Courant Research Centre

'Poverty, Equity and Growth in Developing and Transition Countries: Statistical Methods and Empirical Analysis'

Georg-August-Universität Göttingen
(founded in 1737)

Discussion Papers

No. 233

The Multidimensional Poverty Index: Achievements, Conceptual and Empirical Issues

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July 2017

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The Multidimensional Poverty Index: Achievements, Conceptual and Empirical Issues

Caroline Dotter and Stephan Klasen*

Abstract

The Multidimensional Poverty Index (MPI) has been an important contribution to the debate on national and international poverty measurement. With the creation of the global MPI, OHPI and UNDP have provided a household-level multidimensional poverty measure for over 100 developing countries that can usefully complement the widely used $1.25 a day income poverty indicator. Given its link to the concept of human development, it is an important element of the suite of human development indicators maintained and published by UNDP. Nonetheless, there are many open empirical questions and issues regarding the conceptual underpinning of the MPI that need to be discussed and carefully considered. This essay discusses issues with the dual cut-off method for poverty identification, and how inequality could be incorporated in this poverty measure. Moreover, the choice of headline indicator is debated. We also propose a number of changes regarding the empirical implementation. These include dropping the WHS as one of the data sources, dropping the BMI as a nutrition indicator, and changing the age ranges and cut-offs for the education and mortality indicators. Different approaches to deal with the large share of households where information on an MPI indicator is missing are also discussed. The empirical relevance of these changes are analysed using the Demographic and Health Surveys (DHS) for Armenia, Ethiopia, and India. We argue that these changes could pose improvements to the current formulation, but one may need to investigate them further and for a larger number of countries. In a final section, we briefly comment on the HDRO revisions to the MPI in the 2014 Human Development Report, which have been partly based on the recommendations made in this paper.

*We would like to thank Sabina Alkire, Isis Gaddis, James Foster, Sanjay Reddy, Nicole Rippin, Jose Manuel Roche, Suman Seth, and Subbu Subramanian for helpful comments and discussions on these issues. In addition, we want to thank Sabina Alkire and her colleagues at OPHI as well as Milorad Kovacevic, Cecilia Calderon, and the HDRO Office for helpful comments on an earlier version of this paper. Funding from the HDRO in support of this work is gratefully acknowledged. All errors remain our own. *Corresponding author: Caroline Dotter (cdotter@gwdg.de).*

Keywords: poverty, poverty estimation, multidimensional poverty estimation

1 Introduction

The Multidimensional Poverty Index (MPI) has been published by the HDRO in the annual Human Development Report since 2010. Up until the 2014 Human Development Report (see below), it was based on an index developed by Alkire & Santos (2014) at the Oxford Poverty and Human Development Initiative (OPHI). This indicator is presented and discussed in detail by Alkire & Santos (2014). It is a particular form of a class of multidimensional poverty indices proposed by Alkire & Foster (2011*a*) using a dual cut-off approach to identify the multidimensionally poor.

Since its introduction, there has been a vigorous debate on the conceptual and empirical merits and problems of the MPI (e.g. Lustig 2011, Silber 2011, Alkire & Foster 2011*b*, Rippin 2013, Ravallion 2011, Bossert et al. 2012, among others). It is impossible to do justice to all the points that have been raised. In particular, it is very difficult to come to definitive judgments on some of the conceptual issues surrounding the MPI. Many of the points raised in this discussion are essentially value judgments about the desirable and undesirable features of the MPI, relative to potential 'competitors'.

Instead, the aim of this paper will be first to briefly assess whether and to what extent a micro-based multidimensional poverty measure such as the MPI can and has enriched our understanding of poverty and deprivation across the world. Second, we will review the conceptual debate surrounding the MPI and suggest some further avenues of thinking about these issues. More importantly, however, this paper will, thirdly, deal with a range of open empirical questions regarding the MPI: the choice of indicators and cut-offs, the treatment of missing information, and ways to simplify the index.

While we will discuss the merits of different conceptual approaches that would require the MPI to be fundamentally reworked, the more specific recommendations will be on the empirical implementation of the index as currently conceived. The final purpose of the paper is to briefly present and comment on the changes HDRO has made to the MPI in the 2014 Human Development Report, some of which were partly based on recommendations made in this paper.

In the following section, we will briefly explain the structure of the original MPI. This is followed by a discussion of the manifold achievements of the MPI, and a summary of the conceptual critique of the MPI. In section 5, we discuss the open empirical questions of the MPI and present a revised version of the MPI in the following sections. We then

summarize our conceptual and empirical proposals. The last section shortly discusses the changes to the MPI in the 2014 HDR.

2 The MPI

The Multidimensional Poverty Index (MPI) has been developed by Alkire & Santos (2014) for the 2010 Human Development Report. It is an index of acute multidimensional poverty and is based on the Alkire & Foster (2011*a*) dual cut-off method for poverty identification.[1] The MPI (M0 measure) itself is the product of the MPI headcount H (measuring the share of the population that is multidimensionally poor), and the weighted deprivation share of multidimensionally poor households A (measuring the weighted percentage of indicators, in which the multidimensionally poor are on average deprived).

Alkire & Santos (2014) identify three dimensions to be included in the MPI: health, education, and the standard of living. These dimensions mirror the Human Development Index (HDI). They have been chosen because there is consensus that any multidimensional poverty measure should at least include these three dimensions; for the ease of interpretability; and finally for reasons of data availability. While there are arguments for including additional dimensions such as powerlessness, deprivation of rights, violence, shame, or time use, there is often no data available and much disagreement about which dimensions are appropriate. However, few would dispute the necessity of health, education, and a decent standard of living for a life free from poverty. Whether an individual may be considered deprived in each indicator is determined at the household level. This choice has largely been made for reasons of data availability of some of the indicators.[2]

Following the Alkire-Foster method, Alkire and Santos first define cut-offs in each indicator, aggregate poverty using weights, and then apply a cross-dimensional poverty cut-off. The three dimensions are represented by ten indicators. Health is represented by child mortality and malnutrition. A household and, thus, all its members is deprived in mortality, if any child has died in the family. Similarly, all household members are deprived in nutrition if there is at least one undernourished person in the household. Education is represented by years of schooling and child school enrolment. Years of schooling are used as a proxy for literacy and level of understanding of the household

[1] The Alkire-Foster method extends the traditional approaches of multidimensional poverty identification, the intersection and the union approach. The method employs two cut-offs: First a cut-off within each dimension or indicator is applied to identify who is poor within each dimension. Then poverty across dimensions is aggregated, and the second cut-off is applied to identify poverty across dimensions.

[2] For a proposal for an MPI at the individual level, see Vijaya et al. (2014).

members. An individual is considered literate, if he or she has at least five years of education. Following Basu & Foster (1998), the MPI assumes all household members benefit from one literate household member (of any age). Therefore, the household is considered non-deprived, if at least one household member has five years of schooling. The household is deprived in the enrolment indicator if any of the children of primary school age are not enrolled in school (see below). The living standard is represented by access to electricity, clean drinking water, improved sanitation, flooring (no dirt, sand, or dung floor), clean cooking fuel, and an asset index. Electricity and floor refer to the quality of housing, while drinking water, improved sanitation, and clean cooking fuel have health impacts and are part of the Millennium Development Goals (MDG 7). Finally, a household is deprived in assets if it does not own more than one small asset (radio, TV, telephone, bike, motorbike, or refrigerator) and does not own a car or truck. After determining the indicator cut-offs, the Alkire-Foster method attaches weights to each deprivation. The MPI applies equal weights across dimensions (each dimension receives a weight of 1/3), and within each dimension indicators are weighted equally. The weighted deprivations are then summed up and the cross-dimensional cut-off is applied. The MPI uses a cross-dimensional cut-off of one third. Hence, a household is multidimensional poor if its weighted deprivations sum up to one third or more.
In the MPI poverty is aggregated using a poverty index (M0) of a class of Alkire-Foster poverty measures M(α), which can account for the incidence of multidimensional poverty (H) and the average deprivation share among the poor (A). The M0 poverty measure fulfils several desirable poverty axioms and is decomposable by indicator and subgroup.

For this analysis, we will illustrate our points regarding the MPI using Demographic

Table 1: Descriptive Statistics

	All	Armenia	India	Ethiopia
urban	30.01%	62.30%	30.83%	11.97%
small household (1-3)	14.58%	24.54%	14.32%	12.92%
medium-sized household (4-6)	51.43%	60.75%	51.73%	45.81%
large household (7+)	33.99%	14.72%	33.96%	41.27%
male-headed household	87.83%	71.37%	89.27%	82.93%
'older' household[3]	22.61%	32.97%	21.85%	24.54%
total observations	594,047	24,351	504,968	64,728

and Health Surveys (DHS) from three countries: Armenia, Ethiopia, and India. While this sub-sample can by no means be representative, it provides an interesting example

since we can see how our proposed changes affect households in countries with vastly different levels of multidimensional poverty and human development. Moreover, the demographic composition of households varies a lot across these three countries. As can be seen in Table 1, the three countries differ substantially in the rates of urbanization, the prevalence of small and large households, and the prevalence of 'older'[4] households. Table 2 also shows a vastly different incidence of multidimensional poverty for the three countries, ranging from 0.6% in Armenia to 90.5% in Ethiopia. Our total sample consists of nearly 600,000 observations, all stemming from the DHS surveys for these countries.

Table 2: Multidimensional Poverty across sub-groups and countries

	H	A	MPI
all	54.85%	55.28%	0.303206
urban	20.82%	48.47%	0.100921
rural	69.44%	56.15%	0.389922
Armenia	0.57%	38.24%	0.002194
Ethiopia	90.48%	64.59%	0.584382
India	52.76%	53.17%	0.28055

3 Achievements of the MPI

The MPI has not been the first attempt in measuring multidimensional poverty. There have been many multidimensional poverty measures proposed in the literature and applied to individual countries (see also the discussion below on conceptual issues). The main contribution of the MPI, as we see it, vis–à–vis the existing work, is its breadth of country-coverage and its international comparability. In 2010 the MPI was calculated for 104 developing countries using just 3 types of datasets (DHS, MICS, and WHS)[5] and since then a few dozen more countries have been added. For an increasing number of countries, multidimensional poverty at the household level has been calculated at two points in time (UNDP 2014). Through this broad coverage, the MPI is, in principle, able to make statements about the extent of global multidimensional poverty in a way similar to those the World Bank's $1-a-day poverty line makes about global absolute income poverty. So far it has not been used in this way, but this could be done using appropriate methods that will make plausible assumptions about the MPI poverty in

[4] A household is considered old if the average age of adult household members is above 35.
[5] For Mexico and Argentina, different datasets were used.

countries where these survey data are not available.[6]

In fact, the data utilized by UNDP to calculate global multidimensional poverty is somewhat more reliable than the one used for the income poverty measure, where the comparability of survey instruments across countries and over time is much less certain (e.g. Devarajan 2013). In that sense the MPI should, we believe, most sensibly be seen as the multidimensional analogue, or multidimensional 'competitor' of the international income poverty line.

In contrast to the $1-a-day line, it has the huge advantage of measuring well-being outcomes directly, in line with Amartya Sen's functioning and capability approach Sen (1999*b*,*a*). Hence, UNDP has a macro level well-being indicator based on the capability approach (the HDI and the IHDI to consider inequalities), and a micro-level deprivation indicator, the MPI, at its disposal.

Conversely, we do not see a clear role for the MPI in relation to the Millennium Development Goals and Sustainable Development Goals. These goals intentionally consider individual well-being dimensions separately in order to avoid the opacity and possible trade-offs that come with a composite index. In that sense, we see the possible role of the MPI as an overall monitoring tool to measure multidimensional well-being, but not a measure for which goals or targets should be directly formulated. It should also not replace the focus on reducing deprivation in the individual dimensions of well-being covered by the SDGs.

A second major achievement is that the MPI, through its base on household survey information, is a much more actionable and policy-relevant indicator for countries and agencies than the HDI. One can decompose the MPI by region, by particular groups, and by indicator, thereby allowing countries to directly see which groups suffer most and in which dimensions they are deprived.

Third, by basing its analysis on households, the MPI is consistent with the axiomatic approaches to poverty measurement in ways that the UNDP's Human Poverty Index, proposed in 1996 (UNDP 1996), was not. The Human Poverty Index combined three aggregate deprivations into a single measure. It was not possible to identify the number of poor people; study the extent of their deprivation, or their regional heterogeneity; or use different aggregation rules to build up the aggregate from the experience of individuals or households. It also allows for an analysis of the joint distribution of deprivations, which the Human Poverty Index could not provide. In contrast to the MPI, the HPI remained an aggregate ill-being measure, akin to the HDI but using different dimensions.

[6]The World Bank faces the same difficulty with their dollar-a-day calculations and has developed approaches for dealing with this. See, for example, Chen & Ravallion (2004)

Fourth, the MPI does *not* suffer from two defects that have been raised in early discussions about it. Some questioned the accuracy of the MPI: While it is surely the case that some of the indicators are measured with error, the data quality is likely to be no worse and often better than for aggregate indicators such as life expectancy or GDP per capita. As has been discussed by Jerven (2012), Devarajan (2013), Harttgen et al. (2013) GDP statistics in many parts of the world, but particularly in Africa, are very poor and subject to drastic revisions. As discussed in Klasen & Vollmer (2013), there is no credible adult mortality data for many developing countries (including, again, most of Africa) so that life expectancy data are usually simulated rather than measured. In fact, the DHS has become the main 'official' source for infant and child mortality data in many developing countries and thus is the main source of the simulations for life expectancy. Moreover, the DHS and MICS data generally are no less official than aggregate statistics produced by national statistical offices. Usually, these surveys are done in conjunction with national statistical offices and in most countries these surveys are part of the regular survey program of national statistical offices.
These strengths are mostly due to the fact that the MPI is built up from micro data and uses standardized and roughly comparable household surveys as their base. In principle, one could construct a very different multidimensional poverty measures that would still retain some of the advantages of the MPI just discussed.

4 Conceptual Critique of the MPI

Since its launch in the 2010 Human Development Report, the MPI has been vocally criticized and the concept has been hotly debated in the sphere of development research. The MPI is based on an ordinal version of the dual cut-off multidimensional poverty measures proposed by Alkire & Foster (2011*a*). There were closely related multidimensional poverty measures proposed in the literature before Alkire and Foster suggested their measure. These are also based on the (weighted) aggregation of deprivations across dimensions, some using ordinal data. As summarized by Subramanian (personal communication and Jayaraj & Subramanian (2010)), very similar formulations were proposed by Jayaraj & Subramanian (1997, 2002, 2005, 2007, 2010), Brandolini & D'Alessio (1998), Bourguignon & Chakravarty (2003), Chakravarty & D'Ambrosio (2006); Bossert et al. (2012) also pursued a similar approach in independent work. The main contribution of Alkire & Foster (2011*a*) is the dual cut-off approach which tries to navigate between the allegedly empirically unappealing union and intersection approaches to multidimensional poverty identification.

The union approach considers anyone who is deprived in any poverty indicator to be poor, while the intersection approach considers people who are deprived in all indicators to be poor. Hence, the former approach usually yields very high and the latter very low levels of poverty incidence (Alkire & Santos 2014). Indeed, Jayaraj & Subramanian (2002, 2007), Rippin (2013), Bossert et al. (2012) have all used the union approach for identifying the multidimensionally poor. Which should be preferred?

4.1 Comparison to union and intersection approach

On the one hand, a strong case can be made for the dual cut-off approach on substantive and empirical grounds. On substantive grounds, one can argue that the simultaneity of deprivations is required for someone to be not only *deprived*, but also to be considered *multidimensionally poor* (Santos et al. 2013).

Moreover, an empirical issue of the union method is that it returns very high poverty outcomes. As shown by Rippin (2013), if one uses the union approach with the MPI indicators and cut-offs, the poverty incidence is over 90% in many countries. This is not only a difficult political sell, but may also be a result of measurement error or instances where the indicators do not cover the particular deprivations well. For example, the MPI presumes households that do not report on the possession of a particular asset (yielding a missing observation in the survey) do not own the particular asset. If the union approach were applied, a household would then be considered multidimensionally poor. Similar measurement errors might exist in the measurements of height and weight, correct ages for enrolment rates, and the like. Or it may be the case that a child has a low weight for age not due to undernutrition, but to a recent bout of illness or simply due to the fact that her parents have (genetically) very light body frames that were transmitted to her.[7] She could also be fasting for religious or other reasons (Alkire & Santos 2014).

Though these individuals may be deprived in nutrition, a poverty measure should not focus on a fasting but otherwise affluent person. By raising the cut-off to 30% (or some other number that is higher than being deprived in just one indicator), one reduces the chance of such misclassifications[8] and allows policy to focus on the simultaneously deprived.

Both the substantive as well as empirical advantages of the dual cut-off approach over

[7] After all, undernutrition definitions based on anthropometrics are based on a statistical likelihood that a person with a low weight for age is actually undernourished (Klasen 2008).

[8] Of course, there might be other ways of dealing with this. One could reduce the number of dimensions, particularly omitting those where such misclassifications are most likely, or one could raise the cut-offs within a dimension. There are downsides to these potential remedies as well.

the union approach increase with the number of indicators chosen. If the MPI was composed of 30 indicators, the union approach would be very hard to justify as the vast majority of households are likely to be deprived in at least one indicator (for reasons to do with a real deprivation suffered in that dimension, particular choices made that lead to an apparent deprivation, or mere measurement error)[9]. One would then vastly inflate the problem of multidimensional poverty, rendering it essentially meaningless.

Conversely, when we apply the intersection approach to a poverty measure with a lot of indicators, only very few individuals would be considered poor, as nearly everyone is likely to be non-deprived in at least one indicator. However, reducing the MPI to only 5 or 6 meaningful and well-measured indicators that signify important deprivations would make this problem much less severe. The conceptual and empirical issues of reducing the number of indicators (tackled below) are thus related. We will come back to this question at the end.

Hence, the dual cut-off approach is advantageous to the union approach if we want to focus on households or individuals suffering from joint deprivations. In addition, the approach suffers less from measurement error in single indicators. Moreover, from a policy perspective, it is preferable to both the union and the intersection approach as it produces a clear and easily communicable poverty outcome that is usable for policy actions.

On the other hand, the dual cut-off off approach may lead to a certain amount of confusion, because it identifies individuals as multidimensionally deprived but not poor. Moreover, it is problematic that these individuals' deprivations are not relevant for the assessment of multidimensional poverty in the whole society, because they fail to surpass the second cut-off. We potentially lose a lot of relevant information about multidimensional deprivations in this society if we solely focus on the MPI headcount and the censored deprivation headcounts.

This approach also creates some formal problems. As discussed by Subramanian (personal communication), it violates monotonicity of poverty measurement among the deprived.[10] As long as people do not surpass the second threshold, we do not care whether

[9] See Santos et al. (2013) for examples of deprivations due to choices or measurement error.

[10] As shown by Santos et al. (2013) and formally shown in Alkire & Foster (2011*a*), it is, of course, entirely possible to generate a set of axioms that are satisfied by the dual cut-off approach and the aggregation procedure of the MPI. These axioms imply a strong separation between identification and aggregation. In the identification step, the focus axiom implies that we should only focus on those who pass the threshold of being multidimensionally poor; if we do that, then the resulting measure will obey monotonicity in the sense that increasing the deprivation of a poor person increases the MPI. But this is only because we chose to ignore the deprivations suffered by those who do not pass the second cut-off (to obey the focus axiom)! More generally, the strict separation between identification and aggregation,

they are deprived in none, one, or two indicators and treat them all as non-poor.[11] One solution would be to consider people who are deprived in at least one indicator but below the cut-off as vulnerable (OPHI is working on proposals in this direction), but this then adds another cut-off.

The additional aggregation of deprivations in the dual cut-off approach also adds the problem of choosing weights, and the possibility of potential trade-offs between deprivations (cf. Ravallion 2011, 2012, among others). Moreover, deprivations are treated as perfect substitutes below the cut-off and as perfect complements above the cut-off, giving substantial importance to the cut-off (Rippin 2013). Finally, the discontinuous nature of the dual cut-off approach clouds the effects that improvements or deteriorations in specific indicators have on aggregate poverty. The introduction of a second cut-off makes the impact of specific policies much harder to pinpoint, and changes in poverty levels aredual cut–off harder to understand.

Summing up, one of the main advantages of the dual cut–off approach is that it is generally open to an unlimited number of indicators. It can therefore capture a much broader definition of poverty and can possibly accommodate several culturally-specific concepts of poverty (i.e. including indicators deemed less relevant in some cultures, but more relevant in others). Conversely, if the MPI was focused on fewer indicators (as suggested below) this advantage is not as compelling.

The dual cut–off method is also less sensitive to misclassifications and mismeasurement. Most importantly perhaps, the method enables politicians to focus on the simultaneously deprived. However, considering someone deprived but not poor is somewhat confusing, and the dilemma of choosing weights and the possibilities of trade-offs between indicators is real.

We therefore believe that a stronger utilization of the poverty intensity (in terms of the number of dimensions one is poor) and possibly inequality (see discussion below) would circumvent the issue of very high poverty headcounts when the union approach is used. The resulting aggregate measures would still allow country and individual rankings and a policy focus on those deprived in many dimensions. One would then need to choose indicators and indicator cut-offs more carefully. Some of these empirical

which makes a lot of sense in uni-dimensional poverty measurement, is less compelling in the case of multidimensional poverty measurement, as the adding up of dimensions where a household is poor can already be seen as a form of aggregation; conversely, one may think of identification not as a yes/no question, but a question of degree as proposed by Rippin (2013).

[11] Related to this, discontinuities arise at the cut-off that could have been avoided had the union approach been chosen (Subramanian, personal communication).

issues are discussed below (cf. section 5).

4.2 Neglect of Inequality

A further conceptual problem is the neglect of inequality in the spread of dimensions across the population. Similar to FGT1 in the uni–dimensional case, only average deprivations (intensity) and deprivation headcounts matter, but we ignore inequality of deprivations among the poor. If deprivations were redistributed in a regressive fashion among the multidimensionally poor (e.g. those with the most deprivations got more, while those with fewer deprivations got less but remained multidimensionally poor), this would not change the MPI outcomes at all.

Several researchers have pointed to this issue (e.g. Silber 2011) and there have been a range of proposals to deal with it, including Chakravarty & D'Ambrosio (2006), Jayaraj & Subramanian (2010), and Rippin (2013). Alkire and Foster themselves are also working on an approach incorporating inequality in the assessment.

Each of these proposals has particular strengths and weaknesses, however it goes beyond the scope of this paper to discuss all of them in detail. A particularly straight-forward solution has been proposed by Rippin (2013): In the identification step, she no longer just decides whether an individual is considered poor or not (as is usually done); she assigns different degrees of poverty to households. These poverty degrees are based on the weighted share of deprivations suffered by households. In the aggregation step, she then adds these deprivation scores over the population. Through this approach inequality in the distribution of deprivations across the population is explicitly considered. In households with many deprivations the marginal impact of an additional deprivation is larger than in households with less deprivations. A particular advantage of the approach is that the resulting Correlation-Sensitive Poverty Index can be readily decomposed into a headcount component, an intensity component, and an inequality component. This might be one way to take this issue forward and should be studied more carefully, alongside other proposals that have been made to address this issue.[12]

4.3 Choice of the headline indicator

A third conceptual issue that might be worth considering relates more to which part of the MPI ought to be the headline indicator. The MPI may be regarded as the

[12]There are, of course, downsides to this approach as well. First, it uses a union-approach to identify who is poor with all the advantages and disadvantages; second, it presumes a particular relationship or substitutability or complementarity between dimensions which is empirically hard to verify and might in any case differ across dimensions.

multidimensional competitor or analogue to the $1-a-day measure (where usually only the headcount is reported and is also the target for the 1st MDG). Therefore, it might be worth focusing on the headcount of the MPI as the headline indicator, rather than the product of headcount and average intensity. Moreover, the variation in the MPI between countries and over time is largely driven by the headcount and much less so by the intensity. This can be readily seen in Alkire & Santos (2014), where it is clearly the case that the variance of the poverty intensity A across countries is much smaller than the variance in the headcount H (see also Table 2).

Additionally, the intensity is truncated from below by the value of the second cut-off (if the second cut-off is 30%, the average intensity among the poor must, by definition, be larger than 30%). As discussed above, whether or not to apply a second threshold is controversially debated in the literature. The choice in the value of the cut-off (MPI applies 1/3, but the Alkire-Foster method is open to other choices) is also open to debate. Hence, this truncation, essentially ignoring the intensity of deprivation of the non-poor, is problematic.

Using the dual cut–off method (contrary to the union or intersection approach), the headcount conveys a much stronger political message and may be able to compete with the $1-a-day measure more directly. When applying the union approach, the headcount is not found to be a very intelligible statistic, as many people are likely to suffer some deprivation. There are two ways out of this dilemma: one is to use the union approach for the headcount, but generate a second measure that can determine the intensity and deprivation level (covering all of the deprived). We then consider the entire depth of deprivations, not just the one below the cut-off. In this case, the variance in intensity (and possibly inequality) is, empirically, likely to be much larger. A second, much less elegant, way out would be to use a dual cut–off approach for the headline indicator and a union approach that considers intensity and inequality (such as the one suggested by Rippin (2013)) as a second measure.

4.4 Relativity of deprivations

A fourth conceptual issue to consider is relativity of dimensional cut-offs. Similar to the international income poverty line that is less and less relevant for an increasing number of countries, one might consider whether one should similarly construct a (weakly) relative MPI cut-off that rises with the average well-being in a country (see Ravallion & Chen (2011) for a weakly relative international income poverty line). In the multidimensional context, one could either adjust the dimensional cut-off to reflect rising average stan-

dards, or one could lower the second cut-off of the weighted deprivation share necessary to be poor.

Given that the data used for the MPI is categorical and cannot be adjusted smoothly, this would be a conceptually and empirically difficult exercise but well-worth considering. If such a smooth adjustment of the cut-offs proves to be impossible due to the categorical nature of the data, an alternative would be to at least define a second MPI that chooses a higher cut-off for each indicator. One would then have MPI indicator thresholds for poorer and richer countries separately. Alternatively, one could also apply a lower second cut-off at the aggregate index. Both approaches are somewhat comparable to the $2 or $4 poverty lines used in some analyses for richer developing countries.

Again, one has to carefully consider the merits and problems of such an approach (Santos et al. 2013). First, there is the apparent counter-argument, going back to Sen's famous article "Poor, Relatively Speaking" (Sen 1983): he argues in the space of capabilities and functionings, one should measure absolute poverty. However, the resources required to reach such capabilities will differ across countries, thus in the income space a relative poverty measure is to be preferred.

This counter-argument might plausibly hold in the health dimension where we indeed try to measure functionings. Nevertheless, in the standard of living dimension, the MPI does not measure functionings or capabilities, but access to goods that might enable some functionings. This is most clearly the case with the asset count which does not have an absolute functioning interpretation at all. Whether one can consider a certain number of assets adequate really depends on the prevailing standards in a society. Similar arguments can be made regarding floor material, electricity access, and possibly even with water, sanitation, and cooking fuel, where in richer countries or urban areas the standards chosen might simply be too low.[13]

Likewise, one could argue for varying thresholds in education. While at some level, education (for example literacy) itself can be seen as an absolute capability, whether education allows for active participation in society, business or the economy will also depend on the average level of education prevailing in a society. This would suggest that the standards in health may be considered universal and absolute, but the ones for the standard of living and education could be higher in countries with higher average achievements. It would also suggest that the logic of Sen's argument would imply higher indicator cut-offs in the education and living standards dimensions, rather that a lower

[13]To take the example of water access, while clean water is the key issue here, whether it is acceptable in a upper middle-income country to have access to clean water 20 minutes away from the house is a legitimate question. Thus the cut-off chosen for the MPI could be relevant for poorer countries and a higher standard would be appropriate for richer countries.

second cut-off for calling someone multidimensionally poor in a better-off society Dotter & Klasen (2014*a*).

To conclude this section, it is important to point out that the particular choices inherent in the dual cut–off method underlying the MPI are controversial. One could easily consider the union approach more relevant for identification and then think about weighted deprivation counts as poverty measures that also consider inequality between dimensions. We would also submit that the intensity component of the MPI, within the current dual cut–off framework, is less relevant and that work should begin on considering relative versions of the MPI. It is also important to reiterate two points. First, many of the critiques and suggestions are essentially judgment calls about the merits and problems of particular ways of framing the issue. Ultimately, pragmatic and policy-relevant decisions that also consider data, communication, and interpretability issues will need to be taken by HDRO. Second, the conceptual issues are linked as are the empirical issues. For example, the union approach with the headcount as the main indicator (and an intensity and inequality adjusted second measure) might make a lot more sense if the MPI consists of few very well-measured and meaningful dimensions; conversely, the more indicators, and the more empirical problems with them, the less useful this proposal would be.

5 Empirical Issues with the MPI

In this section, we will discuss the of data sets, indicators, and dimension- and indicator-specific cut-offs. Here we will simply consider the MPI in its current formulation and thus no longer discuss the conceptual issues we had just raised. We will return to the issue below since the conceptual and empirical issues are linked. In this section, we will not discuss the weights or the basic three-component set-up of the MPI (health, education, and standard of living) as this would go beyond the scope of the paper. We broadly agree with these choices and particularly see a compelling rationale that the dimensions and weights should closely mirror similar decisions made in the HDI.

5.1 Problematic use of the WHS

A serious problem arises with the use of the three different datasets. While the DHS basically allows a complete assessment of all indicators, the MICS lacks information on the nutritional status of adults. More seriously, the WHS lacks information on children's

nutrition (and just has it on the respondent), and also lacks data on school attendance. While the MPI adjusts for these data gaps by reweighting the other component in the same dimension (e.g. if attendance is missing in the education dimension, the years of schooling indicator gets a higher weight), this is not without problems as the different components have different mean deprivation levels and the reweighting systematically biases the results for these countries. Moreover, this practice implicitly assumes, one of the components can proxy for the other one in the same dimension. This is, however, not necessarily the case. There are many households who are deprived in schooling years but not in attendance and vice versa; similarly in the health dimensions, not all households who lost a child also have a person who is undernourished.

A second problem arises particularly with the nutrition indicator: in surveys where only adults are measured there is an automatically lower probability that households will be deprived compared to surveys where both adults and children are measured. The WHS is obviously the more limiting dataset here, and we therefore strongly suggest that the MPI is based solely on the DHS and MICS. These could be supplemented by individual surveys that meet all the criteria of the DHS and MICS. This approach would reduce the country coverage somewhat, but ensure better comparability and reliability of the results.[14]

5.2 Dynamics

One might suspect that the MPI would suffer from the problem of great inertia and low dynamics. The limited literature on dynamics in non-monetary poverty indicators found, these indicators generally respond slower than monetary indicators of poverty (cf. Günther & Klasen 2009, Baulch & Masset 2003). Examining the deprivation indicators used, one would assume we observe little dynamic in the mortality indicator, which is a backward-looking stock measure, the education stock variable, and most of the standard of living indicators. But results from a workshop on dynamic comparisons, organized by OPHI and the University of Gttingen, (http://www.ophi.org.uk/workshop-on-monetary-and-multidimensional-poverty-measures/) suggested that there are surprising dynamics in the MPI over time when using new waves of the DHS or MICS. In fact, in some country case studies the dynamics of the MPI are as large as the income poverty dynamics. For example, Mitra (2016) observes a significant reduction in the multidimensional

[14] As raised by Santos et al. (2013) who broadly support the idea to drop the WHS, of particular concern would the omission of China from the MPI. One option might be to consider whether the China Health and Nutrition survey would be suitable to calculate the MPI; it has limited coverage but is considered quite reliable.

poverty headcount for Nepal between 1995 and 2010 (80% to 27%). This is accompanied by a similarly strong reduction in monetary poverty (64% to 25%). However, different households are identified as poor when each poverty measure is applied.
Santos (2013) applies different weighting structures and cut-offs when analyzing multidimensional poverty in Bhutan between 2003 and 2007. She observes a significant reduction in multidimensional poverty for all specifications; for a specification comparable to the MPI the multidimensional poverty headcount decreases from 47% in 2003 to 32% in 2007.
Tran et al. (2015) find for Vietnam, dynamics in consumption and multidimensional poverty between 2007 and 2010 are similar. Nevertheless, the mobility across sub-groups differs; transitions out of and into monetary poverty are usually not accompanied by the same transitions in multidimensional poverty.
Analyzing a sample of 34 countries, Alkire et al. (2015) observe statistically significant reductions in multidimensional poverty in 30 countries. Top-performing countries decreased their original MPI level by 5% to 9% per year. Comparing multidimensional poverty outcomes with the $1-a-day poverty line for 22 countries, they find a clear trend in poverty dynamics is not discernable. In some countries multidimensional poverty reduced faster than monetary poverty, while for others the opposite holds true. Only in the case of Nepal reductions in multidimensional and monetary poverty are fairly uniform.
To some degree this level of dynamics is surprising and the source is not well understood yet. On the other hand, it is reassuring to observe that a multidimensional poverty measure reacts to policy action. While the standard of living indicators (such as access to electricity, clean water) may be easiest to improve from a policy point of view; a change in the MPI is accelerated more by improvements that bear higher weights, such as education and health. In general, multidimensional poverty dynamics and their direction vary greatly across countries and seem to be influenced more by country and policy characteristics, rather than general trends such as GDP growth (cf. Alkire et al. 2015).

5.3 Choice of indicators and cut-offs

In the remainder of the section, we discuss individual indicators and the chosen cut-offs. In addition, we will check the robustness of particular choices regarding indicators and cut-offs, and suggest an alternative treatment for ineligible populations. We illustrate these choices for a selection of three countries, India, Armenia, Ethiopia. In the following section, we then propose an alternative version of the MPI that would have some

advantages relative to the current formulation.

Standard of Living While the health and education dimensions consist of two indicators each, living standard of the household is captured by six indicators. Are there opportunities for constraining the number of indicators in this dimension? The original living standard dimension consists of the following indicators:

- **asset index**: The household is deprived in this indicator if they do not own more than one of a group of small assets (radio, TV, telephone, bike, motorbike, or refrigerator) and do not own a car or truck.
- **cooking fuel**: The household is deprived if they cook with wood, coal, straw or dung.
- **electricity**: The household is deprived if they do not have access to electricity.
- **drinking water**: The household is deprived if its main source of water does not meet MDG standards[15], or they require more than 30 minutes to fetch water.
- **floor**: The household is deprived if it has a dirt floor (earth, sand, or dung).
- **sanitation**: The household is deprived if its toilet does not meet MDG standards or is shared with another household.[16]

In poorer countries, one typically observes that the standard of living indicators have by far the strongest contribution to multidimensional poverty. Alkire & Santos (2014) found that in countries with a high poverty incidence and MPI, the living standard dimension is the biggest contributor to overall poverty. For 17 of the 104 countries analyzed, the living standard dimension contributes even more than 50% to overall poverty.
Moreover, households in rural areas are more deprived in these indicators than households in urban areas. Comparing the contributions of indicators across India, Ethiopia and Armenia, we find that the living standard indicators contribute nearly 50% to overall poverty in rural areas; though they contribute only around 36% in urban areas (cf. Dotter & Klasen 2014*a*, Graph B). Hence, scrutinizing these indicators carefully appears

[15]If the water source is not protected (i.e. open or not protected wells or spring , or surface water such as a river, damn, pond, etc.) or the household relies on an irregular water source such as bottled water or a tanker truck the household is deprived. A protected well or spring (and the use of rainwater) would however suffice to meet this definition of clean water.

[16]A flush toilet or improved pit latrine (ventilated and with slab) would meet this requirement. A household with no sanitation facilities or rudimentary facilities (open lit, pit latrine without slab, composting toilet, etc.) is deprived.

to be relevant.

In principle, all living standard indicators capture separate dimensions of well-being (some being more important than others). The indicators are well-derived following research on the consequences of deprivation in these dimensions and their linkages to the MDGs (Alkire & Santos 2014, Santos et al. 2013). Each indicator represents an important constituency and how one can easily streamline them is not obvious. At the same time, some of the indicators are weaker, either conceptually or empirically and they are relatively closely correlated (at least for the countries in our analysis: India, Ethiopia, and Armenia), so some simplification is feasible. While recognizing the importance of each dimension, we question whether each indicator can capture what it intends to measure.

Following the need to simplify the MPI, one can discuss the adequacy of some of the standard of living indicators. Some indicators are hard to measure, as the household's benefit depends on the quality of the service. Moreover, there are substantive differences in needs for access (between urban and rural areas and across countries) which might bias the results. We will discuss the different indicators in turn.

The household's benefit of access to the **electricity** grid will depend on the quality and price of the service, as access to electricity is hardly a goal in and of itself. Though electricity has manifold advantages, this cannot be equated with access to the grid. Frequent power outages are common in several developing countries and a low reliability of the grid diminishes the potential use of electricity significantly. In some countries the cost of electricity is very high and access does not actually imply use; in fact, in a substantial number of African countries, households have access but do not use it and in other countries household access is not provided precisely because household incomes are too low to pay for it (even if the hook-up is subsidized). The link to a particular functioning that access to electricity ensures is also somewhat more tenuous.

The **sanitation** indicator suffers from the problem of different needs across countries and regions. In more densely populated regions and urban areas, improved sanitation facilities are more important as they prevent the spreading of infectious diseases. Research differentiating between urban and rural areas, find larger effects of improved sanitation on health in densely populated urban areas. This contrasts to small and sometimes insignificant results, when analyzing the effect of improved sanitation in rural areas (cf. Esrey 1996, Gunther et al. 2010, Gross & Günther 2014). This strand of the literature also finds that simple sanitation technology has already had an effect on diarrhea and child mortality.

Finally, the indicator **cooking fuel** appears to be an indicator that is among the last ones

to have been improved upon[17] and the indicator cut-offs are disputable. The household is non-deprived in this indicator if the cooking fuel being used has a low environmental impact[18] and a low effect on indoor air pollution.[19] Only to the extent that it causes indoor air pollution can this indicator be seen as an important well-being indicator, mainly due to its health impact. But health is already captured elsewhere. Independently of the undoubted importance of cooking fuel for respiratory diseases, is it unclear why one would want to capture it in the living standard dimension again (particularly if the health argument is the main justification). Whether health effects exist may also depend on whether cooking takes place outside or inside (which depends largely on the climate and cultural practices), and what kind of cooking implements (stoves, open fire, etc) are used. As a result it is somewhat unclear to what extent the use of non-modern fuel sources should invariably be seen as an indicator of deprivation.

In contrast, the categories of **drinking water**[20] and **flooring** are easy to measure and are arguably more objective measures of living standards, additionally they are comparable across countries. We therefore suggest considering only three instead of six living standard indicators: flooring; drinking water; and assets as a category capturing household wealth and potentially also reflecting several indicators that are correlated with asset possession (similar to the function of the income component in the HDI).[21] Consequently, the weights of the remaining three standard of living indicators would then be increased to maintain the total weight of that component of 1/3. This would also reduce the complexity of the living standards indicator and the overall MPI.[22] Moreover, in

[17]This is a result of a workshop on dynamic comparisons between multidimensional and monetary poverty (http://www.ophi.org.uk/workshop-on-monetary-and-multidimensional-poverty-measures/).

[18]One reason to include cooking fuel was its association with MDG 7.

[19]Therefore, coal, wood, and animal dung are poor categories, while kerosene is not.

[20]The main problem with the water indicator is that it is based on water source, not on whether the water is actually clean. As shown in Klasen et al. (2012), providing piped water access when quality cannot be assured can significantly lead to worse health outcomes than when households purchase the water from tank cars. Also, often water gets contaminated in transport or during storage in the household, issues that are neglected here (for which there is, however, no comparable data).

[21]There is the question of whether the assets included also suffer from some urban bias and whether rural assets should be included. The DHS surveys include some information on land and livestock ownership. But it is very hard to include this data in a systematic fashion. Not owning land or livestock is neither a necessary nor a sufficient condition for deprivation in rural areas (many households in rural areas do not work on agriculture) and livestock ownership also depends on geographic endowments, population density, religious traditions, and the like. As a result it is very hard to deduce deprivation from these assets and we propose keeping the current list of assets.

[22]One could also use some statistical data reduction technique (such as principal component analysis or factor analysis) to create an asset index and use that instead of the individual indicators (see e.g. Alkire and Santos 2010 for a discussion). We caution against the use of such indices for the MPI for several reasons: first, they increase the complexity (and opacity) of the MPI; second, one cannot replace a normative judgment about the importance of certain assets with a statistical procedure (see also

the three countries we analyze, the remaining indicators are least correlated with each other. The three indicators we propose dropping are more highly correlated with each other and with the indicators we retain (see correlation coefficients in appendix Table 7 and 8). Due to the high correlation with the indicators we retain, we do not lose very much information on the distribution of deprivation across the population.[23]

Enrollment The enrolment indicator considers a household deprived if any school aged-child is not currently enrolled. The school age is determined by looking at the primary school entrance age[24] plus one year[25] and assuming necessary enrolment to be up to grade 8[26]. In many developing countries, however, children enroll at a later age than the official school entrance age, even if they will be enrolled for their whole school life (grades 1-8).

There are manifold reasons why children are enrolled late. Several studies find boys are more likely to be stunted and enrolled later than girls, and more generally poor physical and cognitive development leads to later enrollment (cf. Glewwe & Jacoby 1995, Bommier & Lambert 2000). Parents consider their children not ready for school if they are too small for their age (Fentiman et al. 1999). Moreover, in some countries boys complete some form of religious education or apprenticeship before enrolling in formal education.[27] In many countries there are also financial barriers that can lead to *delayed* enrolment. While some children who enrolled late are less likely to complete the education or might perform worse in school (Santos et al. 2013), this is not invariably the case and drop-out would be captured in any case by the enrolment measure. Thus, we suggest reconsidering the current proposition that the entire household is considered deprived in the enrolment indicator if a child that is not enrolled in time, but a year later.

Nguefack-Tsague et al. (2010) for a discussion). And third, it is unclear whether such an index should be created at the national level, sub-national level, international level, and whether one should pool data for different time periods to create such an index.

[23]We should emphasize that even the three indicators we propose retaining could be improved upon once additional data were available. In the case of water, indicators of water quality would be an important addition and in the case of assets, some sense of age, current value, and state of repair would be useful additions.

[24]Derived from the UNESCO education statistics.

[25]As children with birthdays in the current school year can only enter school in the next school year.

[26]This covers primary and lower secondary education in most countries.

[27]In many parts of Africa, young boys are sent to Madrassas for few years. Similarly, in some East Asian countries it is common for young boys to live in a monastery before enrolling in school.

Mortality In its current design, the multidimensional poverty index does not apply a cut-off period for child mortality. Hence, a household may theoretically be deprived in child mortality, if it suffered a child death 50 years prior to the survey. This choice was mainly data-driven, as DHS surveys with information on the time of death for each child were not available for all countries. Nevertheless, this is definitely a second-best solution to account for child mortality and this problem is fully acknowledged in Alkire & Santos (2014). We therefore suggest only considering under five mortality in the household in the past five years.[28]

In the MICS, the information about year of death is not available in most surveys. But one could get closer to the concept of more recent deaths, if one included only the deaths of children born to younger women in the household (for example women who are below age 40).[29]

Nutrition Malnutrition is a direct indicator of the functioning 'nutrition'. Malnourished individuals are also more susceptible to other health risks and are less able to perform well at work. Moreover, malnutrition at an early age has life-long effects on development. The MPI considers a household deprived if any household member is malnourished.[30] While the importance of malnutrition itself is indisputable, the indicators used in the MPI are imperfect.

The MPI uses the BMI for adults and weight-for-age for children to determine whether the household is deprived in nutrition. Both indicators cannot reflect micronutrient deficiencies. Especially the BMI is prone to inclusion errors, particularly related to the nutrition transition which also biases the underweight indicator (see below). There are also questions regarding the international comparability of BMI cut-offs and its comparability between males and females. Moreover, this indicator is not available in the MICS to begin with and thus there is an in-built bias from the use of different surveys.[31] To prevent these potential inclusion errors and deal with the measurement error issues,

[28] Whether to limit it to children under five years or not is debatable. Empirically it does not make a large difference (Santos et al. 2013).

[29] This is a suboptimal solution and would leave out some recent child deaths but possibly better than the current solution where the deaths might have occurred decades ago.

[30] This differs across surveys used: If a DHS survey is available for the country, this refers to any child below the age of five or women in reproductive age. When the MICS survey is used, the indicator definition refers to any child below the age of five. For some countries only WHS surveys are used. In this case the household is deprived if the respondent (men or women of any age) is undernourished.

[31] This is a more general issue touching other indicators as well. HDRO uses more comprehensive information if available to get the best estimate for each country. This may, however, reduce comparability across countries. These issues mainly affect the category lists in the water, sanitation, and cooking fuel indicators and therefore do not lead to large changes in the MPI. Nevertheless, it is recommended that it be as consistent as possible throughout.

one could consider determining the household's nutrition status using only observations on children. Combined with dropping the WHS as a data source, this would make the MPI more transparent and comparable across countries. However, households without children in the respective age range could then no longer be deprived in this indicator at all. The issue of households without eligible population is already prevalent in this indicator, but would be aggravated through the exclusion of adults.[32] We address the problem of households without an eligible population below.

Additionally one could use stunting as an indicator of child malnutrition. Stunting is an indicator of chronic undernutrition. In addition, it is less susceptible to influences from the so-called nutrition transition where households across the world (including many poor countries) are switching to foods that contain more calories, fats, and sugar. Household members then gain weight without being substantively better nourished and still often lack required micronutrients. As a result, many children in these households are stunted but of normal weight, and we even observe children that are stunted and overweight (WHO 2006, Popkin 2006). Stunting is therefore a much better indicator of undernutrition as it reacts sensitively to not only the quantity, but also the quality of nutrition. In fact one can show that underweight rates fall over time with the nutrition transition, while stunting rates remain high in many countries, suggesting that the quality of nutrition has not improved (Misselhorn 2010, de Haen et al. 2011). Thus the use of stunting as the undernutrition indicator is to be preferred on conceptual and empirical grounds. Even though this would not significantly affect country rankings (cf. Alkire & Santos 2014), it increases the observed incidence and intensity of multidimensional poverty.

Moreover, one could only consider children above the age of 6 months in the nutrition indicator. This would reflect the very distinct age pattern of anthropometric shortfalls which emerges between 4-6 months, deteriorates until about 24 months and stabilizes thereafter (see e.g. Wiesenfarth et al. 2012). Households with children below 6 months might therefore erroneously be considered non-deprived, as the anthropometric shortfall has not materialized yet.

Economies of Scale The MPI assumes full economies of scale apply to literacy (measured by schooling years) and in the living standard indicators. For most living standard indicators, the public good assumption is indisputable, though we may observe some ri-

[32] It is also problematic that the health portion would then entirely focus on children with no apparent concern for other age groups. Clearly it would be useful to think more fundamentally about a different health indicator such as a health status response by all members of the household. But such data is currently not available in reliable and comparable form.

valry in consumption of assets (and potentially sanitation). Moreover, the household is non-deprived, if any household member has at least five years of education. This follows the concept of effective literacy defined by Basu & Foster (1998), they argue one literate household member is a kind of public good for illiterate members. Their hypothesis is supported by several studies explaining farm-level productivity with household literacy (cf. among others Foster & Rosenzweig 1996).
Unfortunately, it is impossible to test the robustness of the MPI to the public good assumption in assets, because the DHS only asks whether or not a household owns a specific asset, not how many assets of a type are owned. Nevertheless, we can test the assumption for the education indicator. While it is sensible to assume that illiterate household members benefit from one literate member in the household, the benefit for the illiterate members will presumably be smaller the larger the household.
We therefore consider it necessary for at least 50% of all household members to have five years of education for the whole household to be not deprived in the education indicator. This increases the poverty headcount significantly (approx. 10 percentage points). The change mostly increases the multidimensional poverty incidence for medium-sized households and for households in Armenia (cf. Dotter & Klasen 2014*b*).

Size Adjustment for Nutrition, Mortality, and the Enrolment Indicator In some indicators the whole household is deprived, if one household member suffers from a deprivation in this indicator (i.e. is malnourished). Hence, larger households have a potentially higher chance of being deprived (in nutrition, mortality, or child enrolment). The whole household is considered deprived, because the household as a whole experiences a negative external effect by the presence of a person deprived in one of these indicators. Also, a human rights perspective could support such an approach (Santos et al. 2013).
Nevertheless, all of these indicators will measure deprivations imperfectly (as discussed in the sections above on enrolment, nutrition and mortality). While the dual cut–off method allows for inclusion errors in one indicator, households falsely categorized into two of the health and education indicators will be considered multidimensional poor. Larger households with more eligible household members in each indicator have a potentially higher chance of being falsely considered poor.
We found, that the original assumption regarding child mortality, nutrition, and enrolments disproportionately affected the poverty status of large households. We change the indicator definitions, in a way that only considers households deprived if one out of five

children is deprived in the indicator.[33] This reduced overall poverty modestly (approximately 1 percentage point for whole sample) for all sub-groups and countries. However, for the sub-group of large households we observed a poverty reduction of nearly 3 percentage points. Hence, with the initial, more restrictive assumption, larger households had a higher chance of being considered multidimensional poor.

5.4 Treatment of households without eligible population

Several indicators of the MPI explicitly refer to a specific eligible population. The nutrition indicator considers children below the age of five and women at the reproductive age (15-49). The mortality indicator refers to households with men and women at the reproductive age. Moreover, households that never had children cannot suffer from the death of a child. In addition, the enrolment indicator considers only households with school-age children. Households without eligible population are considered non-deprived in the respective indicator. The household's demographic composition may therefore determine its chances of being considered poor or not.

Table 3 shows the share of households without eligible population in the respective indicator. As we can see, this is not a marginal problem but affects a large share of households for the three countries we analyze. It is more severe in the enrolment indicator, where over a third of households do not have children of school age and are therefore automatically non-poor in this indicator. In fact, if they have no children at all, it is going to be quite hard for them to be considered multidimensionally poor since they are automatically considered non-deprived in 50% of the indicators.[34]

The relative importance of these households differs across indicators and countries.

Table 3: Relative importance of households without eligible population

	Nutrition (health)	Mortality (health)	Enrollment (education)
All	9.1%	17.84%	36.97%
Armenia	14.81%	23.58%	51.25%
India	8.57%	17.13%	37.90%
Ethiopia	11.07%	21.23%	24.38%
'older' household	28.44%	32.48%	38.24%

[33] A household is deprived, if at least 20% of all (not only children below 5) children in the household have died. A household is deprived, if at least 20% of all school-aged children are not enrolled. A household is deprived, if at least 20% of all eligible household members are undernourished

[34] This is particularly the case if the MICS are used (where adult nutrition information is not included).

Older households are more likely to have no eligible population in the three indicators. Typically this is more of an issue in middle-income and transition countries like Armenia. In Ethiopia several households only consist of children and grand-parents and have no men or women at the reproductive age. This is a potentially even bigger problem in countries with a higher HIV prevalence than Ethiopia.

In the following, we will shortly discuss other approaches to deal with the non-eligible population in the MPI: First of all, one could drop households without an eligible population. However, this not only reduces the sample, but the outcomes are also no longer representative since we exclude a significant share of the population. One could also substitute the missing indicator with an indicator from the same dimension, i.e. substitute the enrollment indicator with the literacy indicator for households without children at school-age. This essentially doubles the weight attached to literacy for this specific household, hence a sensible decomposition by indicator will no longer be possible. Nevertheless, we could still decompose by dimension. One could also consider substituting these indicators for children with indicators for adults (ideally for all household members). However, comparable adult indicators in these dimensions are not available for all countries. Indicators that are equally relevant for all household members are also hard to come by. Finally, we could also consider changing the poverty cut-off (k) for households without an eligible population. As the household can only be deprived in less than ten weighted indicators, one would lower the overall poverty cut-off respectively.

We follow a hybrid approach, combining substitution and change of the poverty cut-off. First, we substitute the missing indicators with available indicators from the same dimension. If these indicators are not available, we lower the poverty cut-off for households with no eligible population in either indicator of the dimension (no eligible population for the nutrition and for the mortality indicator). The advantage of this approach is that it makes maximum use of the data without having to rely on imputations or on dubious assumptions of non-deprivation of childless households. The disadvantage is, decompositions by dimensions are no longer possible for those households that have no eligible information for the entire health dimension.

UNDP also acknowledged the serious problem of ineligible population but decided to follow a different route in the 2014 HDRO (Kovacevic & Calderon 2014). For households with missing information in the education or health dimension, the remaining indicator receives the entire dimension weight of 1/3. Thus, they substitute the indicator with one from the same dimension as we suggested above. Households with missing information on both indicators are excluded from the MPI and the sample weights are adjusted to account for the exclusion of the household. The sample weight adjustment ensures, the

distribution is unchanged across age groups, gender and place of residence (rural and urban).

6 A revised MPI

On the basis of the discussion above and sensitivity tests we performed in an accompanying working paper (Dotter & Klasen 2014*b*), we propose a revised multidimensional poverty measure. In this measure we still follow the Alkire-Foster dual cut–off method, apply the same normative weights, and also consider an overall cut-off of 1/3; of course, these choices could also be reviewed in light of our conceptual discussion above and will be taken up below. However, we apply new indicator definitions and suggest only utilizing DHS and MICS surveys for global poverty estimation.

In our revised MPI, we consider three living standard indicators instead of six: floor (the household is deprived if it has a dirt floor); drinking water (the household is deprived if it has no access to clean drinking water, or they require more than 30 minutes to fetch water); assets (the household is deprived if they do not own more than one small asset and do not own a car or truck). These indicators are arguably more objective and easier to measure, as the household's benefit does not depend on the quality of the service. Moreover, the remaining three indicators are highly correlated with the three dropped indicators, and comparable across countries and regions.

The relative contribution of the living standard dimension is lower, when these indicators are chosen and more in line with its weight of 1/3. It also varies less across countries and urban and rural areas compared to the initial situation with six indicators. It, however, retains substantial variation in the contribution of the individual living standard indicators.

Moreover, we suggest shortening the enrollment window by two years (i.e. a child in India was considered to be at school age if it was aged between 7 and 15. Now, we only consider children between 9 and 15.) to allow for the late enrollment of children in school. It is common practice in many developing countries for younger children to enter school at a later age for a range of reasons. The original indicator definition considers these households as deprived, while the shorter enrollment window does not. A household is deprived in the new enrollment indicator if more than 20% of its school-age children (when the new enrollment window is applied) are not enrolled.

In the education indicator, we only consider a household as non-deprived if at least half of its adult members have 5 years of schooling. We, thus, assume some economies of scale exist for education in the household, but do not consider education as a pure

public good. The original education indicator considers a household with one household member with five years of schooling as non-deprived.
The suggested nutrition indicator does not include adult BMI, as this measure is prone to miscategorization. Stunting is the preferred malnutrition indicator for children. In addition, we suggest only considering children above the age of 6 months to reflect the very distinct age pattern of anthropometric shortfalls which emerges between 4-6 months, deteriorates until about 24 months and stabilizes thereafter (see e.g. Wiesenfarth et al. 2012). Households with children below 6 months might therefore erroneously be considered non-deprived, as the anthropometric shortfall has not materialized yet. We consider households deprived in the new nutrition indicator, if at least one out of five of the household's children between 6 months and 5 years are stunted.
For the mortality indicator, we only account for the death of children below the age of five in the past five years. The original indicator was a stock variable as it considered the death of any child in the household without age or time cut-off. The MPI is, however, supposed to reflect acute multidimensional poverty. A household is deprived in the mortality indicator if at least one out of five children in the household died in the past five years.
Finally, we also propose a new treatment for households without an eligible population. In the original MPI, households without an eligible population were considered non-deprived in the respective indicator. This reduced the chances of these households being considered multidimensionally poor. Our strategy follows a hybrid approach. First, we proxy malnourishment with adult BMI for households without children. Then, we substitute missing indicators with indicators from the same dimension, i.e. for households without children at school-age we double the weight on the education indicator. Finally, we rescale the overall cut-off k for households where both indicators in one dimension were missing. Households without an eligible population in both health indicators (mortality and malnourishment) can only be deprived in the education and standard of living dimension. We, thus, lower the overall cut-off (k) they face. These households are deprived if the sum of weighted deprivations is above $2/9$[35].

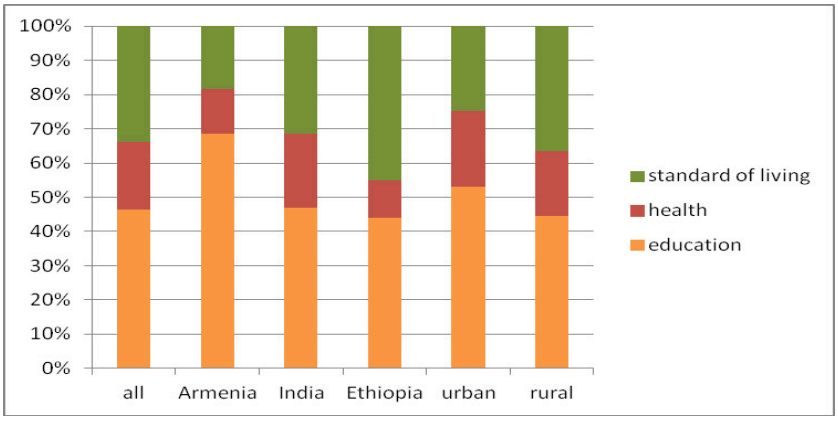
Applying our revised MPI measure, the intensity and incidence of multidimensional poverty is higher. The increase in the headcount of multidimensional poor is strongest for small households and households in Armenia. Moreover, the poverty rate in large households is lower in the revised measure compared to the UNDP / OPHI MPI estimation. Since we apply a hybrid approach for households without eligible population in some indicators, a sensible decomposition by indicator is no longer possible. Instead

[35] $2/9 = 1/3 * 2/3$

Table 4: Revised multidimensional poverty estimation

	H	A	MPI
all	60.28%	61.46%	0.370522
urban	27.22%	55.57%	0.151271
rural	73.24%	62.89%	0.460657
small household	53.53%	59.77%	0.319907
medium-sized household	57.58%	61.70%	0.355257
large household	64.78%	62.89%	0.407391
female-headed household	59.98%	61.41%	0.368327
'older' household	57.44%	60.77%	0.349068
young household	60.02%	62.20%	0.373302
Armenia	2.96%	46.89%	0.013863
Ethiopia	92.25%	69.25%	0.638847
India	57.82%	60.37%	0.349068

Figure 1: Decomposition by dimension



we decompose the MPI by dimension. Though poverty profiles differ by country and region, we observe that education contributes by far the most to multidimensional poverty. In contrast to that, deprivations in the health dimension contribute the least to being multidimensional poor. The increase in the relative contribution of education may to some extent be attributed to the change in the education indicator. In the original MPI, the household was non-deprived if at least one household member had five years of education. We however propose a more stringent criterion, considering households as non-deprived where at least 50% of household members had five years of education.

7 Severe Multidimensional Poverty

Alkire & Santos (2014) consider households to be severely poor, if they are deprived in more than 50% of the sum of weighted indicators. They thus define severity of poverty through an adjustment of the second cut-off. Hence, households need to be deprived in several dimensions to be identified as severely poor. We, however, suggest to define severity of poverty not only as multiple deprivations, but also to consider the frequency and intensity of deprivations within the household. Hence, we adjust indicator cut-offs to identify a household as severely poor, rather than raising the second cut-off as Alkire and Santos do.

The way Alkire and Santos define the severely poor (raising the second cut-off) makes it harder to fall into severe poverty as several original MPI indicators are stock indicators (education, most of the original living standard indicators). Thus, the original severe poverty measure reflects chronic, severe poverty.[36] Moreover, it is nearly impossible for households without eligible population (i.e. without children) to be severely deprived as these households are considered non-deprived in some indicators already.

We propose a different route and adjust indicator cut-offs to identify the severely poor, but keep the overall cut-off of one third. A household is considered severely deprived in education if less than 20% of its household members have 5 years of schooling. Similarly, the household is severely deprived in enrollment, malnourishment, or mortality if more than 50% of its eligible household members are deprived in the respective indicator. Moreover, the household is deprived in assets if it owns no assets. Finally, a household is considered severely multidimensional poor, if the weighted severe poverty indicators sum up to one third. In our restricted sample over 40% of the population live in households, which are severely multidimensionally poor (cf. Table 5). Severe multidimensional poverty is more prevalent in rural households, large households, and

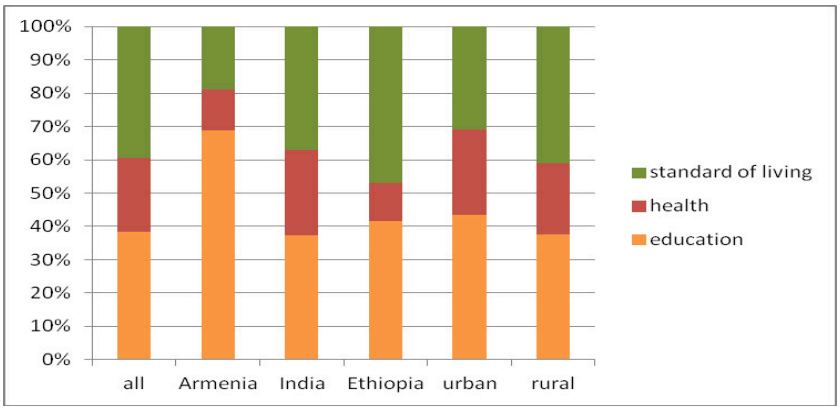
[36] Though we still may observe movement out of severe poverty

Table 5: Severe multidimensional poverty estimation

	H	A	MPI
all	40.29%	58.46%	0.235532
urban	12.06%	54.28%	0.065448
rural	51.38%	59.41%	0.305242
small household	36.76%	58.21%	0.213948
medium-sized household	38.17%	59.49%	0.227105
large household	42.92%	58.47%	0.250946
female-headed household	43.12%	59.89%	0.258286
'older' household	40.92%	58.87%	0.240913
young household	39.19%	58.97%	0.231063
Armenia	0.21%	44.79%	0.000959
Ethiopia	83.28%	65.45%	0.54512
India	35.70%	56.94%	0.203261

female-headed households. In Ethiopia, most households that are considered multidimensionally poor may also be considered severely poor. This is not so much the case in India, were only around half of the multidimensional poor are also severely poor. In Armenia, less than 10% of the multidimensional poor are severely poor. The poverty

Figure 2: Decomposition by dimension



profile of the severely poor is similar to the multidimensional poverty profile discussed above (see above section 7). However, deprivations in the living standards and health contribute more to severe poverty compared to multidimensional poverty (cf. Figure 2. Hence, health and the standard of living are more important in understanding severe

multidimensional poverty.

8 Conclusion: Combining Conceptual and Empirical Proposals

The MPI has been the first attempt to provide a multidimensional poverty measure that competes in depth and coverage with the widely used (and problematic) $1–a–day income poverty indicator. However, there are many open questions and issues regarding the conceptual underpinning and alternative formulations of the MPI. These issues need to be discussed and considered carefully. Among the issues we would flag particularly are the use of the union (instead of the dual cut–off) method for identification, and considering inequality in deprivations across people in the MPI (at least in some version of the MPI). We also believe that the headcount is in principle understood better and easier to communicate as a headline indicator, in contrast to the current product of headcount and intensity. Nevertheless, this should also be complemented with a measure that also considers intensity and inequality such as the one proposed by (Rippin 2013) or a similar measure. These proposals (particularly concerning the union approach) would make more sense if, at the same time, changes in the empirical implementation were made to reduce the indicators used to a set which are of particular importance and are particularly well-measured.

In that vein, we propose a number of changes, including dropping the WHS as one of the data sources, dropping the BMI as a nutrition indicator, and changing the age ranges and cut-offs for the education and mortality indicators. We also recommend focusing on only three living standard indicators (water, floor, and assets). These changes would represent improvements over the current formulation; but we want to emphasize that one would need to investigate these in more detail to come to more definitive conclusions about them. In addition, we suggest tackling the important issue of households without an eligible population. In the current formulation, the poverty estimation may be biased as some households cannot be considered poor in the nutrition, mortality, and enrollment indicator.

9 Revisions made to the MPI in the 2014 Human Development Report

In the 2014 Human Development Report, HDRO presented a revised MPI that addresses some of the issues raised above. For ease of comparison, it also published the MPI using the previous method (that is also still used by OPHI) and presented data for changes in the MPI over time using the new approach. HDRO did not change the basic conceptual underpinnings of the MPI. The MPI still utilizes the dual cut–off approach as well as the product of headcount and intensity, and inequality is not considered. Thus, the conceptual issues raised here have not been addressed in the revision. These issues may require more discussion and analysis before such fundamental changes can be implemented. All the changes refer to the empirical issues and all tackle issues identified in the paper above (although sometimes deviating from our proposals in terms of solutions).

A first important change is that, as recommended here, the World Health Survey has indeed been dropped as the survey to track the MPI in countries without a DHS or a MICS. In China, the China Health and Nutrition Survey for 2009 has been used for the MPI calculation. This is a good (and more recent) substitute, although it only covers part of the country. In other selected countries, national surveys that contain the relevant information have been added.

There are more changes to the indicators and cut-offs, many of which relate to the discussion above. More specifically, in the health dimension, the childhood underweight indicator was replaced by a stunting indicator for the reasons outlined above. Moreover, the child mortality indicator now refers to deaths of children that occurred in the past 5 years, as suggested above. In the education dimension, the minimum years of schooling to be non-deprived was raised to 6 years (from 5). This issue was not identified here as a particular problem, but it appears to be a sensible change since it links the minimum years of schooling to completed primary education (which is six years in most countries). Furthermore, the MPI now considers late enrolment, as proposed above. Now a household is only deprived if the children 8-15 are not all in school (rather than 7-15), thereby allowing for late entry to schooling (by one year) that may not be a sign of deprivation. In the standards of living dimension, all six indicators were retained. The only change was that ownership of arable land and livestock is now included as possible assets in the asset indicator to better capture asset holdings in rural areas.

Lastly, HDRO also addresses the issue of the ineligible population that was also raised above. It picks up some of the suggestions made above and reweights information of indicators within a dimension. For households lacking information on both indicators

in the health or education dimension (which affects a substantial share of households), HDRO chose a different route to the one proposed above. These households are now dropped from the sample, and the remaining sample is reweighted to make sure that it is still representative of the entire population. Essentially this implies that households without health information are now proxied by similar households (in terms of age and gender composition, as well as place of residence) that have this health information.[37] Overall, the changes made to the MPI all appear sensible. They address many of the issues identified in this paper and implement solutions that address the problems within the constraints of data availability. It would be best now to learn from the experience of these revisions over the next few years and, in the meantime, consider tackling some of the conceptual issues raised in this paper to see whether they merit more fundamental revisions to the MPI.

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[37] Details on this procedure can be found in (Kovacevic & Calderon 2014).

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Appendix

Table 6: Relative importance of households without eligible population – improved nutrition and mortality indicators

base	Nutrition (health)	Mortality (health)	Enrollment (education)
all	67.94%	11.82%	36.97%
Armenia	78.51%	15.45%	51.25%
India	66.35%	11.55%	37.90%
Ethiopia	76.38%	12.58%	24.38%
Old hh (above35)	85.30%	33.70%	38.24%

Table 7: Correlation coefficients between living standard indicators: Spearman (rank) correlation

	electricity	sanitation	drinking water	Floor	cooking fuel	assets
electricity	1***					
sanitation	0.3855***	1***				
drinking water	0.3196***	0.2205***	1***			
floor	0.5767***	0.4613***	0.3153***	1***		
cooking fuel	0.4524***	0.4855***	0.2837***	0.5668***	1***	
assets	0.4861***	0.4469***	0.2802***	0.4672***	0.4795***	1***

Table 8: Correlation coefficients between living standard indicators: Tetrachoric correlation

	electricity	sanitation	drinking water	Floor	cooking fuel	assets
electricity	1***					
sanitation	0.6870***	1***				
drinking water	0.5183***	0.4053***	1***			
floor	0.8336***	0.7011***	0.5191***	1***		
cooking fuel	0.8518***	0.6965***	0.5342***	0.8424***	1***	
assets	0.7440***	0.6693***	0.4710***	0.6728***	0.7147***	1***