de facto* population (excluding the *de jure* members -usual residents- that did not spend the night). These would be excluded
(3) Many surveys interview the *de facto* members personally, which indicates that they consider this information to be relevant.

Why not exclude the information of the *de jure* members that did not spend the night in the house? Because:

(1) If we followed this criterion (including the *de facto* members but excluding the *de jure* members that did not spend the night there), the education of an occasional visitor could make the household be non-deprived in education, but the education of a usual resident that only coincidentally did not spend the night there would not be considered. This would be arbitrary.

The MPI, being rigorous, omits from the retained sample any household that is missing information in *any* of the indicators for that country unless the following indicator-specific treatments apply.

- **Education:**

Years of Education: The indicator is whether there is at least one household member with 5 years of education (or when this is not available, with complete primary education).
If there is missing information for some household members we proceed as follows:
If we observe at least one member with 5 or more years of education then, regardless of the number of other members with missing, we classify the household as non-deprived.
Only if more than 1/3 of the household members have missing information on years of education, and the people for which we observe the years of education have less than 5 years, the household is given a missing value in this indicator. However, if we have information of 2/3 (or more) of household members, and these report less than five years, the household will be classified as deprived.

With examples:

Household	Individual	Years of Education	Household Deprived in Education?

1	1	3	Deprived
1	2	2	Deprived
1	3	Missing	Deprived
2	1	Missing	Missing
2	2	Missing	Missing
2	3	3	Missing
3	1	Missing	Non-Deprived
3	2	Missing	Non-Deprived
3	3	10	Non-Deprived
4	1	Missing	Missing
4	2	Missing	Missing
4	3	Missing	Missing

Children's school attendance:
The indicator is that the household is deprived if there are children in school age not attending school.

Set aside for the moment the case of households with no children in school age (this is addressed later). Suppose households have children of school age. I**f ALL children members have missing information on years of education, they are considered as missing.** As long as we have information for one of the children in the household, the household will be classified as non-deprived or deprived depending on whether that child is reported attending school or not.

Household	Individual	Child 6-15?	Attending school?	Household Deprived in Children's school attendance?
1	1	No	No	Non-deprived
1	2	Yes	Missing	Non-deprived
1	3	Yes	Missing	Non-deprived
1	4	Yes	Yes	Non-deprived
2	1	No	No	Deprived
2	2	Yes	Missing	Deprived
2	3	Yes	Missing	Deprived
2	4	Yes	No	Deprived
3	1	No	No	Missing
3	2	Yes	Missing	Missing
3	3	Yes	Missing	Missing
3	4	Yes	Missing	Missing

- **Health:**

Women and Children Nutrition
The indicator is whether there is a woman OR a child (or both) who are undernourished.

Only if both indicators are missing, we consider the household as missing. If we have information on one of them, we use it to construct the deprivation profile.

There are **two steps involved** here:

Step 1: creating the household indicator for each nutritional variable
1a) Children's nutrition:

Household	Individual	Child eligible?	Undernourished?	Household Deprived in Children's nutrition?
1	1	No	No	Non-deprived
1	2	Yes	Missing	Non-deprived
1	3	Yes	Missing	Non-deprived
1	4	Yes	Well-nourished	Non-deprived
2	1	No	No	Deprived
2	2	Yes	Missing	Deprived
2	3	Yes	Missing	Deprived
2	4	Yes	Undernourished	Deprived
3	1	No	No	Missing
3	2	Yes	Missing	Missing
3	3	Yes	Missing	Missing
3	4	Yes	Missing	Missing

1b) Women's BMI

Household	Individual	Woman eligible?	Undernourished?	Household Deprived in Women's nutrition?
1	1	No	No	Non-deprived
1	2	Yes	Missing	Non-deprived
1	3	Yes	Missing	Non-deprived
1	4	Yes	Well-nourished	Non-deprived
2	1	No	No	Deprived
2	2	Yes	Missing	Deprived
2	3	Yes	Missing	Deprived
2	4	Yes	Undernourished	Deprived
3	1	No	No	Missing
3	2	Yes	Missing	Missing
3	3	Yes	Missing	Missing
3	4	Yes	Missing	Missing

Step 2: Producing the combined indicator:

Household	Deprived in Women's BMI?	Deprived in children's nutrition?	Household Deprived in Nutrition?
1	Non-deprived	Non-deprived	Non-deprived
2	Deprived	Deprived	Deprived
3	Deprived	Non-deprived	Deprived
4	Non-deprived	Deprived	Deprived
5	Missing	Deprived	Deprived
6	Deprived	Missing	Deprived
7	Missing	Non-deprived	Non-deprived
8	Non-deprived	Missing	Non-deprived
9	Missing	Missing	Missing

IMPORTANT NOTE: If we LACK one indicator (which happens in certain countries), then the nutritional indicator is reduced to the one that is available.

Child Mortality
The indicator is whether there was a child who had died in the household in the last five years.

Suppose households have at least one eligible female or male. For age non-restricted variables:

Household	Female reported child death?	Male reported child death?	Household Deprived?
1	No	No	Non-Deprived
2	Yes	Yes	Deprived
3	Yes	No	Deprived
4	No	Yes	Deprived
5	Missing	Yes	Deprived
6	Yes	Missing	Deprived
7	Missing	No	Non-Deprived
8	No	Missing	Non-Deprived
9	Missing	Missing	Missing

For age restricted variables, it is missing if woman did not answer, deprived if woman reported child death under 5 age (or 15, corresp), and non-deprived if reported no child death under 5 (or 15).

- **Living Standard:**

There are six living standard variables: water, electricity, toilet, cooking fuel, floor and an assets indicator.

If there is missing information on water, electricity, toilet, cooking fuel or floor, then this indicator is excluded from the computation of the poverty measure. Weights are re-adjusted accordingly. Ex: if there are 10 indicators in total, then originally each of the living standard indicators received a relative weight of 1/18 (5.56%). If one is missing, they will receive a relative weight of 1/15 (6.66%).

The assets indicator considers a household as non-deprived if it has more than one of: TV, radio, telephone, refrigerator, motorcycle, bicycle OR if it has a car/truck. If there is one of these missing, then, we implicitly assume that they do not have it. The indicator takes missing value ONLY if we do not have information for any of the 7.

Some examples:

Household	TV	Radio	Telephone	Refrigerator	Motorcycle	Bicycle	Car	Assets Deprived?
1	Yes	Yes	missing	missing	Missing	Yes	No	Non-deprived
2	No	Yes	No	No	No	No	missing	Deprived
3	missing	missing	missing	missing	Missing	Missing	Yes	Non-deprived
4	missing	missing	missing	missing	Missing	Missing	No	Deprived
5	missing	missing	missing	missing	Missing	missing	missing	Missing

3 - Missing Households

Once each indicator has been constructed treating missing values as explained above, for the poverty estimates we only use households that have complete information in all the constructed indicators. However to fully assess missing data it is necessary also to review the next session, on applicable populations. .

VIII. APPLICABLE AND NON-APPLICABLE POPULATIONS

The next issue is to clarify how to treat households with non-applicable populations. Four of the ten indicators are not applicable to all the population. These are:

(1) **Children's school attendance:** not applicable to households without children in school age
(2) **Children's nutrition:** not applicable to households with no children within the eligibility criteria (under 5 years old) to be weighed and measured.
(3) **Women's BMI:** not applicable to households with no eligible women, which in DHS are generally women aged between 15 and 49 that were de facto members of the household. In some countries eligibility also excludes women who have never been married.
(4) **Child mortality:** When we use the age-restricted indicator (child mortality in the past five years), this is not applicable to households that did not have eligible women to be interviewed. When we use the non-age restricted indicator, this is not applicable to households that did not have either a woman nor a man eligible for interview (as the men's questionnaire did not ask about the age at death, only the incidence of death).

The procedure followed here is to consider as non-deprived in each indicator the households that do not have the relevant population.

Definition: Eligible Women: "Eligible women are usually defined to be women aged 15-49 who slept in the household the previous night, irrespective of whether they usually reside in the household or are visiting the household. In early DHS II surveys, the eligibility criteria also required that the members slept the previous night in the household. In later surveys, this criteria was dropped and all usual residents and visitors who slept in the household the previous night were interviewed. Non *de facto* women were later dropped in the analysis and do not appear in the Individual Recode Data File. In some countries an evermarried sample is used for the individual interview, and so the eligibility criteria is further restricted to ever-married women." (pp. 14, 86).

Definition: Eligible Men: "**Eligible men** are usually defined to be men aged 15-59 (or 15-54 in some cases) who slept in the household the previous night, irrespective of whether they usually reside in the household or are visiting the household. In some countries an ever-married sample is used for the individual interview, and so the eligibility criteria is further restricted to husbands of eligible women." (p. 103).

For **children's school attendance** **we create** a variable with value one if the household has children in school age (we consider an eight year span from the country's actual year at which school begins), and we consider non-deprived the households that have no children within that age range. For households that do have children in school age and have missing information, the criterion detailed in the previous section applies.

For **children's nutrition** we use a variable such as that provided by DHS in the PR file (variable hv035), which indicates the number of eligible children, and we consider as non-deprived in child nutrition households that did not have any eligible children. **Note that we use the variable provided by the survey itself**, rather than creating one, because eligibility criteria may vary for one country to another (in terms of age, and some other things such as whether the child was present or not, etc). This avoids any erroneous definition of the variable (which will affect the number of households considered non-deprived in this indicator).

For **Women's BMI** we use a variable such as that provided by DHS in the PR file (variable hv041), which indicates the number of eligible women to be weighed and measured, and we consider as non-deprived in women's BMI households that had 0 eligible women. **Note that, again, we use the variable provided by the survey itself** rather than creating one because eligibility criteria may vary for one country to another. This avoids any erroneous definition of the variable (which will affect the number of households considered non-deprived in this indicator).

For **child mortality**, the criterion depends on whether the indicator is restricted by age or not as follows:

For the under 5 or under 15 child mortality: we use a variable such as that provided by DHS in the PR file (variable hv010) which indicates the number of eligible women for interview in the household. We consider as non-deprived (in child mortality) all households

having zero eligible women to be interviewed. **Note that we use the variable provided by the survey itself** rather than creating one because eligibility criteria may vary for one country to another. This avoids any erroneous definition of the variable (which will affect the number of households considered non-deprived in this indicator).

For the age-unrestricted mortality indicator: we use **two variables** akin to those provided by DHS in the PR file (variable hv117 and hv118) which indicate the number of eligible women and men for interview in the household correspondingly. The criterion for women was already stated above. Eligible men are defined above. In some countries only women are interviewed. Households that have 0 females AND 0 males eligible for interview are considered non-deprived in this indicator. **Note that we use the variable provided by the survey itself** rather than creating one because eligibility criteria may vary for one country to another. This avoids any erroneous definition of the variable (which will affect the number of households considered non-deprived in this indicator).

Note then that for each of the households with non applicable population for the indicator were considered as non-deprived. However, households with applicable population that had missing values are considered as missing.

VIII.1 Education

The MPI uses two complementary indicators for education. One looks at completed "years of schooling" of household members, the other at whether children are attending school. Note that both years of schooling and school attendance are imperfect proxies. They do not capture the quality of schooling, the level of knowledge attained or skills. Yet both indicators are robust and widely available, and provide the closest feasible approximation to levels of education for household members.

In terms of deprivation cut-offs for this dimension, the MPI requires that at least one person in the household has completed **five years** of schooling and that **all children** of school age are attending school up to the age in which they would complete class eight.

It is important to note that because of the nature of the MPI indicators, someone living in a household where there is at least one member with five years of schooling is considered non-deprived, even though she may not be educated. Analogously, someone living in a household where there is at least one child not attending school is considered deprived in this indicator, even though she may have completed schooling. People living in households with no school-aged children are considered non-deprived in school attendance. Hence the incidence of deprivation in this indicator will reflect the demographic structure of the household and country, as well as the educational attainments.

VIII.2 Health

Comparable indicators of health for all household members are generally missing from household surveys, making this dimension the most difficult to measure. The MPI uses two health indicators that, although related, depart significantly from standard health indicators: nutrition and child survival.

The first indicator uses data on child survival and child deaths. Most, although not all, child deaths are preventable, being caused by infectious disease or diarrhoea. Child malnutrition also

contributes to child death. In the MPI each household member is considered to be deprived if there has been at least one observed child death in the household in the last five years. It is important to observe that this indicator differs from the standard mortality statistics

The second indicator looks at nutrition of household members. For children, malnutrition can have life-long effects in terms of cognitive and physical development. Adults or children who are malnourished are also susceptible to other health disorders; they are less able to learn and to concentrate and may not perform as well at work. The nutritional indicator used for children relates to being under-weight (also called weight-for-age), which is used to track the MDGs. A child is under-weight if she is two or more standard deviations below the median of the reference population. The nutritional indicator used for adults is the Body Mass Index (BMI). An adult is considered to be undernourished if he or she has a BMI lower than 18.5. We do not consider children or adults that are overweight to be deprived in nutrition.

The MPI identifies a person as deprived in nutrition if anyone in their household (for whomever there is information on—children, women or other adults) is malnourished. Therefore, it is fundamental to note that deprivation rates by indicator depart from the standard nutritional statistics, and depend upon the survey used and the demographic structure of the household.

In some countries, the DHS capture information in nutrition only for a subsample of the eligible population.[15] The MPI will be computed based on the subsample when:

a. the subsample for anthropometrics was designed to be nationally representative, and
b. the sampling weights were appropriately designed to generate unbiased nationally representative MPI estimates, and
c. bias analysis shows that there is no statistically significant difference in the remaining MPI indicators between the whole sample and the subsamples.

If the above conditions are not met, then the MPI will be estimated using the full sample and considering all information contained in the survey. If nutrition is measured only for a subgroup of the whole sample, the MPI estimations will be a 'lower bound', because the assumption will be made that households in which no woman or child has been measured for nutritional status are non-deprived in nutrition.

In 2010-2011 rounds of the MPI the subsamples in nutritional data were not taken into account as they were not so prevalent.

VIII.3 Living standards

The MPI considers six indicators for standards of living. It includes three standard MDG indicators that are related to health and living standards, and which particularly affect women: access to clean drinking water, access to improved sanitation, and the use of clean cooking fuel. The justification for these indicators is adequately presented in the MDG literature. It

[15] The eligible population are normally children under 5 years of age, and adults in reproductive age (only women or both genders). When a subsample is taken for anthropometric indicators, only a percentage of eligible households are included for anthropometric measures (usually 50% or 1/3 of the whole national sample). Technically, this subsample is also nationally representative, but it incurs a higher standard error due to a smaller size.

also includes two non-MDG indicators: access to electricity and flooring material. Both of these provide some rudimentary indication of the quality of housing. The final indicator covers the ownership of some consumer goods, each of which has a literature surrounding them: radio, television, telephone, bicycle, motorbike, car, truck and refrigerator.

The selected deprivation cut-offs for each indicator (except for the one relating to assets) are backed by international consensus as they follow the MDG indicators as closely as data permit.

Water: A person 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). If it fails to satisfy these conditions, then the household is considered deprived in access to water.[16]

Improved sanitation: A person is considered to have access to improved sanitation if the household has some type of flush toilet or latrine, or ventilated improved pit or composting toilet, provided that they are not shared. If the household does not satisfy these conditions, then it is considered deprived in sanitation.

Electricity: A person is considered to be deprived here if it does not have access to electricity.

Flooring: Flooring material made of dirt, sand dung or 'other' (unspecified) types of floor counts as deprivation in flooring.

Cooking fuel: A person is considered deprived in cooking fuel if the household cooks with dung, charcoal or wood.

Assets: If a household does not own more than one radio, TV, telephone, bike, motorbike or refrigerator, and does not own a car or tractor then each person in it is considered deprived.[17]

Clearly, all the living standard indicators are means rather than ends; they are not direct measures of functionings. Yet, they have two strengths. In the first place, these are means very closely connected to the end (or the functionings) they are supposed to facilitate. Second, most of the indicators are related to the MDGs, which provide stronger grounds for their inclusion in our index.

VIII.4 Changes in 'complementary' information

If the complementary information used to compute the MPI is updated, then the MPI will be computed using the most up-to-date complementary information relevant for the survey year. For example, if the compulsory starting age at which children enter school changes (as

---

16 Following the MDGs, improved water sources do not include vendor-provided water, bottled water, tanker trucks or unprotected wells and springs. If bottled water is the main source of drinking water, the household is considered to have improved access to water if the source of non-drinking water is other than drinking water.

17 Note that the "asset index" of the MPI is exactly the same for all countries. It is not based on principal components analysis (PCA) as other asset indices are (such as the DHS Wealth Index) because if such a procedure were used, (a) it would require a relative cut-off rather than an absolute cut-off for the asset index, which would be inconsistent with the rest of the measure; (b) it would not be comparable across countries or across time, because the PCA would weight each component differently in each survey. Prices could not be used to construct the asset index as the surveys lack information on the price, quality or age of assets.

reported in the official tables of UNESCO), then the MPI indicator for school attendance will reflect the appropriate compulsory starting age that was in effect during the year(s) of the survey. Similarly, if other standards such as BMI or reference groups for child malnutrition change, the corresponding MPI indicator will change.[18]

IX. ROBUSTNESS AND BIAS ANALYSIS

When analysing the MPI estimates there are a number of robustness checks that are worth performing.

Robustness to deprivation cut-offs. Are the rankings between countries, or between regions within a country, robust to changes in the deprivation cut-off? In a basic way, this requires computing the MPI for the set of countries or regions you are handling with slightly different deprivation cut-offs, or maybe different indicators altogether. For example, you may use stunting rather than under-weight for the nutritional indicator for children, or you may use a slightly more demanding criterion for what is considered "adequate sanitation." Once computed, build the rankings and then compute rank correlation coefficients such as Kendall's Tau b or Spearman. For examples and details, see Alkire and Santos (2010, 2014).

Robustness to the poverty cut-off. Are the rankings between countries, or between regions within a country, robust to changes in the poverty cut-off? The rankings may be robust to changes within a certain reasonable range, but not necessarily for every possible cut-off value. At the most basic level, this requires computing the MPI for the set of countries or regions you are handling with different poverty cut-offs, and not just the 1/3 cut-off, then building the rankings and computing rank correlation coefficients such as Kendall's Tau b or Spearman. For examples and details, see Alkire and Santos (2014).

Robustness to weight. Are the rankings between countries, or between regions within a country, robust to changing the indicators' weights? Rankings may be robust to changes in indicator weights across a reasonable sets of weights. At the most basic level, this requires computing the MPI for the set of countries or regions using alternative weighting schemes, building the rankings, and then computing rank correlation coefficients such as Kendall's Tau b or Spearman. For examples and details, see Alkire and Santos (2010, 2014) and Alkire, Santos et al (2010).

Bootstrapping and Standard Errors. MPI estimates, as well as its components H and A, may vary with the sample. A very basic statistical principle is that point estimates are proxies to the true value of the parameter but they are not exactly the true value. Point estimates vary with changes in the sample. The question is how much? The reliability of the point estimate depends upon the variability around it. That is why it is useful to construct

[18] As explained in Alkire and Santos (2010), the nutritional indicator for children is weight-for-age. A child is considered to be underweight if he or she is two or more standard deviations below the median of the reference population. To guarantee strict comparability of the nutritional indicators for children across surveys, they are estimated in all cases (DHS, MICS or other surveys considered in every round) following the algorithm provided by the WHO Child Growth Standards (http://www.who.int/childgrowth/software/en/). The reference population from which the median is calculated has recently been updated by the WHO, as has the methodology used to construct the growth curves (WHO 2006).

confidence intervals around the point estimate to know how much that point estimate can vary. This are done using analytical standard errors or bootstrapping.

X. FURTHER METHODOLOGIES AND SPECIFICATIONS

Decomposition of national MPI at sub-national level

Subnational decompositions of MPI are performed if the datasets 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 0.05) so that a meaningful sub-national analysis can be pursued.
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 perform 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.

The Measurement of Destitution

In 2014, to illustrate the ability of the MPI to consider the 'depth' of deprivations rigorously although data may be ordinal, we estimate a new poverty measure which we call **destitution**. This destitution measure has precisely the same dimensions, indicators, weights, and poverty cutoff as the MPI. Only one set of parameters changes: the deprivation cutoffs. The cutoffs for 8 of the 10 indicators now reflect more extreme deprivations. As a result, the destitution measure identifies a strict subset of the MPI poor who are also deprived in at least one-third of the indicators according to the destitution cutoffs.

That is, those identified as 'Destitute' are deprived in at least one third or more of the same weighted indicators with more extreme deprivation cutoffs (as described in Table 2); for example, two or more children in the household have died, no one in the household has more than one year of schooling, a household member is severely malnourished, or the household practices open defecation. Data on destitution is available for 49 of the 108 countries analysed in the MPI 2014. For detail, see Alkire Conconi & Seth (2014).

Table 2: The dimensions, indicators, deprivation cutoffs and weights of the Destitute

Dimensions of poverty (same as for standard MPI)	Indicator (same as for standard MPI)	Deprived if…
Education	Years of Schooling	No household member aged 10 or older has completed **at least one** year of schooling.
	Child School Attendance	**No children** are attending school up to the age at which they should finish **class 6.**
Health	Child Mortality	**2 or more children have died** in the household.
	Nutrition	**Severe undernourishment** of any adult (**BMI<17kg/m²**) or any child (**-3 standard deviations** from the median).
Living Standard	Electricity	The household has no electricity (**no change**).
	Improved Sanitation	There is **no sanitation facility (open defecation).**
	Improved Drinking Water	The household does not have access to safe drinking water, or safe water is more than a **45-minute** walk (round trip).
	Flooring	The household has a dirt, sand, dung or other unspecified type of floor (**no change**).
	Cooking Fuel	The household cooks with dung, wood or organic waste (**coal/lignite/charcoal are now non-deprived**).
	Assets ownership	The household has **no assets (radio, mobile phone, refrigerator, etc.)** and no car.

Inequality Among the Poor

Although the ultimate goal is to alleviate poverty, it is important to understand if the fruit of poverty alleviation is share by all poor people and by all groups. A drastic reduction in the number of poor or their average intensities may not ensure that those with larger number of multiple deprivations have been benefitted. We attempt to measure the level of inequality in deprivation scores among the poor, both at the national level and within subnational regions, by using a separate, decomposable inequality measure. We also use the measure to assess disparity across subnational MPIs.

In order to fit our goal of studying both inequality among the poor within population subgroups and disparity between population subgroups, Seth and Alkire (2014) proposed an additively decomposable inequality measure. This inequality measure – which is a positive multiple of "variance" – can be broken down into a within-group and a between-group component. For measuring inequality among the poor at the national level, the inequality measure I^q uses the vector of deprivation scores of the q poor people $c_i(k)$.

$$I^q = \frac{\tilde{\beta}}{q}\sum_{i=1}^{q}[c_i(k) - A]^2.$$

The difference between each poor person's deprivation score and average intensity is squared, and the squared distances summed and multiplied by a constant $\tilde{\beta}$ to create the measure of inequality. The deprivation scores of the poor range between 1/3 and 1, and so we set $\tilde{\beta} = 1/9$. This is the maximum possible value the inequality measure can take given the range of deprivation scores and thus ensures that the inequality measure is bounded between zero and one. In practice, in the MPI 2014 estimations, inequality among the poor at the national level varies from 0.006 to 0.300.

The same measure is used to compute inequality among the poor within each subnational region as

$$I^{q^\ell} = \frac{\tilde{\beta}}{q^\ell} \sum_{i=1}^{q^\ell} [c_i(k) - A^\ell]^2,$$

where q^ℓ is the number of poor in subgroup ℓ and A^ℓ is the average intensity within that subgroup. As earlier, in this case, we also choose $\tilde{\beta} = 1/9$. In the MPI 2014 estimations, inequality among the poor at the subnational level varies from 0 to 0.346.

A lower level of inequality among the poor or a reduction in the level of inequality among the poor, however, may not mean that poverty has uniformly gone down in all regions or population subgroups. For measuring regional or subnational disparity across MPIs, the MPI of each of the m subnational regions, denoted by MPI^ℓ (each having a population of n^ℓ for $\ell = 1, \ldots, m$) is combined in a similar manner with the national MPI (with population size n). The measure of subnational disparity is denoted by I^{MPI} and is calculated as

$$I^{MPI} = \tilde{\beta} \sum_{\ell=1}^{m} \frac{n^\ell}{n} \left(MPI^\ell - MPI\right)^2.$$

Thus, the difference between each regions MPI and the national MPI is squared, and the population-share weighted squared distances are summed and multiplied by a constant $\tilde{\beta}$ to create the measure of disparity. In this case, we choose $\tilde{\beta} = 1/4$ because MPIs range between zero and one. In the MPI 2014 estimations, it varies from zero to 0.144.

For further details of the measure and how it is applied, see Seth and Alkire (2014), available at http://www.ophi.org.uk/measuring-and-decomposing-inequality-among-the-multidimensionally-poor-using-ordinal-data-a-counting-approach/.

Changes Over Time

A strong motivation for computing multidimensional poverty is to track and analyse changes over time. This section describes how to compare M_0 and its associated partial indices (as well as Destitution measures) over time using repeated cross-sectional data, which are the most widely available data. We also compare inequality over time.

The basic component of poverty comparisons is the absolute pace of change across periods. The **absolute rate of change** is the simple difference in poverty levels between two periods. We denote the initial period by t^1 and the final period by t^2, and the corresponding achievement matrices for these two periods by X_{t^1} and X_{t^2}, respectively. The same set of

parameters – deprivation cutoff vector z, weight vector w and poverty cutoff k – are used in each period.

The **absolute rate of change** (Δ) is the difference in MPIs between two periods and is computed as

$$\Delta MPI = MPI(X_{t^2}) - MPI(X_{t^1}).$$

Similarly, for H and A:

$$\Delta H = H(X_{t^2}) - H(X_{t^1}).$$

$$\Delta A = A(X_{t^2}) - A(X_{t^1}).$$

The absolute rate of change is indifferent to the initial level. For example, a 5 percentage point reduction of H could mean that H decreased from 75% to 70% or from 10% to 5%. Changes (increases or decreases) in poverty across two time periods are also evaluated using relative rates. The **relative rate of change** is the difference in poverty as a percentage of the initial poverty level. Interpreting the analysis of absolute and relative changes together provides a clear sense of overall progress.

The **relative rate of change** (δ) is computed for the MPI (and similarly for H, and A which are not presented) as

$$\delta MPI = \frac{MPI(X_{t^2}) - MPI(X_{t^1})}{MPI(X_{t^1})} \times 100.$$

The absolute and relative changes, however, are not comparable for different countries when the reference periods are of different length. To compare the rates of poverty reduction across countries that have different period of references, annualized changes are used. The **annualized absolute rate of change** ($\bar{\Delta}$) is the difference in the MPI between two periods divided by the difference in the two time periods ($t^2 - t^1$) and is computed for the MPI as

$$\bar{\Delta} MPI = \frac{MPI(X_{t^2}) - MPI(X_{t^1})}{t^2 - t^1}.$$

The **annualized relative rate of change** ($\bar{\delta}$) is the compound rate of reduction in the MPI per year between the initial and the final periods, and is computed for the MPI as

$$\bar{\delta} MPI = \left[\left(\frac{MPI(X_{t^2})}{MPI(X_{t^1})} \right)^{\frac{1}{t^2 - t^1}} - 1 \right] \times 100.$$

The same formula can be used to compute and report annualized changes in the other partial indices, namely H, A, censored headcounts, or percent contributions. And all of these formulas may be used for MPI or for destitution measures.

The reductions in MPI can be broken down by dimensions. An analysis of changes in MPI considers both changes in the raw or uncensored headcount ratios (h_j) and in the censored headcount ratios ($h_j(k)$). The changes in censored headcount ratios depict changes in deprivations among the poor.

Changes in the national MPI can be decomposed by subnational regions, ethnic groups, or other population subgroups. That is, poverty in each period can be expressed as: $\text{MPI} = \sum_{\ell=1}^{m} v^{\ell}\text{MPI}(X^{\ell})$, where $\text{MPI}(X^{\ell})$ and $v^{\ell} = n^{\ell}/n$ denote the MPI and the population share of subgroup ℓ, respectively. It can be extremely useful to analyse poverty changes by population subgroups, to see if the poorest subgroups reduced poverty faster than less poor subgroups, and to see the dimensional composition of reduction across subgroups (Alkire and Seth 2013, Alkire and Roche 2013, Alkire Roche and Vaz 2014). Population-shares for each time period must be analysed alongside subgroup trends in order to take into account demographic shifts such as migration or population growth.

Changes in inequality over time has been computed for each period and then applying the annualized and non-annualized changes over time as introduced earlier in this section for the MPI.

2010-2011 changes:

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.[19] Second, for countries lacking two or more indicators we made the poverty cutoff precisely equivalent to that of those with 9 or 10 indicators.[20]

[19] 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.

[20] 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.

REFERENCES

Alkire, S. 2008. "Choosing Dimensions: The Capability Approach and Multidimensional Poverty." In N. Kakwani and J. Silber (eds.), *The Many Dimensions of Poverty*. Basingstoke: Palgrave Macmillan.

Alkire, S. 2011. "Capability and Functionings: Definition and Justification." Human Development and Capabilities Association (HDCA) Briefing Note. [Online] Available at: <http://www.capabilityapproach.com/pubs/HDCA_Briefing_Concepts.pdf > [Accessed 5 August 2011].

Alkire Foster *et al.* 2015. Alkire, S, J. E. Foster, S. Seth, M. E. Santos, J. M. Roche, and P. Ballon. *Multidimensional Poverty Measurement and Analysis: A Counting Approach.* Oxford University Press.

Alkire, S., Conconi, A., Robles, G. and Vaz, A. 2015. "Destitution: Who and Where are the Poorest of the Poor?" OPHI *Briefing* 35, University of Oxford. [Online] Available at: <http://www.ophi.org.uk/wp-content/uploads/Destitution-Who-and-Where-are-the-Poorest-of-the-Poor.pdf?d4a512> [Accessed 22 May 2015].

Alkire, S., Chatterjee, M., Conconi, A., Seth, S. and Vaz. A. 2014b. "Poverty in Rural and Urban Areas: Direct Comparisons Using the Global MPI 2014." OPHI *Briefing* 24, University of Oxford. [Online] Available at: <http://www.ophi.org.uk/wp-content/uploads/Poverty-in-Rural-and-Urban-Areas-Direct-Comparisons-using-the-Global-MPI-2014.pdf?d4a512> [Accessed 22 May 2015].

Alkire, S., A. Conconi, and S. Seth 2014. "Multidimensional Poverty Index 2014: Brief Methodological Note and Results." OPHI *Briefing* 19, Oxford University.

Alkire, S., A. Conconi, and J. M. Roche 2013. "Multidimensional Poverty Index 2013: Brief Methodological Note and Results." OPHI *Briefing* 12, Oxford University.

Alkire, S., Conconi, A. and Seth, S. 2014. "Measuring Destitution in Developing Countries: An Ordinal Approach for Identifying Linked Subset of Multidimensionally Poor." OPHI *Research in Progress* 42a, University of Oxford. [Online] Available at: <http://www.ophi.org.uk/wp-content/uploads/OPHI-RP-42a.pdf?d4a512> [Accessed 22 May 2015].

Alkire, S. and Deneulin, S. 2009. "The Human Development and Capability Approach." In *An Introduction to the Human Development and Capability Approach: Freedom and Agency*, eds., S. Deneulin and L. Shahani. London: Earthscan.

Alkire, S. and Foster, J. E. 2007. "Counting and Multidimensional Poverty Measures." OPHI *Working Paper* 7, University of Oxford.

Alkire, S., and Foster, J. E. 2011a. "Counting and Multidimensional Poverty Measurement." *Journal of Public Economics*. 95(7-8): 476-487.

Alkire, S., and Foster, J. E. 2011b. "Understandings and Misunderstandings of Multidimensional Poverty Measurement." *Journal of Economic Inequality*. 9(2): 289-314.

Alkire, S, Foster, J. E. and Santos, M. E. (2011), 'Where has Identification Gone?' *Journal of Economic Inequality,* 9(3): 501-505.

Alkire, S., and Robles, G. (2015). "Multidimensional Poverty Index 2015: Brief Methodological Note and Results." *OPHI Briefing* 31, University of Oxford.

Alkire, S. and G. Robles Aguilar 2015. "High Visibility: How Disaggregated Metrics Help to Reduce Multidimensional Poverty." OPHI *Briefing* 28. [Online] Available at: <http://www.ophi.org.uk/wp-content/uploads/Global-MPI-highlights-briefing-Jan-2015.pdf?d4a512> [Accessed 22 May 2015].

Alkire, S. and J. M. Roche 2013. "Beyond Headcount: Measures that Reflect the Breadth and Components of Child Poverty." In A. Minujin and S. Nandy (eds.), *Global Child Poverty and Well-Being: Measurement, Concepts, Policy and Action*. Bristol: The Policy Press. 2012.

Alkire, S., Roche, J. M. and Seth, S. 2011. "Sub-national Disparities and Inter-temporal Evolution of Multidimensional Poverty across Developing Countries." OPHI *Research in Progress* 32a, University of Oxford. [Online] Available at: <http://www.ophi.org.uk/wp-content/uploads/OPHI-RP-32a2011.pdf?d4a512> [Accessed 22 May 2015].

Alkire, S., Roche, J. M., Santos, M. E., and Seth, S. (2011). "Multidimensional Poverty Index 2011: Brief Methodological Note." OPHI *Briefing* 07, University of Oxford,.

Alkire, S., Roche, J. M. and Seth S. (2011), 'Sub-national Disparity in Multidimensional Poverty', *mimeo.*

Alkire, S., Roche, J. M., Seth, S. and Sumner, A. 2015. "Identifying the Poorest People and Groups: Strategies Using the Global Multidimensional Poverty Index." *Journal of International Development* 27: 362-387.

Alkire, S., Roche, J. M. and Vaz, A. 2014. "Multidimensional Poverty Dynamics: Methodology and Results for 34 Countries." OPHI *Research in Progress* 41a, University of Oxford. [Online] Available at: <http://www.ophi.org.uk/wp-content/uploads/OPHI-RP-41a.pdf?d4a512> [Accessed 22 May 2015].

Alkire, S. and Santos, M. E. (2010), 'Acute Multidimensional Poverty: A New Index for Developing Countries,' OPHI *Working Paper 38*, Oxford Poverty and Human Development Initiative, University of Oxford.

Alkire, S. and Santos, M.E. 2014. "Measuring Acute Poverty in the Developing World: Robustness and Scope of the Multidimensional Poverty Index." *World Development.* 59: 251-274.

Alkire, S., Santos, M. E., Seth, S. and Yalonetzky, G. 2010. "Is the Multidimensional Poverty Index Robust to Different Weights." OPHI *Research in Progress* 22a, University of Oxford. [Online] Available at: <http://www.ophi.org.uk/wp-content/uploads/OPHI-RP22a.pdf> [Accessed 22 May 2015].

Alkire, S. and Seth, S. 2015. "Multidimensional Poverty Reduction in India between 1999 and 2006: Where and How?" *World Development* 72: 93–108.

Atkinson, A. B., Marlier, E., Nolan, B., and Vandenbrouke F., (2002) *Social indicators: The EU and Social Inclusion.* Oxford, Oxford University Press.

"Description of the Demographic and Health Surveys Individual Recode- Data File. Version 1.0 (with differences from DHS III)." March 5, 2008.

Demographic and Health Surveys, (Various Years and Countries)[21], ORC Macro, Calverton, Maryland, USA. http://www.measuredhs.com/
Encuesta Nacional de Nutrición y Salud (ENNyS), Argentina (2004-2005). http://www.unsa.edu.ar/bibsalud/descargas/Guia_para_la_elaboracion_de_analisis_e_informes.pdf

Economic Commission for Latin America and the Caribbean (ECLAC) 2014. *Social Panorama of Latin America.*

Encuesta Nacional de Salud y Nutrición (ENSANUT), Mexico (2006). http://www.insp.mx/encuesta-nacional-salud-y-nutricion-2006.html

Enquete Nationale sur les Niveaux de Vie des Menages (ENNVM), Morocco (2007). http://www.hcp.ma/downloads/Niveau-de-vie-et-pauvrete-Enquete-nationale-sur-les-niveaux-de-vie-des-menages_t13111.html

Foster J. E., McGillivray, M. and Seth, S. (2009), 'Rank Robustness of Composite Indices', OPHI *Working paper 26*, University of Oxford.

Multiple Indicator Cluster Surveys, (Various Years and Countries)[22], UNICEF, United Nations Children's Fund, http://www.unicef.org/statistics/index_24302.html

[21] Gabon (2000), Lesotho (2009), Maldives (2009), Dominican Republic (2007), Nicaragua (2006), Sao Tome and Principe (2009), Mozambique (2009), Colombia (2010), Bangladesh (2007), Benin (2006), Senegal (2005), Uganda (2006), Guyana (2005), Zimbabwe (2006), Malawi (2004), Sierra Leone (2008), Republic of Congo (2009), Bolivia (2008), Nigeria (2008), India (2005), Honduras (2006), Moldova (2005), Cote d'Ivoire (2005), Kenya (2009), Jordan (2009), Ukraine (2007), Madagascar (2009), Liberia (2007), Cameroon (2004), Pakistan (2007), Namibia (2007), Timor-Leste (2009), Indonesia (2007), Swaziland (2007), Niger (2006), Armenia (2005), Turkey (2003), Mali (2006), Philippines (2008), Ethiopia (2005), Guinea (2005), DR Congo (2007), Zambia (2007), Peru (2004), Azerbaijan (2006), Albania (2009), Rwanda (2005), Tanzania (2008), Ghana (2008), Cambodia (2005), Nepal (2006), Haiti (2006), Viet Nam (2002), Egypt (2008).

[22] Comoros (2000), Myanmar (2000), Vanuatu (2007), Syrian Arab Republic (2006), Mauritania (2007), Djibouti (2006), Iraq (2006), Suriname (2006), Angola (2001), Kyrgyzstan (2006), Somalia (2006), Central African Republic (2000), Belize (2006), Bhutan (2010), Burkina Faso (2006), Georgia (2005), Montenegro (2005), Mongolia (2005), Togo (2006), Serbia (2005), Macedonia (2005), Trinidad and Tobago (2006), Tajikistan (2005), Lao (2006), Gambia

National Income Dynamic Study (NIDS), South Africa (2008), http://www.nids.uct.ac.za/home/

National Income Dynamics Study (2008), Southern Africa Labour and Development Research Unit (SALDRU), University of Cape Town's School of Economics, http://www.nids.uct.ac.za/home/

Palestinian Family Health Survey (PAPFAM), Occupied Palestinian Territories (2006), http://www.childinfo.org/mics3_surveys.html

Pesquisa Nacional de Demografia e Saúde (PNDS), Brazil (2006) http://bvsms.saude.gov.br/bvs/pnds/saude_nutricional.php

Robles Aguilar, G. 2015. "An Exploration of the Multidimensional Poverty of Women at Household and Individual Level." Oxford Poverty and Human Development Initiative (OPHI), University of Oxford. [Online] Available at: <http://www.ophi.org.uk/ophi_events/an-exploration-of-the-multidimensional-poverty-of-women-at-household-and-individual-level/> [Accessed 22 May 2015].

Sen, A, K. 1999. *Development as Freedom*. Oxford: Oxford University Press.

Seth, S. and Alkire, S. 2014. "Measuring and Decomposing Inequality among the Multidimensionally Poor Using Ordinal Data: A Counting Approach." OPHI *Working Paper* 68, University of Oxford. [Online] Available at: <http://www.ophi.org.uk/wp-content/uploads/ophi-wp-68.pdf> [Accessed 22 May 2015].

UNDP (United Nations Development Programme). 2010. *Human Development Report 2010. The Real Wealth of Nations: Pathways to Human Development*. UNDP, New York.

Vaz, A. 2014. "Are Children Among the Poorest?" OPHI *Briefing* 26, University of Oxford. [Online] Available at: <http://www.ophi.org.uk/wp-content/uploads/Age-decomp-briefing.pdf?d4a512> [Accessed 22 May 2015].

World Health Surveys, (Various Years and Countries)[23], World Health Organization (WHO). http://www.who.int/healthinfo

(2006), Burundi (2005), Uzbekistan (2006), Thailand (2005), Yemen (2006), Bosnia and Herzegovina (2006), Kazakhstan (2006), Belarus (2005).

23 United Arab Emirates (2003), Ecuador (2003), Guatemala (2003), Chad (2003), Sri Lanka (2003), Slovenia (2003), Tunisia (2003), Latvia (2003), Russian Federation (2003), Slovakia (2003), Paraguay (2003), Czech Republic (2003), Estonia (2003), Croatia (2003), Hungary (2003), Uruguay (2003), China (2003).