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An absolute multidimensional poverty measure in the functioning space (and relative measure in the resource space): An Illustration using Indian data

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An absolute multidimensional poverty measure in the functioning space (and relative measure in the resource space): An Illustration using Indian data

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Abstract

In this paper we develop a multidimensional poverty measure that attempts to capture absolute poverty in the functioning space. As suggested by Sen, if the measure aims to be absolute in the functioning space, it needs to be relative in the resource space. To generate a relative measure, this measure adapts the poverty cut-off in resource-related indicators in a multidimensional poverty measure to prevailing standards in a region. As illustration, this poverty measure utilizes the Indian Demographic and Health Survey (DHS) and is based on UNDP's global Multidimensional Poverty Index (MPI). Similar to the global MPI, we apply the Alkire-Foster dual cut-off approach (Alkire and Foster, 2011a) and broadly follow the global MPI in the choice of indicators, weights, and overall cut-off. However, adaptable indicator thresholds are considered when appropriate. We argue that global MPI indicators in the health dimension are not open to a relative assessment, as they reflect specific health functionings (i.e. being free from premature mortality and being well nourished). In the education and standard of living dimensions, we set indicator thresholds at the median of the reference population, while experimenting with different reference populations. Empirically we find that the overall ranking of poverty in India does not change using our relative MPI, but the differentials in poverty are substantially smaller between states and rural and urban areas, also depending on the choice of the reference population.

Keywords: relative poverty, multidimensional poverty, India

JEL Codes: I32,O15, D63

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1. Introduction

The measurement of monetary poverty strongly differs across countries: While absolute monetary poverty lines are typical for poverty measurement in developing countries, the concept of relative poverty is popular in richer countries. Relative income poverty lines are prevalent across Europe and the concept of relative poverty is generally accepted as more appropriate for advanced economies (e.g. Fuchs 1967, Ravallion and Chen, 2011). These relative lines are usually set at a fixed proportion (e.g. 40% –60%) of the mean or median income and try to account for costs of social inclusion which depend on average prosperity in a society (cf. Ravallion and Chen, 2011, for examples). In contrast to these strongly relative poverty lines which rise proportionately with increases in mean or median income, Ravallion and Chen (2011) recently have also proposed a weakly relative poverty line for developing countries. This poverty line lies between a fixed absolute line such as the international $1.25 a day line, and a strongly relative one, such as the ones just discussed. By applying a weakly relative poverty line, the income poverty threshold is rises less than proportionately to an increase in mean incomes.

In addition to monetary poverty lines, there has been a (re-)emergence of multidimensional poverty and deprivation measures in recent years, following pioneering work by Sen (1983) suggesting that poverty relates to functioning shortfalls in different dimensions such as education, health, housing, clothing, and the like. The most well-known example is probably the UNDP's global multidimensional poverty index (MPI), developed jointly with the Oxford Poverty and Human Development Initiative (UNDP, 2010; Alkire and Santos, 2014). This measure has been used to calculate multidimensional poverty for over 100 (mostly developing) countries and allows us to compare multidimensional poverty outcomes across the world; it is an absolute concept in the sense that the poverty lines applied are the same everywhere, i.e. they do not differ across space or time.

In addition, several country-specific and region-specific multidimensional poverty measures have been developed for (among others): Buthan (Alkire, Dorji, Nahmgay and Gyeltshen, 2014; Santos and Ura, 2008), Colombia (Salazar, Roberto Carlos Angulo Díaz and Pinzón, 2013), Afghanistan (Trani et al., 2013), Germany (Busch and Peichl, 2010; Rippin, 2013), and the EU (among others: Alkire, Apablaza and Jung, 2014; D'Ambrosio et al., 2011; Guio et al., 2009; Whelan et al., 2014). These different multidimensional poverty measures co-exist side by side and usually the poverty lines are more generous in richer societies. Even if they use the same methodology (i.e. the Alkire Foster dual cut-off approach, see below), it is impossible to compare poverty outcomes as these measures use different datasets, poverty lines, and/ or indicators.

While the use of relative poverty lines (in richer countries) is well-documented in monetary poverty measurement, this is not the case for multidimensional poverty measurement. Most multidimensional poverty measures are usually conceived as absolute measures, applying identical thresholds across groups and time. This is particularly the case for developing countries, while in rich countries some relative multidimensional poverty measures exist (see below).

Following Sen (1983) who proposed an absolute approach to poverty measurement in the space of functionings/capabilities, such multidimensional poverty measures would ideally directly measure available capabilities and functionings such as being healthy, adequately educated, well-housed, adequately clothed and the like.[1] However, this is rarely the case. While it is relatively straightforward to measure functionings in the broad sphere of health (e.g. being well-nourished, no considerable health impairment, free from premature mortality), this is more difficult in the area of living standards and education. Hence, most indicators used in multidimensional poverty measurement are rather means for better functionings rather than the functionings themselves (sometimes both); and some are a measure of resources (e.g. assets, floor material, or cooking fuel) rather than functionings that might derive from them.

Sen argued in 1983 that poverty measured as "*absolute* deprivation in terms of a person's *capabilities* relates to *relative* deprivation in terms of commodities, income and resources" (Sen, 1983, p. 153). He points out that there are enormous differences in the fulfillment of the most basic functionings and capabilities across societies (and to some extent even within), such as being educated or being adequately housed and clothed. In richer societies, these functionings will, for example, require more years of schooling or more costly housing.

As a result, it might be important to consider adaptable or "relative" versions of such multidimensional poverty measures. If multidimensional poverty indicators do not measure functionings directly, the available indicators in the commodity and resource space need to be adapted to varying requirements across societies. In this paper we develop a multidimensional poverty measure that reflects differences across societies to fulfill specific basic functionings. We thus aim to measure absolute poverty in the functioning space, realizing that this may translate to varying indicator thresholds across societies.

The adaptable poverty measure developed in this paper can account for varying needs across countries due to different environments, customs, and culture. The global MPI, for example, finds the standard of living dimension contributes the most to overall poverty in the majority of countries, particularly those high levels of multidimensional poverty. In 20 of these countries the standard of living contributes even more than 50% to overall poverty. In contrast to this, countries with a low poverty incidence report a lower contribution of the living standard to overall poverty (Alkire and Santos, 2014). Given the nature of these indicators that largely track resources, a relative MPI might well find a lower importance of these standard of living indicators in poor countries, and consequently lower multidimensional poverty, as the resources required to reach a certain functioning norm may well be lower.

[1] Capabilities (the ability to achieve functionings) are hard to measure and most empirical applications, including this one, focus on measuring functionings.

When considering ways to make indicators relative, different options exist, from raising the poverty cut-off within a dimension, different weights of indicators/dimensions, different indicators, or changing the cut-off for calling someone multidimensionally poor. We discuss these options and then favor an adaptable poverty cut-off within a dimension dependent on prevailing conditions in a reference group. In principle, our concept is applicable to different indices and data sets. For the exercise at hand, we apply it to the Demographic and Health Survey (DHS) for India. This allows us to directly compare our measure to the global MPI. India poses an interesting example for the exercise at hand. We observe vast differences across states when the global MPI is applied: In Kerala only 15.9% of the population is multidimensionally poor, while 81.4% are poor in Bihar (Alkire and Santos, 2010). Due to the sheer size of India, living conditions, climate, and ethnicities differ vastly across states. Thus, India is a good example to illustrate the effect an adaptable poverty measure has on absolute poverty outcomes in the functioning space. One can adapt the poverty cut-off in the different dimensions to different circumstances across states, urban and rural areas.

Following the construction of the global MPI, we consider three equi-weighted dimensions in multidimensional poverty measurement: health, education, and the standard of living. We also apply the Alkire-Foster dual cut-off method of poverty aggregation (cf. Alkire and Foster, 2011*a*). The Alkire-Foster method first applies a cut-off at the indicator level (e.g. BMI below 18.5). Deprivations in each household are then aggregated using weights, and a second cut-off is applied to each person's deprivation score. People are identified as multidimensionally poor if they fall below this second poverty threshold: in the case of the global MPI, they are multidimensionally poor if they experience deprivations in one-third or more of the weighted indicators.

Though this method is not without critics who criticize indicators, weights, aggregation rules and the neglect of inequality among the poor(cf. among others: Ravallion, 2011, 2012; Rippin, 2013; Silber, 2011), it is currently one of the most commonly used methods of multidimensional poverty measurement. It is also the method applied in the most well-known example of multidimensional poverty measurement, the UNDP's MPI. Among its many theoretical merits, it also has the advantage that it produces a clear, policy-relevant headline figure.

In the empirical exercise in this article , we stick to the global MPI for the second cut-off of one third to qualify for multidimensional poverty. However, adaptable cut-offs are applied at the indicator level, as discussed in detail below. We follow the UNDP's global MPI for the choice of weights and indicators (Alkire and Santos, 2014; Kovacevic and Calderon, 2014). We then generate three adaptable poverty measures capturing absolute deprivation in the functioning space: one uses the whole country as reference group, another uses each Indian state as the reference group, while the third allows for different urban and rural poverty lines within the state.

Poverty outcomes for the example of India differ vastly, depending on the poverty measure we apply. All adaptable poverty measures find a higher poverty incidence than the global MPI (55.53%). We observe a lower poverty incidence, the smaller the reference group. Our preferred specification allows for different thresholds in urban and rural areas within each state. Applying this measure, we find a poverty incidence of 57.94%. However, as we observe lower poverty intensity for this poverty measure, the resulting multidimensional poverty index (M0) measure lies below the global MPI (global MPI: 0.282, adaptable MP: 0.261). The poverty distribution across different household types is similar across the different poverty measures and the ranking of states by poverty hardly changes. However, the adaptable poverty measures find a more equal contribution of the different poverty dimensions to overall poverty. This contrasts to the global MPI, where deprivations in the standard of living contribute the most to overall poverty. Finally, the adaptable measures appear to account better for the incidence of urban poverty.

In the next section, we will review the existing literature on multidimensional poverty measures. This is followed by a discussion of different possibilities to adjust a multidimensional poverty measure to local circumstances. In Section 4, we briefly describe the structure of the UNDP Multidimensional Poverty Index. Section 5 presents our application of an adaptable multidimensional poverty measure for India and compares poverty outcomes to the global MPI. In the conclusion, we summarize our results.

2. Multidimensional Poverty Measurement

Early examples of multidimensional poverty measures have been provided by Booth (1894, 1903), Rowntree (1901), and Townsend (1954, 1979) for the United Kingdom. In the 1950s, the use of monetary poverty lines became popular. Amartya K. Sen's work on the capability approach provided a theoretical justification for taking a non-monetary approach (e.g. Sen, 1980, 1987, 1999*a*). He deviates from the welfarist, utility-based approach of measuring poverty and suggests focusing on a person's capabilities. Certain commodities may enable an individual to achieve certain functionings, for example, a certain amount of food will make the individual capable of achieving the functioning "being well nourished". These capabilities differ across individuals for a given commodity attainment, as a certain amount of food may feed one individual sufficiently but leave another one hungry. Since these capabilities or functionings cannot be reduced to a single number or dimension, it is important to consider multiple dimensions of well-being when examining whether an individual or household is poor in the sense of being deprived in basic capabilities.

Following Sen, multidimensional poverty measures have been proposed for several countries in different formats (e.g. Bourguignon and Chakravarty, 2003; Klasen, 2000; Majumdar and Subramanian, 2001; Qizilbash and Clark, 2005). The most prominent recent example is certainly the Multidimensional Poverty Index (MPI) introduced by UNDP and Oxford Poverty and Human Development Initiative (OPHI) in the 2010 Human Development Report. It was the first attempt to calculate a concise and comparable multidimensional poverty measure for a larger number of countries (104) utilizing comparable surveys. Our adaptable multidimensional poverty measure will build upon the MPI and we will compare our results to it.

In addition to creating multidimensional poverty measures for developing countries, several authors have also developed deprivation and poverty measures for richer countries and regions, such as the EU. Nicole Rippin (2013) creates a multidimensional poverty index for Germany and compares the results to the at-risk-of-poverty (AROP) rate (60% of median income) and a multidimensional poverty index. She utilizes the German Socio-Economic Panel and mainly applies objective indicator thresholds aligned with the existing minimum legal requirements in Germany. Her index includes 13 indicators, among them socially necessary amenities in housing, disposable income with reference to a 'breadline', and 2 subjective health indicators. She develops two indices with different weighting structures: one applies equal weighting, while for the other prevalence weights, where higher weights are given to indicators where more households are not deprived, are applied. The correlation between those two indices is high[2] and the ranking of different German states hardly changes. Although in her example only the value of the breadline changes over time, this example is in general open to a relative assessment of poverty as legal requirements may differ across countries and time.

Another example for Germany has been provided by Busch and Peichl (2010). They use the same data set and create a poverty index including adjusted household income (threshold 60% of median income), number of years of education (threshold 9 years), and satisfaction with health status (range of 1 to 10, threshold at the median). They estimate multidimensional poverty in Germany for the years 1985 to 2007. In contrast to Rippin, their indicator thresholds vary, as all but the education threshold are set at the median.

Halleröd et al. (2006) develop a relative material deprivation index for Britain, Finland, and Sweden. They consider a total of 57 consumption items and activities. The lists of items differ across countries. They develop so-called possession weights, similar to prevalence weights,[3] for the different countries, six different age groups, and households with and without children. The resulting index is comparable across countries and groups, but accommodates different needs and customs across reference populations. The index is relatively unique in the sense that it allows for a multitude of different reference groups.

In an earlier paper, Halleröd (1995) applied a similar strategy and developed a deprivation index for Sweden. He builds on Mack and Lansley (1985) and applies consensual weights. The weights are adjusted to differences in preferences between women and men, age groups, household types, and geographic regions. He calibrates the overall multidimensional poverty line on Sweden’s relative income

[2] Spearman Rank correlations range from 0.9979 to 0.9982 for 2004.

[3] The weight is determined by the percentage of people wanting, but not having an item.

poverty line (50% of mean income), so both poverty measures find that 21.3% of the population is poor. Those deprived in both measures are defined as being truly poor.

Bossert, Chakravaty and D'Ambrosio (2013) develop a measure for material deprivation for EU countries. They consider 10 binary indicators capturing material deprivation, and apply consensual weights based on information from the 2007 Eurobarometer survey. Identical weights are considered across the EU, though consensual weights may well differ between countries and sub-populations. Comparing equal and consensual weighting structures, they observe similar outcomes regarding the material deprivation ranking of countries. However, the results are sensitive to the choice of weights for Austria, Estonia, Iceland, and Spain.

Anne-Catherine Guio (2009) develops a material deprivation index for Europe using information on nine discrete items. She applies different weighting schemes (equal-weighted, consensus-weighted, prevalence-weighted) and illustrates the use of a relative, country-specific overall poverty cut-off (300 and 320 percent of the mean weighted deprivation index for each country). She finds that adopting such a relative national threshold hides the existing differences in deprivation across member states. When a relative overall cut-off is applied, the most absolutely most deprived member states (Poland, Lithuania, Latvia, Slovakia, Hungary, and Cyprus) show the lowest poverty rates.[4] This is due to the fact that, in poor countries, a large part of the population suffers from various deprivations and is located close to the mean. For the lesser-deprived member states, she observes higher poverty rates.

D'Ambrosio, Deutsch, and Silber (2011) utilize the third wave of the European Community Household Panel Survey (ECHP) to estimate multidimensional poverty in Belgium, France, Italy, and Spain. They consider a total of 18 ordinal or binary indicators and compare results using the so-called fuzzy approach, the information theory approach, and the axiomatic approach.[5] For the latter, they apply relative thresholds at the indicator level (half the mean value of the indicator), aggregate using equal weights, and apply a second relative threshold at the aggregate index (individual is poor, when the aggregate index is above the 75th percentile). They thus assume that exactly 25% of individuals are poor in each country. The main objective of the paper is to analyze the overlap in poverty outcomes between the three different approaches. Nevertheless, one can easily see from this example that such a fully relative approach does not provide a lot of meaningful information, as we observe identical poverty outcomes across the four countries.

Whelan, Nolan, and Maître (2014) analyze multidimensional poverty in the EU in 2009. Their multidimensional measure consists of four dimensions with ordinal and binary indicators, and the AROP rate of each country.[6] Within dimensions, they apply uniform prevalence weights across the range of

[4] She observes poverty rates as low as 0.2% for Cyprus and Poland.

[5] For details on these approahces, please refer to D'Ambrosio, Deutsch, and Silber (2011).

[6] They apply factor analysis to identify six dimensions, but end up using only four due to missing data and the effect of location on some indicators.

countries and aggregate across dimensions using equal weights. Multidimensional poverty outcomes range from 6.7% for Iceland to 59.2% for Romania. In contrast to the AROP measure, multidimensional poverty varies strongly across countries and is in line with average income levels in these countries.

Alkire, Apablaza and Jung (2014) have recently developed a multidimensional poverty index for the EU. It is an individual poverty measure, considering adults (above 16) as unit of identification. Of the 12 indicators, the only indicator threshold varying across countries in this measure is the AROP rate.

This review shows that there are different ways to adapt a poverty measure to varying living standards across countries and time. One can calibrate the multidimensional measure on a relative income poverty line, one can apply relative thresholds at the indicator or aggregate index (based on the median or mean), or one could change the weights in the aggregation process. In the following section, we will discuss these different possibilities and develop our own concept of an adaptable multidimensional poverty measure.

3. Options to adjust multidimensional poverty measures to relative considerations

When applying the dual cut-off method in multidimensional poverty estimation, relative considerations could enter at different stages. The choice of indicators, indicator thresholds, weights in the aggregation process, and the overall cut-off could all be adapted to different living circumstances across societies to ensure that a multidimensional poverty measure is absolute in the space of functionings but relative in the space of resources or means.

3.1. Choice of dimensions and indicators

The dimensions identified in most multidimensional poverty measures are health, education, and the standard of living. These appear to be of importance to all societies across the world. One could introduce relative considerations by choosing different indicators within these dimensions; indeed one notices that MPIs for rich countries use different indicators, esp. for standard of living where the indicators tend to relate to higher standards of housing, clothing, financial sufficiency, etc. than in poor countries (e.g.. D'Ambrosio, Deutsch and Silber, 2011). Using different indicators makes multidimensional poverty comparisons across countries, however, close to impossible. This is therefore not the best way to include relative considerations.

3.2. Choice of weights

Different weighting schemes have been proposed in the literature to introduce relative considerations. Authors have particularly proposed consensus and prevalence weights to include relative considerations. For determining *consensual weights*, individuals are asked whether owning a specific item or taking part in a specific activity is considered “necessary”; these weights are then used to weigh indicators in an MPI and thus introduce a relative dimension. The advantage of these weights is that they are non-paternalistic and amenable to cultural differences. This is, however, limited to the items in the questionnaire as there are usually no open questions to name additional "necessary" items.

Nevertheless, these weights suffer from certain disadvantages: First, having foregone certain comforts for a while, the poor may adapt to a low level of living and consider this as being the “new normal". For example, they may get used to having only one meal per day and living in unhealthy and crowded housing (Sen, 1998). Second, the non-poor in the society influence what should be relevant for the poor without knowing their specific living situations. Mack and Lansley (1985) found that the voting behavior of the middle class differed strongly from the voting of the poor for certain items, such as TV or cigarettes. The poor deemed these items as absolutely necessary, as they provided the only distraction in their otherwise miserable life and would rather forego other comforts (regular warm meals, decent living circumstances) to be able to keep those items.

Third, using consensus weights does not, in our view, capture the problem that some indicators only measure resources or inputs, not functionings. Applying different weights does not solve this problem. A final problem with such an approach is that such a list of necessary items needs to be updated regularly to truly reflect the importance of different items in a society.

Prevalence or *frequency* weights are another popular way to reflect unique conditions in a society. These weights can reflect the importance of owning a specific item in a given society. They can thus capture two aspects: a sense of “belonging” to the society because you own the same items (e.g. a TV); and the way a society may be adjusted to certain needs of an individual. For example, in a society where only few people own a washing machine at home, public launderettes are common while it may be difficult to find one in a society where many people have washing machines at home. Similarly, it is less important to own a refrigerator in a society where few people do, because small shops selling perishable goods are more frequent and these goods are sold in smaller quantities. In this sense, frequency weights can get a sense of the particular resources needed to achieve a certain functioning.

But there are also problems: First, weights are only applicable to dichotomous items in the survey. Though ordinal or cardinal indicators can also be converted to binary indicators, this includes a potential loss of information. Second, applying prevalence weights may also lead to perverse and unintended weighting structures. Analyzing multidimensional poverty for Italy in 1995, Brandolini and D‘Alessio (1998) found that 19.5% of the population were deprived in terms of health, and only 8.6% were deprived in education. This would lead to education receiving a weight more than twice as high than that of health.

Finally, prevalence weights give less importance to the most common non-possessed items, though these may nevertheless have a high normative or cultural value in the society, or are clearly required in that society to achieve certain functionings. Thus prevalence weights are an option, but they also come with some problems.

3.3. Choice of indicator threshold

In order to apply the dual cut-off method in multidimensional poverty measurement (Alkire and Foster, 2011*a*) one has to define a poverty cut-off at the indicator level and an overall cut-off at the aggregated deprivation index. Both could be adapted to varying circumstances across societies. At the indicator level, one first has to determine whether the available indicator can capture a specific functioning or if indicators are rather just means to a specific end. In the latter case, one would need to adapt indicator thresholds across societies. Health indicators usually belong to the former category, as they reflect specific health functionings (e.g. being well-nourished, being in good health and free from premature death, Sen 1998). Additionally, average health levels in the society should not affect the assessment of the individual's health status for ethical reasons. An individual with a poor health status ought to be considered deprived, irrespective of the health status of other individuals in the society.

Adaptable thresholds may, however, be appropriate in the education and standard of living dimensions. While education could also be regarded as a goal in and of itself,[7] the role of education for social integration, ability to earn a decent living, and being without shame likely depends on the local environment [8]. Education outcomes enable the individual to achieve certain functionings, such as taking up a fulfilling and well-paid job, or participating in civic society. The capability of an individual to do so will depend on his / her characteristics and on average achievement levels in the rest of the society.[9]

The standard of living of an individual is defined through the availability of various resources. A sufficient standard of living enables you to have a healthy lifestyle and gives you social acceptance. The question of social acceptance is inherently relative and outcomes differ vastly across and within countries. It thus seems reasonable to realign poverty thresholds for these indicators, such as housing, assets, or fuels used to levels prevailing in the rest of the society.

After deciding which dimensions will be examined in a relative fashion, one needs to discuss how to do so. Several authors use poverty-related legal requirements or policy goals. Examples include Rippin (2013) for Germany, or Alkire, Apablaza and Jung (2014) for Europe. However, legal requirements are slow to change. They may be too low or too high, and thus may have little meaning. These requirements may reflect policy priorities, not necessarily priorities in the population. In addition, these thresholds may be difficult to compare across countries and time.

Take the example of education in Germany: The legal requirement is nine years of schooling. However, simply visiting school for nine years and leaving without a degree may not be enough to succeed in, and be fully accepted by, the German society. Thus, the legal requirement may be too low as a threshold.

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[7] Sen (2003) argues that illiteracy and innumeracy are forms of insecurity.

[8] In the same speech, Sen (2003) argues that most aspects of education depend on a gap in education within communities (among groups and genders). Illiterate people then have problems to invoke their legal rights or participate in the political arena.

[9] Such a relative view of education is even more relevant if education is mainly a signaling device of ability, rather than an absolute measure of human capital (cf. Pritchett, 2001; Spence, 1973).

In contrast to this, several least developed countries have now introduced compulsory primary schooling, with the reality lagging far behind these goals.

Some authors have simply adopted relative thresholds from income poverty measurement, e.g. a fraction of the mean or median (D'Ambrosio et al., 2011; Guio, 2009). This is clearly not appropriate for ordinal variables. Though one may use the median as threshold, a fraction of the median is not appropriate as this imposes a cardinal structure onto an ordinal variable. Given the ordinal nature of the variables, only the mode or median are appropriate as indicator thresholds. We do not recommend using the mode, as one very often comes across bi-modal structures in which it is usually far from clear which mode to choose in these situations. In the following application, we will therefore use the median as the indicator threshold. While we believe the median of a reference population provides a good reference point for the resources needed to achieve certain functionings, it is not without problems. First, the median in categorical variables is sensitive to the number of categories included in surveys, and may change if sub-categories are aggregated. Second, the median may reflect that most households are lacking a critical functioning rather than setting the standard for a functioning achievement. For example, while it may be ok to achieve the functioning 'access to clean water in a socially acceptable way' via a public standpipe in one setting and indoor plumbing in another, taking water from a dirty river or lake cannot reflect this functioning even if the median household of a reference gets water this way. Thus one might want to put in absolute lower bounds as poverty cut-offs in some dimensions that replace median achievements as threshold. This will be illustrated below.

3.4. Choice of poverty line

After aggregating deprivations across indicators using weights, a multidimensional poverty cut-off has to be applied to the aggregated poverty index. It differentiates between those parts of the population who are "simply" deprived in one or two indicators and those that are actually considered multidimensionally poor. One can introduce relative considerations at this stage as well.

A fully relative threshold such as the poorest 20% does not make much sense as is illustrated by Guio (2009) for the case of Europe. She found that adopting such a fully relative national threshold hides the existing deprivation diversity across member states. More importantly, it is not clear how such a relative overall threshold would be justified. One can justify a relative indicator threshold by arguing that relative deprivation in certain indicators will translate into absolute deprivation in the realm of functionings (cf. Sen, 1983). However, this argument cannot be applied for the aggregate poverty index which only considers the number of shortfalls in different dimensions. Varying this threshold in some way in richer societies seems very arbitrary. We hence argue for applying an absolute threshold to the aggregate index. Due to the construction of the MPI with three equally weighted dimensions, a second threshold of one third equals being deprived in one of the three dimensions. An individual deprived in either health, education, or the living standard (reflected through several indicators) is therefore considered to be multidimensionally absolutely poor in the functioning space.

3.5. Choice of reference population

Finally, one has to choose the appropriate reference population. This choice will depend on the context of the analysis and data availability. The group size needs to be big enough to give statistically reliable poverty estimates. How narrowly one should define the reference population is open to debate. Ravallion (2008) argues, "neither psychological, nor economic theories of relative deprivation offer much insight into who constitutes the relevant comparison group". Research usually focuses on neighbors, coworkers, and friends, but relevant comparison groups may enlarge with access to media (cf. Lohmann, 2015). Relative income poverty lines are usually set at the national level. Sometimes a differentiation between urban and rural areas is made.

In the multidimensional poverty analysis we observe various approaches. Some researchers set thresholds and weights at the subnational level (cf. Bossert et al., 2013; D'Ambrosio et al., 2011), while others focus on different countries (cf. Whelan et al., 2014) or groups within countries. One extreme example is provided by Halleröd (1995) for Sweden, who adjusts weights to differences in preferences between women and men, age groups, household types, and geographic regions.

Age cohort effects may also be important: Alkire, Apablaza and Jung (2014) find striking differences across age cohorts in health and education. A similar observation is made by Brandolini and D'Alessio (1998) who consequently adjust the education threshold, and apply the level of compulsory education for each cohort as threshold. However, the observation of differences across groups should not automatically lead to variable thresholds. While different outcomes may to some extent reflect different needs, this may also be evidence of existing deprivations. A too narrow focus may therefore result in overlooking actual poverty.

One can also turn to the use of reference groups for monetary poverty measurement for guidance. In monetary poverty measurement, relevant reference groups are defined at varying geographical levels. As we observe varying prices across and within countries, absolute monetary poverty lines are adapted to those varying prices. For the example of India, different urban and rural poverty lines are estimated by the National Planning Commission. These lines are then adapted to varying prices across states (Planning Commission, 2013). Thus, for India, we follow this tried-and-tested approach and set poverty thresholds at the state and urban/rural level. We compare this to thresholds at the country and the state level.

4. The Multidimensional Poverty Index

The MPI is an index of ”acute multidimensional poverty” and reflects deprivations in core human functionings and rudimentary services. It has been developed by Alkire and Santos (2014) for the 2010 Human Development Report and applies the Alkire-Foster dual cut-off method (Alkire and Foster, 2011*a*) for poverty identification. For the 2014 Human Development Report, UNDP has slightly updated the indicator definitions and adjusted the weighting structure to account for households with missing information or non-eligible population (i.e. no children or women between 15-49) (cf. Kovacevic and Calderon, 2014).

The Alkire-Foster method employs two cut-offs: First an indicator cut-off is applied to identify those who are poor in the specific indicator. Then poverty across dimensions is aggregated using indicator-specific weights, and the second cut-off is applied to this aggregated poverty index identifying the multidimensionally poor. The Alkire-Foster method therefore navigates between the traditional approaches of multidimensional poverty measurement, the intersection approach (where only those who are deprived in all dimensions are multidimensionally poor) and the union approach (where one is considered multidimensionally poor if one is deprived in a single dimension).

Although this method has also been criticized, it is widely used in multidimensional poverty measurement. Moreover, it is applied in the most well-known example of multidimensional poverty measurement, the UNDP’s MPI. Among its many theoretical merits, the Alkire-Foster method also has the advantage of producing a clear, policy-relevant headline figure. Our empirical application of a relative multidimensional poverty measure thus builds upon this method.

In the global MPI, poverty is aggregated using the M0 Alkire-Foster poverty index, accounting 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 (Alkire and Foster, 2011*a*; Alkire and Santos, 2014). The MPI itself is a 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).

The MPI includes three dimensions: health, education, and the standard of living. These dimensions mirror the Human Development Index (HDI). In the global MPI the same poverty cut-offs are applied across countries and years. The global MPI is therefore an absolute measure. The three dimensions of the MPI are represented by ten indicators. Health is represented by equally weighted child mortality and malnutrition indicators. A household is deprived in mortality if there was a child death in the household in the past five years or to a woman of age 35 or less. Similarly, a household is deprived in nutrition if there is at least one malnourished person (child below the age of five or adult woman) in the household.

Education is represented by equally weighted years of schooling and child enrolment indicators. Years of schooling are considered as a proxy for literacy and level of understanding of the household members. An individual is considered literate if he or she has at least six years of education. Following Basu and Foster (1998) the MPI assumes all household members benefit from one literate household member. Therefore, the household is considered non-deprived if at-least one household member has six years of schooling. The household is also deprived, if any primary school-age child is not enrolled in school.

The living standard dimension is represented by equally weighted access to electricity, source of drinking water, improved sanitation, flooring, clean cooking fuel, and an asset index indicators. Electricity and floor refer to the quality of housing, while drinking water, improved sanitation, and clean cooking fuel have health impacts. Finally, the household is not deprived in assets if it owns at least one information asset (radio, TV, telephone), and one mobility (bike, motorbike, car, truck, animal cart, motorboat) or livelihood asset (refrigerator, agricultural land, livestock) (Kovacevic and Calderon, 2014).

After determining the indicator cut-offs, the Alkire-Foster method attaches weights to each deprivation. The MPI weighs each dimension equally (1/3) and within each dimension, each indicator is weighed 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 considered multidimensionally poor if its weighted deprivations sum up to at least a third.

5. Application to India

We illustrate the theoretical considerations discussed above using the example of India and contrast our results to the global MPI which applies uniform thresholds. We use the same dataset (the 2005 DHS survey for India, also known as the India Family Health Survey) and indicators as the global MPI. Poverty thresholds in the education and standard of living dimensions differ from the global MPI, as these are set at the median of a reference population. Health outcomes measure absolute functionings directly and are thus not open to a relative assessment. We therefore apply the identical indicator thresholds as in the global MPI.

Relative poverty lines are often set at the national level. However, for a country as big as India, a national relative poverty line is disputable: The differences in ethnicity, culture, living standard, and climate are too large in this subcontinent with more than 1.2 billion people. To apply the same poverty line when comparing a Bihari farmer with a Bombayite is problematic. On the other hand, one does not want to define these groups too narrowly to avoid the threshold being meaningless, i.e. comparing a slum dweller in Mumbai only with other slum dwellers in the same city.

The government of India applies separate urban and rural poverty lines within the different states for the estimation of national (monetary) poverty in India (Planning Commission, 2013). These are still relatively big groups as populations in the different states range from 0.6 million people in Sikkim to nearly 200 million in Uttar Pradesh (cf. Census of India, 2011). In this illustrative exercise, we follow this choice of reference group. We compare poverty outcomes for this estimation with poverty estimations which use the whole country and the state as reference group, also distinguishing between urban and rural areas within each state.

5.1. Education dimension

The global MPI considers a household as not deprived if at least one household member has six years of schooling (Kovacevic and Calderon, 2014).). We set indicator thresholds at the median of the reference population as shown in Table 1. Although education may

Table 1: Median levels of schooling per adult (above 12)

State	urban	rural	State-wide
Jammu and Kahsmir	9	6	7
Himachal Pradesh	10	8	9
Punjab	9	5	7
Uttarchanal	9	6	7
Haryana	9	5	7
Delhi	9	8	9
Rajasthan	8	0	4
Uttar Pradesh	8	3	5
Bihar	7	0	4
Sikkim	9	4	6
Arunchanal Pradesh	6	3	4
Nagaland	8	5	7
Manipur	9	7	8
Mizoram	8	6	7
Tripura	8	5	6
Meghalaya	9	3	6
Assam	9	5	7
West Bengal	8	0	6
Jharkhand	9	3	5
Orissa	8	3	5
Chhattisgarh	8	3	5
Madhya Pradesh	8	2	6
Gujarat	8	5	7
Maharashtra	9	5	8
Karnataka	9	4	6
Goa	9	8	9
Kerala	9	9	9
Tamil Nadu	8	5	7
India	7	7	7

also be regarded as a goal in and of itself, its role for earnings and associated functionings, social integration and going without shame depends on education levels in one's community. The number of years of schooling necessary to succeed in a society — taking up a meaningful job, claiming legal rights, or participating in civil society — may therefore depend on the education levels in the reference population (cf. Pritchett, 2001; Sen, 2003; Spence, 1973). Hence, we consider the median of the distribution as the indicator cut-off. Households with education outcomes below the median are considered poor.

For urban areas, the education threshold is well-above the global MPI threshold of 6 years of schooling in most states. Nevertheless, in rural areas we observe much lower thresholds and in general a higher variability of thresholds. Only in Kerala do we observe the same threshold of 9 years for both urban and rural areas (cf. Table 1).

The variation in education outcomes across rural areas may be surprising. However, access to education varies significantly in India across states and areas, due to the federal nature of India's education policies. Teacher absenteeism is higher in poorer states. Moreover, more remote schools and schools with worse infrastructure (no sanitation, electricity connection, covered classroom, type of flooring) also face higher rates of teacher absenteeism (Kremer et al., 2005). Most importantly, however, these varying thresholds reflect policy priorities of the different state governments. While some states committed themselves to the goal of universal literacy early on, other states attached a lower importance to education. (Drèze and Sen, 1999)

Education may also be valued less in rural areas due to a trade-off with child labour (Borooah and Iyer, 2005), resulting in children dropping out earlier. In contrast, attaining higher education may be more important in the urban job market. This may be another reason for the higher education outcomes in urban areas.

The second education indicator is child enrolment. In the global MPI, a household is deprived if any child at school age is not enrolled. The school age is determined by looking at the primary school entrance age[10] plus one year[11] and assuming necessary enrolment to be up to grade 8[12]. For India this covers the age group 7-14. We observe that the median enrolment ratio in all states and rural/urban areas is 100%. Hence, in the median household all school-aged children are sent to school. We set the threshold at the median enrolment ratio in the reference population, i.e. 100%, so that we therefore do not deviate from the global MPI threshold.

5.2. Standard of living

The standard of living dimension is fully open to a relative assessment. Whether a specific standard of living is deemed sufficient depends on the social context and the living standard of one's reference group. While some standard of living indicators only distinguish between having an item, or benefiting from a service (electricity), for other indicators (e.g. water and sanitation access) varying quality is observed.

The global MPI allows for six equi-weighted living standard indicators: type of flooring, source of drinking water, adequacy of sanitation, type of cooking fuel, access to electricity and an asset index. The

[10] Derived from UNESCO education statistics

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

[12] This covers primary and lower secondary education.

household is deprived if either indicator does not fulfill standards defined by the Millennium Development Goals (MDGs), or when the household has no access to the electricity grid. The asset index is an asset count. Households are considered deprived if they do not own at least one information asset (either radio, TV, telephone) and one mobility (bike, motorbike, truck, animal cart, motorboat) or livelihood asset (refrigerator, agricultural land, livestock) (Kovacevic and Calderon, 2014).

Similar to the education dimension, the relevant indicator cut-off is defined as the median of the distribution. Where a varying quality can be observed in an indicator (floor, drinking water, sanitation, cooking fuel), we align the indicators with decreasing quality. We then assess the distribution within the reference population and a household with a quality below the median is considered deprived. For example, if the median in floor is cement, households with a stone floor or worse are considered deprived.

Access to electricity is a binary variable and thus we cannot apply an adaptable threshold and therefore keep the original global MPI category. For the asset indicator, we count the number of asset categories (information, mobility, livelihood) the household owns and set the threshold at the median of the asset category count. A household is non-deprived if it owns at least as many asset categories as the median of the reference population. In all areas except Meghalaya, the asset median lies below the global MPI threshold of 2. In most states, the median household owns assets in only one category. Median households in urban areas sometimes do not own any of the specified assets. Ownership in the specified assets is higher in rural areas, as many rural households own land or livestock.

For the other living standard indicators, we follow the ordering in the DHS dataset with few changes in the categories floor, sanitation and drinking water.[13] We present the final order in Table 2. In Table 3 we show the global threshold, the Indian one, and the range of thresholds when state and urban/rural is used. If the household's floor, water source, type of sanitation or cooking fuel does not fit into the existing categories (category "other"), we consider the observation missing.

Table 2: Order of the living standard indicators

Floor	**Water**	**Sanitation**	**Cooking Fuel**
polished stone/ marble/ granit	bottled water	flush toilet	electricity
carpet	piped water	flush to piped sewer	lpg, natural gas
ceramic tiles	piped into dwelling	flush to septic tank	biogas
vinyl, asphalt strips	piped to yard / plot	flush to pit latrine	kerosene
parquet, polished wood	tube well water	flush to somewhere else	coal, lignite
finished	tube well or borehole	flush, don't know where	charcoal
cement	protected well	pit toilet latrine	Wood
stone	protected spring	ventilated improved pit latrine	straw / shrubs /grass
brick	dug well (open / protected)	pit latrine with slab / open pit	agricultural crop
palm, bamboo	unprotected well	composting toilet	animal dung
raw wood planks	surface water	dry toilet	
rudimentary	unprotected spring	shared facility	
Dung	river/dam/etc	no facility / bush / field	
Sand	tanker truck		
mud/ clay/ earth	cart with small tank		
Natural	time to water above 30 min		

[13] The global MPI does not change the order in this way.

Flooring.[14] The global MPI defines a household as non-deprived in the category "floor" if the household does not have a sand, dung or dirt floor. The median flooring in most states and areas is cement, brick or better, and therefore above this threshold. However, in rural areas in several states, the norm is a mud or dung floor. Taking the median as threshold in flooring allows us to respond to local customs in flooring. In nomadic or semi-nomadic societies, for example, unfinished floors are the norm. A household should not be considered poor in these societies because of an unfinished floor.

Sanitation. In the sanitation category we consider composting and dry toilets better than having no access to any sort of sanitation facility. Having access to a shared sanitation facility is regarded better than having no access to any facility, but worse than any other sanitation facility independent of the actual facility at hand. We find that the median in sanitation is generally higher in urban areas. In most states, there is a striking difference between the sanitation standards in urban and rural areas. Exceptions are Goa, Kerala, Delhi, and the northeastern states. While we observe high sanitation standards — different kinds of flush toilets — in urban *and* rural areas in the first three states, we observe uniformly poorer standards in the Northeastern states (pit latrine as median). In most other states, we find flush toilets represent the median in urban areas, while no facilities or shared facilities are the norm in rural areas. In the global MPI, every household without access to an improved sanitation facility (flush toilets or latrines connected to sewer, septic tank, pit; and improved pit latrines) or with a shared sanitation facility is considered deprived. The global MPI can therefore not take into account different needs in urban and rural areas because of varying population density.

Nevertheless, sanitation research differentiating between urban and rural areas finds larger effects of improved sanitation on diarrhoea incidence and malnutrition among children in densely populated urban areas, in contrast to the small and sometimes insignificant results of the effect of improved sanitation in rural areas (cf. Esrey, 1996; Gross and Günther, 2014; Günther et al., 2010;). Günther et al. (2010) and Esrey (1996) also find that already simple sanitation technology has an effect on diarrhoea and child mortality. Therefore, it appears sensible to allow for varying sanitation thresholds in different environments, including higher thresholds for urban areas.

Water. We define bottled water[15] to be the best category and time to the next water source above 30 min as the worst.. Furthermore, we reorder the water category in a way that improved water sources (protected well, protected spring, rainwater) — as defined by the global MPI — are above unprotected water sources, such as an unprotected well.

In the category of drinking water, the median in urban and rural areas is usually a form of piped water or tube well water. This is well-above the global MPI threshold, which includes rain water, protected

[14] In the category floor in the original DHS dataset, cement is above ceramic tiles and below carpet. We reorder the category floor so that cement is below finished and above stone floor.
[15] Bottled water seems to be a voluntary choice consumed largely by the richest quintile.

spring and well; and all kinds of tube and piped water into the category "improved water source". The only exceptions are Jharkhand, Madhya Pradesh, Meghalaya, and Manipur, where in rural areas the median water source is an unprotected well or spring.

Evidence on the effect of water services on health is mixed. Most research finds a positive impact is contingent on access to improved sanitation facilities (among others: Esrey, 1996, Günther et al., 2010) and may depend on parental health knowledge (Jalan and Ravallion, 2003). While historical data shows that large-scale investments in water and sanitation infrastructure may have strong impacts on child mortality, more recent randomized controlled trials find no substantial health impacts (Waddington and Snilstveit, 2009).

As the health effects of different water sources are relatively unclear, we argue that a household may consider itself deprived if it has to use a worse water source than its peers. Our strategy can also account for discrimination (e.g. by caste) on water access and will consider worse access than the reference group as deprived, even if the household would not be considered deprived by the global MPI as the water source may still be an "improved water source".

Cooking Fuel. The global MPI requires a household to use clean cooking fuel to be considered non-deprived (electricity, lpg, biogas, kerosene). Indoor air pollution from the combustion of biomass fuels is a global health problem mostly affecting women and children (Bruce et al., 2000). The precise health effects of the kind of cooking fuel used, however, depend mostly on the stove and place of cooking (indoor cooking is more harmful than outdoor cooking). When cooking takes place outdoors, or with an improved stove, indoor air pollution is much lower (among others: Albalak et al., 2001; Chengappa et al., 2007; Grieshop et al., 2011). Moreover, the use of kerosene (defined as clean cooking fuel) also incurs significant health impacts. Though the combustion of kerosene produces far less carbon monoxide than that of solid cooking fuels, women and children are exposed to nitrogen dioxide, benzene and toluene (Muller et al., 2003).

Finally, the choice in cooking fuel is to a large extent determined by cultural preferences and local availability of fuels, and only to a lesser extent by price and income effects (Kowsari and Zerriffi, 2011; Masera et al., 2000). Some households prefer to use traditional (biomass) cooking fuels out of habit or routine. These local customs appear to be more entrenched in rural areas. In addition, not all kinds of cooking fuels are readily available in rural areas. More recent research shows that we usually do not observe a linear transition from traditional to modern fuels determined by fuel prices and household income; other factors matter (cf. for a review of the literature: Kowsari and Zerriffi, 2011).

In the vast majority of states, the median cooking fuel in urban areas is LPG or kerosene. Exceptions are the states of Bihar, Jharkhand and Orissa, where households in urban areas use coal; and the state of Kerala where households in urban *and* rural areas use wood as cooking fuel. However, in rural areas cooking usually takes place with wood, though, sometimes straw and agricultural crops are used as cooking fuels.

Assets. For the asset indicator, we count the number of asset categories (information, mobility, livelihood) the household owns and set the threshold at the median of the asset category count. A household is non-deprived if it owns at least as many asset categories as the median of the reference population. In all areas except Meghalaya, the asset median lies below the global MPI threshold of 2. In most states, the median household owns assets in only one category. Median households in urban areas sometimes do not own any of the specified assets. Ownership in the specified assets is higher in rural areas, as many rural households own land or livestock.

In summary, we find that the adaptable thresholds in many of the living standard and education indicators are usually well-above the global MPI threshold in urban areas. However, in rural areas the threshold is often below the global MPI threshold. In general, we observe quite a divergence in the median values depending on the state and the place of residence (urban vs. rural). The varying threshold therefore enables us to reflect the different needs and customs in urban and rural areas. In several of the living standard categories, households in rural areas keep a more traditional style of living. We argue that this may well be a voluntary choice in some circumstances. In addition, households may also have different needs in rural areas (sanitation, water). Finally, all living standard indicators are also status symbols and since an important aspect of poverty is to be socially accepted, this will depend on the prevalence of these status symbols in one's area.

At the same time, it may be argued that our standards, dictated by the median, in rural areas are sometimes too low, lower than what is required to achieve a certain functioning. Having just 1 year of education maybe too little to be even minimally educated even in an area where the median is 0; similarly, some of the water and sanitation standards might be lower than what is required to avoid adverse health effects. One way to deal with this would be to add such absolute thresholds as a further constraint to be met. We do not do this here in our illustrative exercise, but this would be an obvious extension.

Table 3: Indicator thresholds for education and living standards

Indicator	threshold global MPI	threshold India	lowest cut-off	region	highest cut-off	region
Schooling	6	7	0	Rajasthan rural, Bihar rural, West Bengal rural	10	Himachal Pradesh urban
Enrolment	1	1	1	all regions	1	all regions
sanitation	pit latrine with slab	shared toilet	no facility / bush/field	16 regions, Example: Tamil Nadu rural	flush to piped sewer system	Punjab urban, Delhi urban, Gujarat urban
water	protected well	tube well or borehole	unprotected spring	Manipur rural	piped into dwelling	8 regions, Example: Himachal Pradesh urban
floor	rudimentary	Cement		11 regions, Example: Orissa rural	polished stone / marble / granite	Gujarat urban
cooking fuel	kerosene	Wood	agricultural crop	Punjab rural, Bihar rural	lpg, Natural gas	25 regions, Example: Jammu and Kashmir urban
assets	1	1	0	11 regions, Example: Goa urban	2	Meghalaya rural, Meghalaya urban

Note: If more than three regions share the same threshold, we only provided one example. The full lists of regional thresholds in the standard of living dimension are provided in the Appendix tables A.1 to A.5

5.3. Results

By analyzing the poverty outcomes for the original MPI (Appendix A.6), the multidimensional measure with reference group India (Relative MP(1), Appendix A.7), the multidimensional measure with reference group state (Relative MP (2), Appendix A.8), and the multidimensional measure with reference group rural-/urban-state (Relative MP (3), Appendix A.9), we find that poverty outcomes differ vastly for the whole country, depending on which measure is applied. All adaptable poverty measures find a higher poverty incidence than the global MPI (55.35%).

The highest poverty incidence is found when we take the whole country as the reference group (65.59%). As to be expected, we find a lower poverty incidence for the smaller reference groups differentiating between states (62.59%) and differentiating between urban and rural areas within the state (57.94%). The poverty intensity (A) is lowest for all four measures when the rural-urban poverty measure is applied.

The high poverty outcome of relative MP (1) (reference group India) is mostly driven by the higher threshold in the schooling and flooring indicator than in the global MPI. While the threshold in the schooling indicator is actually higher for the majority of states when Relative MP (2) and Relative MP (3) is applied, the thresholds in the poorer and often population-rich states (Chattishgarh, Jharkhand, AP, Bihar, Uttar Pradesh, Rajasthan) are lower than the global MPI threshold, particularly in rural areas. This also holds true for most of the standard of living indicators, leading therefore to lower poverty rates as it is easier to surpass these lower thresholds.

5.3.1. Multidimensional poverty across states

By analyzing poverty outcomes across states, we find that the *variation* in the poverty incidence is in general lower for the adaptable poverty measures (see appendix tables A6-A9). When comparing the global MPI (appendix Table A6) with the one using urban and rural thresholds (Relative MP 3, Table A9), the increase in the poverty headcount is notable in the states of Delhi (from 14.13% to 44.84%), Mizoram (from 18.57 to 33.18%), Gujarat (from 39.23 to 54.59%), and Goa (from 20.13% to 34.02%). In these states, we observe comparatively high thresholds in the standard of living and schooling indicators, while at the same time attainment in these indicators is unequally distributed. Thus, the poverty incidence increases. We also observe a significant reduction in the poverty incidence for the state of Rajasthan (from 60.57% to 48.24%), the indicator thresholds in rural areas are relatively low but the (low) attainment in these indicators appear to be more uniformly distributed. This reduction in variation is to be expected as higher thresholds in better-off areas increase poverty there and lower them in worse-off areas, compared to the uniform standards of the global MPI

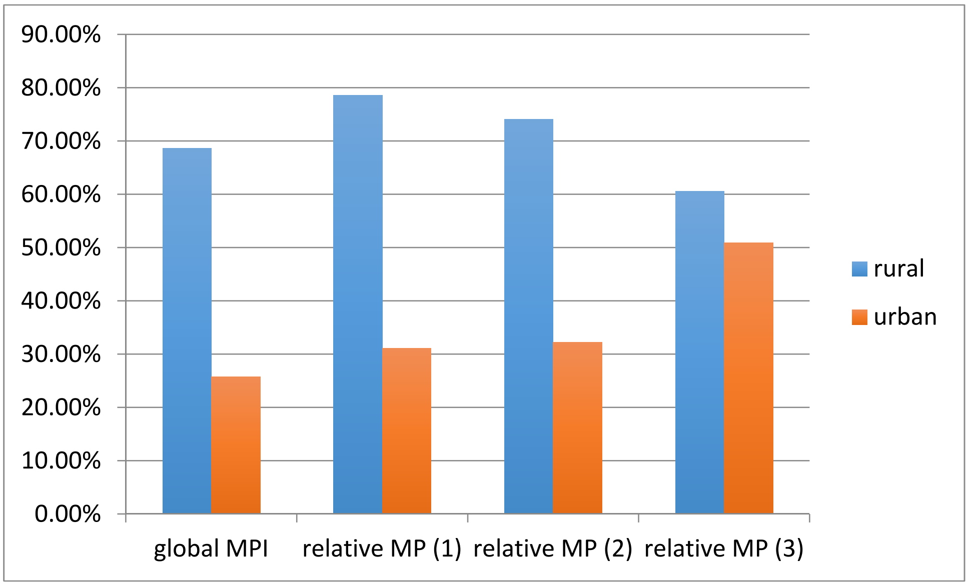
Ranking the states by poverty incidence and comparing the outcome to the global MPI, we still find that Kerala exhibits the lowest poverty outcomes even though the poverty incidence increased from 11.64% to 20.89% using state and urban-rural thresholds. However, Bihar is no longer the poorest state. Applying state and urban-rural thresholds, the poverty incidence in Uttar Pradesh increases from 71.55% to 75.46% and thus Uttar Pradesh is India's poorest state; this suggests a combination of high median achievements pushing up thresholds and large inequality, ensuring that many fail to meet those thresholds.[16]

5.3.2. Decomposition of multidimensional poverty by household type and location

The effect of household size and gender of the household head on poverty outcomes is relatively small and does not differ greatly between the measures. However, all adaptable poverty measures find more poverty in urban areas, compared to the global MPI (see Figure 1). Allowing for separate urban and rural poverty lines within each state, we unsurprisingly find the highest incidence of urban poverty. These differentiated thresholds can better reflect different living circumstances in urban and rural areas and allow us to accurately represent urban poverty.

[16] Rank correlations at the household level also show a high correlation.

Figure 1: Urban-Rural Gap in Poverty depending on Thresholds used

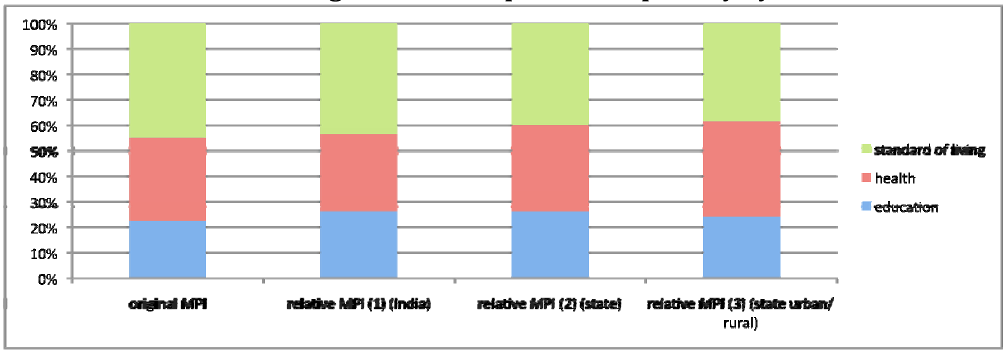


Though the rate of rural poverty still outweighs that of urban poverty, we find a more even distribution of poverty across groups when the relative measures are applied.

5.3.3. Decomposition across dimensions

By analyzing the relative contribution each indicator has on the poverty outcome (see Figure 2), we find the importance of the education dimension (enrolment and schooling) in explaining poverty increases when the adaptable measures are applied, while the relative importance of the standard of living dimension decreases. The contribution of the standard of living dimension decreases when we move to more fine-grained reference groups, related to lower thresholds in some states and many rural areas within states. Conversely, the relative contribution of the health dimension to overall multidimensional poverty also increases when the relative MP (3) is applied, even though indicator thresholds in this dimension are identical across the three measures. Using the global MPI thresholds, poverty in India is to a large extent determined by deprivations in the standard of living dimension, which mirrors findings from other countries (Alkire and Santos, 2014; Pasha, 2017). In contrast to this, the contribution of three dimensions to poverty is more balanced when the adaptable measures are applied which we find to be a desirable feature as it does not give higher implicit weights to one dimension.

Figure 2: Decomposition of poverty by dimension



6. Conclusion

In this paper, we develop three adaptable multidimensional poverty measures to create a measure that is closer to being absolute at the level of functionings, and thus relative at the level of resources. Our poverty measures build upon the global MPI and apply the same database. Poverty outcomes can hence be compared to the global MPI. We illustrate our theoretical considerations using the example of India.

Following the construction of the global MPI, we consider three dimensions: health, education, and living standards, and apply the Alkire-Foster dual cut-off method. Relative concerns can determine the choice of indicator, indicator thresholds, weights and the overall cut-off. We argue for adjusting indicator thresholds as the most appropriate way to introduce relative considerations for resources. We generate three adaptable poverty measures, one uses the whole country as reference population, one differentiates across different Indian states and Union Territories, and the third allows for different urban and rural poverty lines within the state. All adaptable poverty measures find a higher poverty incidence for India than the global MPI does. The poverty incidence is highest, when the whole country is used as the reference group. Allowing for separate rural and urban poverty lines within the state returns a poverty outcome similar to that of the global MPI. The poverty incidence across states vary significantly when this measure is compared to the global MPI, though there are few changes in the poverty ranking of states; but the differential between states, and between urban and rural areas falls significantly, when using state and urban/rural-specific thresholds.

The relative contribution of the living standard dimension to overall poverty is decreased when the adaptable poverty measures are applied, while the importance of the education dimension increases. Overall, the contribution of the three dimensions to poverty is more balanced when the adaptable measures are applied. We note, however, some potential drawbacks that merit further investigation. First, some of the thresholds may be too low to adequately reflect absolute functionings. Maybe one needs to mix this relative approach with some fixed minima, e.g. in the education, water, or sanitation indicators, which would likely reduce some of the differences between the measures. Second, while this approach can usefully be applied to measure absolute multidimensional poverty in the functioning space across developing countries, it is not clear that a suitable adjustment of the indicator thresholds would generate a sensible absolute functioning poverty for rich countries. Particularly in the living standards dimension, other indicators may be required to measure functioning poverty adequately there, where size and quality of housing, access to transportation, media, finance, and services might figure more prominently.

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Appendix

Table A.1: Thresholds in the indicator sanitation across regions

	Urban	Rural
Punjab	Flush to piped sewer system	Shared toilet (irrelevant of what kind)
Delhi	Flush to piped sewer system	Flush to somewhere else
Gujarat	Flush to piped sewer system	No facility/bush/field
Jammu and Kashmir	Flush to septic tank	Shared toilet (irrelevant of what kind)
Himachal Pradesh	Flush to septic tank	No facility/bush/field
Uttarchanal	Flush to septic tank	No facility/bush/field
Haryana	Flush to septic tank	No facility/bush/field
Uttar Pradesh	Flush to septic tank	No facility/bush/field
Sikkim	Flush to septic tank	Pit latrine with slab
Mizoram	Flush to septic tank	Pit latrine with slab
Chhattisgarh	Flush to septic tank	No facility/bush/field
Madhya Pradesh	Flush to septic tank	No facility/bush/field
Maharashtra	Flush to septic tank	No facility/bush/field
Andhra Pradesh	Flush to septic tank	No facility/bush/field
Goa	Flush to septic tank	Flush to septic tank
Kerala	Flush to septic tank	Flush to septic tank
Rajasthan	Flush to pit latrine	No facility/bush/field
Jharkhand	Flush to pit latrine	No facility/bush/field
Karnataka	Flush to pit latrine	No facility/bush/field
Tamil Nadu	Flush to somewhere else	No facility/bush/field
Arunchanal Pradesh	Pit latrine with slab	Dry toilet
Nagaland	Pit latrine with slab	Pit latrine without slab/ open pit
Tripura	Pit latrine without slab/ open pit	Pit latrine with slab
Meghalaya	Pit latrine with slab	Shared toilet (irrelevant of what kind)
Assam	Pit latrine with slab	Pit latrine without slab/ open pit
Bihar	Shared toilet (irrelevant of what kind)	No facility/bush/field
Manipur	Shared toilet (irrelevant of what kind)	Composting Toilet
West Bengal	Shared toilet (irrelevant of what kind)	No facility/bush/field
Orissa	Shared toilet (irrelevant of what kind)	No facility/bush/field

Table A.2. Threshold in the indicator water across regions

	Urban	Rural
Punjab	Piped to yard/plot	Tube well or borehole
Delhi	Piped into dwelling	Piped to yard/plot
Gujarat	Piped into dwelling	Public tap/standpipe
Jammu and Kashmir	Piped into dwelling	Tube well or borehole
Himachal Pradesh	Piped into dwelling	Public tap/standpipe
Uttarchanal	Piped into dwelling	Public tap/standpipe
Haryana	Piped to yard/plot	Tube well or borehole
Uttar Pradesh	Tube well or borehole	Tube well or borehole
Sikkim	Piped into dwelling	Protected Spring
Mizoram	Piped to yard/plot	Protected Spring
Chhattisgarh	Tube well or borehole	Tube well or borehole
Madhya Pradesh	Piped to yard/plot	Unprotected Well
Maharashtra	Piped into dwelling	Public tap/standpipe
Andhra Pradesh	Piped to yard/plot	Piped to yard/plot
Goa	Piped into dwelling	Public tap/standpipe
Kerala	Protected Well	Protected Well
Rajasthan	Piped to yard/plot	Rainwater
Jharkhand	Tube well or borehole	Unprotected Well
Karnataka	Public tap/standpipe	Public tap/standpipe
Tamil Nadu	Public tap/standpipe	Public tap/standpipe
Arunchanal Pradesh	Piped to yard/plot	Public tap/standpipe
Nagaland	Protected Well	Protected Well
Tripura	Tube well or borehole	Tube well or borehole
Meghalaya	Piped to yard/plot	Unprotected Well
Assam	Tube well or borehole	Tube well or borehole
Bihar	Tube well or borehole	Tube well or borehole
Manipur	Tube well or borehole	Unprotected Spring
West Bengal	Public tap/standpipe	Tube well or borehole
Orissa	Tube well or borehole	Tube well or borehole

Table A.3 Thresholds in the indicator floor across regions

	Urban	Rural
Punjab	Cement	Brick
Delhi	Cement	Cement
Gujarat	Polished stone/marble/granite	Cement
Jammu and Kashmir	Cement	Dung
Himachal Pradesh	Cement	Cement
Uttarchanal	Cement	Dung
Haryana	Cement	Brick
Uttar Pradesh	Cement	Mud/clay/earth
Sikkim	Cement	Cement
Mizoram	Parquet, polished wood	Cement
Chhattisgarh	Cement	Mud/clay/earth
Madhya Pradesh	Cement	Dung
Maharashtra	Ceramic tiles	Dung
Andhra Pradesh	Cement	Stone
Goa	Cement	Cement
Kerala	Cement	Cement
Rajasthan	Cement	Dung
Jharkhand	Cement	Dung
Karnataka	Cement	Stone
Tamil Nadu	Cement	Cement
Arunchanal Pradesh	Palm, bamboo	Palm, bamboo
Nagaland	Cement	Mud/clay/earth
Tripura	Mud/clay/earth	Mud/clay/earth
Meghalaya	Cement	Raw wood planks
Assam	Cement	Mud/clay/earth
Bihar	Cement	Mud/clay/earth
Manipur	Mud/clay/earth	Mud/clay/earth
West Bengal	Cement	Mud/clay/earth
Orissa	Cement	Mud/clay/earth

Table A.4 Thresholds in the indicator cooking fuel across regions

	Urban	Rural
Punjab	Lpg, natural gas	Agricultural crop
Delhi	Lpg, natural gas	Lpg, natural gas
Gujarat	Lpg, natural gas	Wood
Jammu and Kashmir	Lpg, natural gas	Wood
Himachal Pradesh	Lpg, natural gas	Wood
Uttarchanal	Lpg, natural gas	Wood
Haryana	Lpg, natural gas	Wood
Uttar Pradesh	Lpg, natural gas	Wood
Sikkim	Lpg, natural gas	Wood
Mizoram	Lpg, natural gas	Wood
Chhattisgarh	Lpg, natural gas	Wood
Madhya Pradesh	Lpg, natural gas	Wood
Maharashtra	Lpg, natural gas	Wood
Andhra Pradesh	Lpg, natural gas	Wood
Goa	Lpg, natural gas	Wood
Kerala	Wood	Wood
Rajasthan	Lpg, natural gas	Wood
Jharkhand	Coal, lignite	Wood
Karnataka	Lpg, natural gas	Wood
Tamil Nadu	Lpg, natural gas	Wood
Arunchanal Pradesh	Lpg, natural gas	Wood
Nagaland	Lpg, natural gas	Wood
Tripura	Lpg, natural gas	Wood
Meghalaya	Lpg, natural gas	Wood
Assam	Lpg, natural gas	Wood
Bihar	Coal, lignite	Agricultural crop
Manipur	Lpg, natural gas	Wood
West Bengal	Kerosene	Straw/shrubs/grass
Orissa	Coal, lignite	Wood

Table A.5 Thresholds in the indicator assets across regions

	Urban	Rural
Punjab	0	0
Delhi	1	0
Gurajat	1	1
Jammu and Kashmir	1	1
Himachal Pradesh	1	1
Uttarchanal	0	1
Haryana	0	1
Uttar Pradesh	0	1
Sikkim	1	1
Mizoram	1	1
Chhattisgarh	1	1
Madhya Pradesh	1	1
Maharashtra	1	1
Andhra Pradesh	1	1
Goa	0	0
Kerala	1	1
Rajasthan	0	1
Jharkhand	1	1
Karnataka	1	1
Tamil Nadu	1	1
Arunchanal Pradesh	1	1
Nagaland	1	1
Tripura	1	1
Meghalaya	2	2
Assam	1	1
Bihar	1	1
Manipur	0	1
West Bengal	1	1
Orissa	0	1

Table A.6: Decomposition of global MPI across states

State	Headcount	Intensity	MPI
India	55.35%	51.03%	0.282
Jammu and Kashmir	40.20%	44.56%	0.179
Himachal Pradesh	26.90%	40.29%	0.108
Punjab	24.41%	44.93%	0.11
Uttarchanal	38.74%	45.55%	0.176
Haryana	38.97%	47.06%	0.183
Delhi	14.13%	44.57%	0.063
Rajasthan	60.57%	52.87%	0.32
Uttar Pradesh	71.55%	52.38%	0.375
Bihar	77.78%	57.32%	0.446
Sikkim	30.79%	46.78%	0.144
Arunachal Pradesh	51.42%	50.31%	0.259
Nagaland	52.09%	51.04%	0.266
Manipur	43.22%	44.94%	0.194
Mizoram	18.57%	43.45%	0.081
Tripura	53.10%	47.85%	0.254
Meghalaya	55.41%	52.51%	0.291
Assam	63.88%	50.98%	0.326
West Bengal	59.08%	51.45%	0.304
Jharkhand	74.97%	56.16%	0.421
Orissa	64.53%	52.58%	0.339
Madhya Pradesh	68.02%	52.81%	0.359
Gujarat	39.23%	47.70%	0.187
Maharashtra	41.43%	46.21%	0.191
Andhra Pradesh	47.85%	47.36%	0.227
Karnataka	47.40%	46.04%	0.218
Goa	20.13%	41.58%	0.084
Kerala	11.64%	38.52%	0.045
Tamil Nadu	34.99%	42.32%	0.148

Table A.7: Decomposition of relative multidimensional poverty (1) across states (reference group whole country)

State	Headcount	Intensity	MPI
India	65.59%	53.38%	0.35
Jammu and Kashmir	41.94%	46.13%	0.193
Himachal Pradesh	34.65%	40.86%	0.142
Punjab	39.22%	45.22%	0.177
Uttarchanal	46.51%	45.86%	0.213
Haryana	54.08%	46.81%	0.253
Delhi	17.16%	44.78%	0.077
Rajasthan	70.55%	53.90%	0.38
Uttar Pradesh	81.23%	55.79%	0.453
Bihar	86.83%	60.24%	0.523
Sikkim	41.19%	46.48%	0.191
Arunachal Pradesh	58.33%	51.49%	0.3
Nagaland	57.04%	50.53%	0.288
Manipur	48.32%	45.02%	0.218
Mizoram	24.10%	45.29%	0.109
Tripura	64.76%	47.19%	0.306
Meghalaya	62.47%	53.82%	0.336

Assam	71.51%	52.04%	0.372
West Bengal	68.36%	53.75%	0.367
Jharkhand	77.40%	58.18%	0.45
Orissa	73.79%	54.69%	0.404
Madhya Pradesh	73.55%	54.16%	0.398
Gujarat	45.73%	48.68%	0.223
Maharashtra	49.13%	46.76%	0.23
Andhra Pradesh	58.36%	48.51%	0.283
Karnataka	57.76%	47.95%	0.277
Goa	24.10%	41.81%	0.101
Kerala	12.63%	37.72%	0.048
Tamil Nadu	36.18%	42.57%	0.154

Table A.8: Decomposition of relative multidimensional poverty (2) across states (reference group state)

State	Headcount	Intensity	MPI
India	62.59%	48.69%	0.305
Jammu and Kashmir	45.45%	46.10%	0.21
Himachal Pradesh	48.11%	43.45%	0.209
Punjab	36.15%	45.61%	0.165
Uttarchanal	50.01%	47.03%	0.235
Haryana	38.94%	47.03%	0.183
Delhi	45.26%	43.98%	0.199
Rajasthan	58.17%	47.82%	0.278
Uttar Pradesh	76.51%	49.03%	0.375
Bihar	75.02%	50.54%	0.379
Sikkim	42.85%	47.09%	0.202
Arunachal Pradesh	50.01%	49.96%	0.25
Nagaland	57.93%	51.82%	0.3
Manipur	24.86%	47.75%	0.119
Mizoram	38.18%	44.80%	0.171
Tripura	55.02%	45.35%	0.25
Meghalaya	64.45%	53.32%	0.344
Assam	68.29%	49%	0.335
West Bengal	68.85%	52.66%	0.363
Jharkhand	64.24%	50.35%	0.323
Orissa	61.60%	45.14%	0.278
Madhya Pradesh	68.89%	49.16%	0.339
Gujarat	50.51%	49.11%	0.248
Maharashtra	63.35%	48.44%	0.307
Andhra Pradesh	64.79%	49.18%	0.319
Karnataka	44.80%	45.86%	0.205
Goa	33.71%	44.05%	0.149
Kerala	20.89%	39.73%	0.083
Tamil Nadu	46.93%	42.78%	0.201

Table A.9: Decomposition of relative multidimensional poverty (3) across states (reference group state urban/rural)

State	Headcount	Intensity	MPI
India	57.94%	45.04%	0.261
Jammu and Kashmir	44.27%	44.64%	0.198
Himachal Pradesh	32.73%	40.38%	0.132
Punjab	30.23%	45.79%	0.138

Uttarchanal	45.55%	43.58%	0.199
Haryana	43.97%	45.45%	0.2
Delhi	44.84%	43.67%	0.196
Rajasthan	48.24%	44.68%	0.216
Uttar Pradesh	75.46%	45.61%	0.344
Bihar	70.17%	45.86%	0.322
Sikkim	36.31%	44.86%	0.163
Arunachal Pradesh	51.38%	49.88%	0.256
Nagaland	48.93%	48.04%	0.235
Manipur	35.83%	45.45%	0.163
Mizoram	33.18%	43.56%	0.145
Tripura	52.04%	43.98%	0.229
Meghalaya	58.39%	49.92%	0.291
Assam	67.55%	47.47%	0.321
West Bengal	52.95%	45.58%	0.241
Jharkhand	66.85%	46.13%	0.308
Orissa	62.42%	44.38%	0.277
Madhya Pradesh	57.57%	46.10%	0.265
Gujarat	54.59%	44.92%	0.245
Maharashtra	55.68%	43.59%	0.243
Andhra Pradesh	53.23%	43.74%	0.233
Karnataka	50.77%	44.39%	0.225
Goa	34.02%	43.39%	0.148
Kerala	20.89%	39.73%	0.083
Tamil Nadu	36.21%	40.73%	0.147

Table A. 10: Spearman Rank correlation

	global MPI	relative MP (1)	relative MP (2)	relative MP (3)
relative MP (1)	98.28% (0.0000)	1		
relative MP (2)	84.83% (0.0000)	83.74% (0.0000)	1	
relative MP (3)	87.09% (0.0000)	87.14% (0.0000)	89.41% (0.0000)	1

Table A.11: Kendall Tau Rank correlation

	global MPI	relative MP (1)	relative MP (2)	relative MP (3)
relative MP (1)	90.15% (0.0000)	1		
relative MP (2)	67.49% (0.0000)	65.52% (0.0000)	1	
relative MP (3)	69.46% (0.0000)	70.44% (0.0000)	71.43% (0.0000)	1

Table A.12: Relative contribution of indicators to overall poverty

	global MPI	relative MP (1)	relative MP (2)	relative MP (3)
education	22.5%	26.24%	26.21%	24.11%
health	32.67%	30.32%	33.87%	37.44%
standard of living	44.83%	43.44%	39.92%	38.54%