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From Income Poverty to Multidimensional Poverty: An International Comparison

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Abstract

The United Nations 2030 Agenda for Sustainable Development clearly recognizes that poverty is more than just the lack of a sufficient amount of income. However, some scholars argue that an income-based measure of poverty can sufficiently capture poverty in other dimensions. Unfortunately, the available international indicators of multidimensional poverty suffer from several weaknesses and cannot be directly compared with monetary measures of poverty. This paper provides two main contributions to the literature on poverty measurement and analysis. First, it proposes a theoretically and methodologically sound indicator of multidimensional poverty, called the Global Correlation Sensitive Poverty Index (G-CSPI), which addresses most of the problems present in other poverty indicators. Thanks to the massive I2D2 database of harmonized household surveys, the G-CSPI was calculated for more than 500 surveys, and the results show that it is stable and robust. Second, for the first time we were able to conduct a comparative analysis between income and multidimensional poverty, relying on the same dataset to calculate both. Previous cross-country evidence was based on very different surveys used for the computation of income and multidimensional poverty and even conducted in different years. Building on recent data for 92 countries, our analysis shows that the headcount ratio of extreme monetary poverty (USD1.90) is highly correlated with that of the G-CSPI, but that the relationship is clearly non-linear. Thus, we provided the first empirical evidence of the fact that income poverty is not a sufficiently good proxy for multidimensional poverty.

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1. Introduction

Proponents of the income-based approach to poverty rarely contest the fact that poverty is actually a multidimensional phenomenon. What they claim is that economic resources provide a sufficiently precise proxy for whatever dimensions poverty might have. The indirect assumption is that all dimensions of poverty are highly correlated and thus can be substituted by just one dimension: income. Upcoming multidimensional poverty measures have challenged this established assumption, claiming that the correlation between the various dimensions of poverty is in fact not strong enough for income to serve as a proxy for them. Instead, the multiple dimensions of poverty should be measured one by one.

The Multidimensional Poverty Index (MPI) developed by the Oxford Poverty and Human Development Initiative (OPHI) and used by the United Nations Development Programme (UNDP) in particular drew attention to this alternative way to measure poverty, especially by demonstrating that there are considerable differences between the number of people living in income poverty and those living in multidimensional poverty according to the MPI. For instance, in Ethiopia, 90 per cent of the population are MPI-poor; however, only 39 per cent live on less than USD1.25 per day. In Uzbekistan, on the other hand, 46 per cent of the population live on less than USD1.25 per day, but only 2 per cent are MPI-poor.

These are huge differences; however, the validity of the results is limited, mainly for two reasons. First, the MPI has several weaknesses, which include the choice of dimensions and indicators of poverty, the assumptions behind the data imputations, and the final aggregation function. The latter in particular makes the heroic assumption of zero correlation among dimensions of poverty, which seems to be an even more unrealistic claim than the indirect assumption of almost perfect correlation of the income poverty approach. It is, in fact, very unlikely that dimensions of poverty such as health and education are not correlated at all, and it is even less likely that indicators such as the possession of a television or a fridge do not correlate with access to electricity—all actually basic indicators of the MPI.

Second, it is not clear to what extent the aforementioned differences between the number of income-poor and multidimensionality poor people are due to the different datasets used for the calculations. The Demographic and Health Surveys datasets, predominantly used for the calculation of the MPI, have a special focus on women's reproductive health, thus focusing in particular on females aged 15–46. Thus, these datasets differ considerably from the ones that are used for the calculation of the USD1.90 (and previously USD1.25) income poverty line, which are mostly labour force surveys, Living Standard Measurement Surveys and Household Budget Surveys. Moreover, the two types of surveys are in almost all cases conducted in different years; therefore, differences in poverty levels may actually reflect real changes occurring in the period between the two surveys.

This paper seeks to improve the current way to measure multidimensional poverty and to more consistently analyse its relationship with income-based poverty measures. First, unlike the process that generated the MPI, particular attention will be devoted to the choice of dimensions and indicators of poverty, to be coherent with the conceptual framework provided by Amartya Sen's capability approach. We will search for a compromise between an 'ideal'

list of dimensions and a 'feasible' one, which allows us to include a larger sample of countries in our analysis. Second, the calculations of multidimensional poverty are based on an aggregation function different from the Alkire-Foster method, the Correlation Sensitive Poverty Index (CSPI). The CSPI allows dimensions of poverty to be correlated and is as decomposable as the MPI. Third, the same dataset—the World Bank's International Income Distribution Data Set (I2D2)—will be used to calculate both income poverty and multidimensional poverty. Thus, for the first time we are able to not only scrutinise whether international poverty numbers differ but, more importantly, whether the two measures indeed diverge in identifying the poorest sections of the population—and whether international poverty trends change depending on which poverty measure is used. The results are of immediate relevance for the targeting of poverty reduction policies as well as the 2030 Agenda debate, in which the question of whether income-based poverty measures should be complemented by multidimensional poverty measures is still a hotly debated topic.

The remainder of the paper is organised as follows. Section 2 provides the conceptual framework. Section 3 provides a brief description of the datasets used in this study; Section 4 a detailed discussion of the existing methods for selecting dimensions of poverty, the proposal for an alternative method, called Constitutional Approach, and the final list used in this empirical study. Section 5 presents our approach to identifying weights for the different dimensions, while Section 6 provides the justification for our choice of indicators and cut-offs. In Section 7 we discuss alternative ways to aggregate dimensions of poverty into one single index. Section 8 presents the results of our empirical analysis; we provide the figures of our multidimensional poverty index for about 100 countries and compare them with those of income poverty, both obtained by using the same datasets. Section 9 verifies how sensitive our results are to different specifications of the indicators, weights or to the use of a different aggregation function. Finally, our concluding remarks are included in Section 10.

2. Conceptual framework

There is emerging consensus—both in academia and within international organisations—that the concept of poverty goes beyond the lack of income to satisfy people's basic needs. This has led to the proliferation of new multidimensional poverty indices, though monetary poverty measures still prevail.

One common limitation of the emerging empirical literature on multidimensional poverty is that it dedicates little attention to theoretical considerations. A conceptual framework should be at the centre of a rigorous measurement exercise, to avoid the well-known problem of "measuring without theory" (Koopman 1947; Burchi and De Muro 2016a). The conceptual framework allows us to have a clear and explicit definition of the concept being measured, and, in the case of multidimensional poverty, to identify the relevant dimensions and indicators. These choices can influence poverty figures more than the choice of the aggregation indices: as argued by Ravallion (2011, 5), "the devil is in these details".

The first point to highlight is that there are many approaches to poverty, well-being, development and quality of life that do recognise that these phenomena are multidimensional. Poverty, for example, can be conceptualised as a lack of relevant assets; in this case it is still

measured in monetary terms (e.g. Attanasio et al. 2000; Brandolini et al. 2012). Alternatively, poverty can be assessed and measured in line with other, non-monetary, approaches, such as the basic needs approach (Stewart 1985; Streeten et al. 1981), the livelihood approach (Chambers 1995) or the life satisfaction/happiness approach (e.g. Kahneman 1999). In this paper we endorse the capability approach, initially elaborated by Amartya Sen (1985a; 1987a; 1989; 1995; 1999) and later extended by a number of other development scholars and welfare economists. The capability approach provides the theoretical foundations to the human development paradigm (Fukuda-Parr 2003; Burchi and De Muro 2016a), supported by UNDP (1990).

The capability approach is centred around three main concepts: functionings, capabilities and agency (Sen 1985a; 1995; 1999). *Functionings* consist of people's achievements—i.e. the set of things they manage to be and to do in their life, such as being literate, being adequately nourished and being in good health. People's *capabilities*, instead, reflect what they *can* be and do in their life—their substantial freedom to function. There is, indeed, a clear relationship between these two concepts: capabilities include all achievable—but not necessarily achieved—functionings.

The third pillar of the capability approach is *agency*—i.e. a person's ability to pursue and realise his/her goals with his/her own means (Sen 1985b). People are viewed as agents of change and not simple recipients of public policies, thus calling for inclusive, bottom-up anti-poverty strategies. This pillar, however, is less relevant for the main purpose of this paper—i.e. to identify a capability-inspired measure of poverty; therefore, we do not discuss these issues further.

Based on this approach, poverty is defined as deprivation in the capabilities that people "value and have reason to value", as a situation in which people lack the basic freedoms to pursue a valuable life. Therefore, the ideal "evaluative space" of poverty measurement and assessment is the capabilities (Sen 1999). Most household surveys, including those used in the present study, however, collect socio-economic information, which reflect people's achieved functionings and not capabilities, the set of substantive freedoms they enjoy. It is, in fact, extremely hard to measure capabilities: this requires *ad hoc* surveys, and so far there have been very few attempts, mostly at micro scale (e.g. Anand and van Hees 2006).[1] Therefore, we measure multidimensional poverty in the space of functionings. But which capabilities/functionings do people value on reflection? As argued by Robeyns (2005, 101), "while the notion of capabilities refers to a very broad range, basic capabilities refer to the real opportunity to avoid poverty". This complex issue will be analysed in depth in the following section.

We endorse the capability approach in this paper, as it is the most adequate conceptual framework to portray people's real-life conditions and poverty experiences for the following reasons. First, it "concentrates on deprivations that are intrinsically relevant" (Sen 1999), while income or commodities—the key informational basis used in the monetary approaches as well as in the livelihoods and basic needs approach—are only instrumentally important. It depicts people's well-being and poverty experiences in the different life domains, rather than on the means that can be used to enhance well-being and escape poverty. Sen (1995, 109) uses

a powerful example to emphasise this point: "there is likely to be more intellectual—and also interpersonal—agreement on the importance of having the capability to avoid acute hunger or severe undernourishment, than on the significance of having an adequate supply of particular food items". A sufficient amount of certain food items is important only as long as it enhances nutritional capabilities (Dreze and Sen 1989; Burchi and De Muro 2016b). Second, by focusing directly on how people fare in the multiple domains of life, it accounts for non-market attributes—i.e. characteristics such as education or social relations that people may value and for which there is no market, or the market is far from perfect (Thorbecke 2008).

Third, the relationship between income and commodities, on the one hand, and functionings and capabilities, on the other hand, is not univocal. Such relationships vary across communities, families and individuals. This is because: (a) the acquisition of income, like that of other resources, is only one of the potential, and not necessarily the most important, means to escape poverty; and (b) the 'conversion' of income or commodities into capabilities is mediated by individual factors (e.g. age, gender, health, metabolism), social factors (e.g. law, social norms, public policies, power relations) and environmental factors (climate). For example, a person with a parasitic disease cannot convert a theoretically sufficient amount of food into a good nutritional status, while a woman with a bicycle in a highly patriarchal society may even be prevented (by social norms) from moving around freely. Only by focusing directly on the nutrition- or mobility-related functionings can we adequately assess people's deprivations.

The reasons highlighted above justify why it is better to view (and measure) poverty as a failure to satisfy certain basic capabilities, as compared to a low level (or inadequacy) of income or resources. An important, original element of this paper consists in the empirical investigation of discrepancies between income and multidimensional poverty figures in a large number of countries, using data from the same dataset. This permits us to examine indirectly the role of other means of poverty reduction and that of the conversion factors.

A last comment pertains to the comparison between the capability approach and the happiness approach in the evaluation of poverty. Coherently with the latter, poverty could be measured with a comprehensive unidimensional measure, or in terms of low satisfaction in multiple dimensions, such as work, health, family life and community life. The use of this approach is problematical because of the issue of *adaptive preferences*. Life satisfaction is only a state of the mind, and people tend to adapt their preferences (and answers to the questions) to the context and conditions in which they live, therefore providing a biased picture of their deprivations (Sen 1987a). Using Sen's (1987b, 45–46) words, "The hopeless beggar, the precarious landless labourer, the dominated housewife, the hardened unemployed or the over exhausted coolie may all take pleasures in small mercies, and manage to suppress intense suffering for the necessity of continued survival, but it would be ethically deeply mistaken to attach a correspondingly small value to the loss of their well-being because of this survival strategy." A number of studies provide evidence of the adaptation hypothesis (e.g. Myers and Diener 1996; Frederick and Lowenstein 1999).

As mentioned above, the conceptual framework guides, among other things, the choice of dimensions, weights and indicators of poverty (see Sections 4–6). Unfortunately, many

national and international indices of poverty and well-being proposed by scholars and institutions lack a strong theoretical background.[2] They often employ a combination of indicators of assets, basic needs, capabilities and subjective well-being, which makes the interpretation of the results and their use in policymaking particularly hard. Other well-known poverty measures, such as the MPI developed by OPHI and used by UNDP, claim to be "grounded in the capability approach" (UNDP 2010, 94). However, some dimensions and indicators are not in line with this approach, as in the case of the MPI. First, the dimension 'living standard' (or 'standard of living', as it is often referred to) is predominantly an asset-based measure of poverty. Having harmless cooking fuel, a radio, a television or a telephone is, indeed, a typical indicator used in a resource-based framework. As the authors themselves admit, "all the living standard indicators are means rather than ends; they are not direct measures of functionings" (Alkire and Santos 2010, 16).

Second, in the capability literature the term 'standard of living' has an exact, rather different, meaning. Standard of living is a narrower concept than well-being, as it does not consider 'sympathies': a person's standard of living consists in her/his personal well-being related to her/his own life (Sen 1987a; Robeyns 2005). It is, therefore, measured in the space of capabilities or functionings, and not in that of assets. Finally, some of the numerous variables included in the 'living standard' measure, such as access to clean drinking water or to improved sanitation, could be considered good proxies for functionings, as they are in between a commodity and a functioning (Qizilbash 1998).[3] In this paper we will justify each of the choices we make and link them to the theoretical insights offered by the capability approach.

3. Data

In the present study we use an original database, the International Income Distribution Database (I2D2). It is a worldwide database drawn from nationally representative household surveys and consisting of a standardised set of demographics, education, labour market, household socio-economic and income/consumption variables. The I2D2 draws on different types of surveys, usually conducted by national statistical agencies, including Household Budget Surveys, Household Income and Consumption Surveys, Labour Force Surveys and multi-topic surveys (such as Living Standards Measurement Study Surveys). The I2D2 database allows cross-country comparison and analysis at various disaggregation levels: gender, urban/rural, age cohorts, deciles of household income, education levels, among others, since the unit of observation is the individual. I2D2 has about 50 harmonised variables and covers over 1500 surveys from over 165 countries. Some of the surveys go back to 1960, but most of them cover more recent years.

I2D2 builds on the World Bank's efforts to harmonise regional household surveys, in some cases making adjustments to the standardised regional files for this global effort. It also takes the consumption/income variables from these teams as constructed by them. In this study the income/consumption variables do not come from I2D2. Instead, the measurements of income/consumption poverty come directly from World Bank's POVCALNET.

I2D2 was started in 2005 as part of the 2006 *World Development Report* on equity. The effort has continued, and a wide variety of World Bank publications, such as the *World Development*

Report, the *Global Monitoring Report*, World Bank *Policy Research Working Papers* and several regional flagship publications use this database.

The use of the I2D2 dataset enables us for the very first time to calculate multidimensional poverty from a single, consistent dataset. The only other global poverty index that is based on household data, the MPI, is based on a mix of datasets, mainly Demographic and Health Surveys, Multiple Indicator Cluster Surveys (MICS) and World Health Surveys. The use of these different datasets leads to serious problems when it comes to cross-country comparisons. When introducing the MPI, Alkire and Santos (2010, 28) they sounded a note of caution, stressing that: i) not all poverty indicators were available for all countries; ii) poverty figures are referring to very different years; and iii) surveys vary from country to country. In fact, there are considerable discrepancies between the surveys.[4]

Thus, it is not at all clear to what extent differences in national multidimensional poverty figures are, in fact, due to differences in the achievements of these countries or due to the discrepancies in the datasets used to calculate the poverty figures. By using the I2D2 dataset, we are able to calculate national multidimensional poverty figures based on the very same datasets and the very same set of indicators, thus reducing possible discrepancies to a minimum[5] and allowing, for the very first time, consistent comparisons of multidimensional poverty across countries.

The use of the I2D2 dataset also enables us for the first time to calculate international multidimensional poverty figures on an individual level. Due to data restrictions, the MPI is calculated at the household level, which prevents any calculation of differences in intra-household distributions. The same is true for the income poverty method, which is also based on household data. Thus, this paper is the first international poverty analysis to separately produce male and female poverty rates.

4. Dimensions of poverty

Dimensions of poverty refer to aspects of people's lives in which deprivations should be examined. There is substantial agreement in the literature on the capability approach that these dimensions should, first, carry an intrinsic value—i.e. they should be valued not just for their contribution to something else (e.g. Alkire 2002). Second, they should be clear and defined broadly to be valid in different contexts. Finally, they should be complete—i.e. they should encompass all human values. According to the capability approach, used here as a reference framework, the exercise of selecting relevant dimensions overlaps with that of identifying basic capabilities.

We share Amartya Sen's (2004a) argument that there should not be a predetermined list of basic capabilities and that, ideally, extensive deliberative processes should be activated for the purpose of generating a shared list of valuable capabilities (Sen 1985a; 1999). While he does not elaborate on how to activate these processes, Ingrid Robeyns (2003; 2005) has identified the main criteria that each list should satisfy. In particular, she argues that both the final list and the process that leads to the generation of that list should be clear and justified on ethical grounds. Moreover, she argues in favour of a two-step approach: researchers should first

identify an 'ideal', theoretically sound list, and only at a later stage move to a 'feasible' one, which is conditioned on the availability of data and resources.

In light of Robeyns's criteria, we argue against those measures of poverty whose list of dimensions depends exclusively on the availability of data. In this approach, researchers do not engage in a debate on relevant dimensions but just pick dimensions and variables that refer to some intuitive ideas of the phenomenon analysed (poverty, well-being, quality of life) and for which data are available (Alkire 2007). These studies lack a clear definition of poverty, skip the phase of identification of an ideal list, and do not justify their dimensions, making the whole process non-transparent. Also, in the long paper in which Sabina Alkire and Maria Emma Santos (2010) introduced the new MPI, the authors dedicated only one page (page 12) to the justification of their dimensions. When, for example, they argued that these dimensions were selected as priorities in "participatory exercises", they did not provide references to studies that obtained these results.[6] Similarly, they argued that these dimensions were identified by also looking at international consensus-building processes, such as the Multidimensional Development Goals (MDGs), but in the MDGs there is no focus on asset ownership or access to electricity, while the attention towards access to sanitation and drinking water is rather limited compared to other dimensions. Therefore, it seems that the selection of dimensions in the global MPI was also data-driven.

Over time, different approaches have been developed to identify dimensions of poverty in a theoretically sound and meaningful way. Maslow's (1948) pyramid of needs and Nussbaum's (2000) list of 10 central functional capabilities (based on the Aristotelian idea of a 'good life') are examples of the *normative assumptions* approach. While this approach has been adopted in empirical studies (e.g. Anand et al. 2005), we believe that this is not a promising direction to take. In a pluralistic society, where people may disagree about what is fundamentally valuable in human life, it is very dangerous to endorse a particular philosophical standpoint (Scanlon 2003). This would imply considering as privileged the conception of the good of one part of the population as compared to another, generating conflict and reducing the probability of these dimensions of poverty being endorsed by the entire population (Burchi, De Muro, and Kollar 2018).

More promising for the purpose of the present paper are three other approaches considered by Sabina Alkire (2007) in a detailed review of the different methods employed to select dimensions in empirical studies on poverty. The first one is the *survey-based approach*. Some international surveys such as the Gallup Opinion Polls or the World Value Survey ask questions that serve these purposes and allow values to be compared across different cultures.

The second one is the *public consensus approach*, where a list of dimensions is generated through "some arguably legitimate consensus building process at one point in time, and are relatively stable, thus not expected to be iterative or subject to ongoing participatory evaluation" (Alkire 2007, 102). The MDGs and, even more, the 2030 Agenda belong to this group.

Finally, dimensions can be selected using the *ongoing deliberative participation approach*. Participatory methods such as focus groups or citizens' juries have a great potential to extract

a list of dimensions that people value (Narayan et al. 2000; Wisor et al. 2016). This is in line with Sen's claim that the list should emerge as a result of a public consultation, where people claim their position, defend it in public and are willing to revise it based on other people's views. As stated by Alkire (2007, 103), in this case, "the value judgements are made and revised directly by the community concerned". In some cases, authors have used a preliminary list, obtained through expert consultation or on the basis of normative assumptions, as a starting point for participatory exercises.

These three approaches have some strength, but also important drawbacks, especially when used to compare multidimensional poverty across the world. The survey-based approach allows us to have information relatively easily and for many countries (in some cases, on a regular basis). However, the results of these surveys show what people may 'value', but not what they 'have reason to value' on reflection, as no public discussion on what constitutes the very core aspects of poverty (or well-being) takes place. The resulting list is, therefore, likely to be significantly different from that obtained in a participatory setting. A problem that is partly shared with the participatory approach is that the surveys may have different objectives: in some cases, they really aim to identify the dimensions that people value, while in others the priority areas for action, which are two distinct—though related—aspects.

Two strengths of the consensus-based approach are that no additional data collection is required and that the list obtained with this approach has some sort of legitimacy, being the result of a large agreement among countries. However, as highlighted by Burchi, De Muro, and Kollar (2014, 237), "taking public consensus (or public opinion) as grounds for justification suffers from conservatism or a status quo bias. The fact the people or societies have come to endorse or agree on a set of moral values does not in itself lend it moral authority." It is, in fact, necessary to scrutinise the ethical soundness of these shared values and to reconsider and actualise the contents of such an agreement, rather than taking it as something valid forever.

Finally, on paper the participatory approach is probably the one that most closely resembles Sen's idea of an in-depth public consultation. However, it is very difficult to operationalise. Power imbalances, educational disparities and the need to representatively involve different population groups are among the factors that make the implementation of these techniques very complex, undermining the normative validity of the final outcome (the list). Moreover, in our paper we cannot fully count on this method, as these exercises have been conducted in merely a few countries, and with different methodologies; thus they are not strictly comparable. A clear example is the recent initiative of the Australian National University and its multiple international partners (Wisor et al. 2014). An outstanding exception is the World Bank's 'Voices of the Poor' initiative in the 1990s (Narayan et al. 2000), which had wider geographical coverage: 23 countries. Its findings are, however, not comparable with those of the other initiatives.

In this paper we argue in favour of a new method to derive a list of dimensions of poverty, which consists in the extension of the *constitutional approach* proposed by Burchi, De Muro, and Kollar (2014; 2017). The authors combine Sen's capability approach and Rawls's method of political constructivism, and use the constitution and its interpretative practices as an

ethically suitable informational basis for identifying publicly justifiable dimensions of poverty (and well-being). The central argument is that the basic norms in which people have been socialised are the source of shared ideas in a political community and, therefore, should provide the starting point for our exercise of selecting dimensions of poverty. This approach has so far been applied in the context of Italy (Burchi, De Muro, and Kollar 2018).

The constitutional approach overcomes the problems implicit in the normative approach, as it does not consider any particular vision of the good as privileged; therefore, by ensuring shared starting points, it respects all citizens. It offers at the same time a pragmatic solution to the problem of contrasting views within a pluralistic society. The resulting dimensions are, therefore, more likely to be endorsed by the population and by policymakers. Unlike the public consensus view, it avoids the status quo bias, as its starts from institutionally embedded norms, which are not taken at face value but actualised, re-interpreted and re-elaborated through moral guidance. It is, then, preferable to the survey-based approach, since it focuses on the structural values of a society and not on what people may temporarily prioritise. Finally, it does not face all the risks embedded in participatory exercises.

Moreover, this approach has the advantage of not requiring the collection of additional data. However, not all national constitutions are valid sources of dimensions of poverty. These constitutions have to satisfy at least some basic criteria. Procedural criteria would refer to the process that led to the finalisation of the constitution, the degree and quality of public participation and how conflicting views were dealt with. The substantive minimum requirement for the constitutional norms is that they treat people with equal respect and as autonomous citizens (Burchi, De Muro, and Kollar 2018). Clearly, the presence of democratic institutions is a prerequisite for a national constitution to be a source of ethically sound dimensions of poverty.[7] Another important condition for the use of this approach is that the constitution has been active for a long time.

Given that, so far, the constitutional approach has been used only to analyse a single society, one challenge is to use it to derive valuable dimensions of poverty across different countries. We envisage two potential routes. The first is to use a broader idea of an international constitution, which goes beyond the definition of the fundamental law of a country. However, at the moment we do not see an adequate source for international comparisons. A second way is to examine several constitutions that meet most of the requirements and see whether there is convergence towards at least a minimal list of dimensions. We follow this second route. But, since it is not feasible to review all (suitable) world constitutions and, especially, to analyse in detail all the relevant interpretative practices to go beyond the face value of the constitutional text, we decided to integrate the list obtained in this way with lists obtained with different approaches at national or international level. Below we report all sources used for each approach.[8]

a) Constitutions

The list of the constitutions that were examined is given in Table 1. In East Asia we selected the Republic of Korea and Japan because they are among the few democratic countries in the region. Though their constitutions were approved at different times (1988 in Korea and 1947

in Japan) and, therefore, look very different (much shorter in Japan), they are considered to afford the strongest recognition to (political, cultural, religious) pluralism and, above all, to recognise and protect several fundamental human rights (Yeh and Chang 2011) against the well-developed idea of 'Asian values', which other countries of this region use to justify authoritarianism. Both these constitutions, therefore, seem to meet the basic requirements to qualify as suitable sources of information on dimensions of poverty.

India is the largest democracy in the world, and its constitution, approved in 1949 and in effect since 1950, is still in place and enjoys wide consensus. It has a substantial focus on people's rights and aims to reflect the values of the society. In South Asia we then looked at the constitution of the Kingdom of Bhutan, the only non-democratic country that we analyse here. The reasons for its inclusion lie in the innovative recognition of Gross National Happiness as the final goal of government action and in its strong protection of human rights. Moreover, it includes detailed articles on the values of the society. Mongolia, on the other hand, was included because it is the most democratic country in Central Asia (e.g. Landman et al. 2005).

In North Africa we selected Tunisia and Egypt, which approved their constitutions in 2014. While nothing can be said about their endorsement in the society, given their short existence, they both have some important features. In particular, Tunisia's constitutional processes have been positively evaluated for the participatory nature of the negotiations. Moreover, its constitution is viewed as modern, given its focus on a number of positive entitlements (Fedtke 2014). In contrast, the consultation and deliberative process was criticised in Egypt. Some commentators contested the limited time dedicated to the negotiations, as well as the selection of the main actors in charge of drafting the constitutional norms (first a committee of 10 experts and then a constitutional committee of 50 people) (El-Sayed 2014; Fedtke 2014). In the referendum that took place in January 2014, nearly 98 per cent of the people voted in favour of the draft text; however, the turnout was very low (38.6 per cent). Having said this, the substance of the constitutional norms referring to rights and freedoms has been much appreciated, and the new constitution is viewed as representing considerable progress in this area (El Shalakany 2014). In particular, all human beings are viewed as equal, and specific norms are directed towards women's empowerment and gender equality. Moreover, the Egyptian constitution is one of the few in the world that contain norms on minimum expenditures on sectors such as education and health that the government has to guarantee. Given the procedural problems in the latest constitution in Egypt, we retained only the dimensions that were also recognised in the 2012 constitution—since the 2014 constitution is formally a revision of the 2012 constitution, rather than a completely new one—and in the constitution of 1971 (also known as the 'Permanent Egyptian Constitution'), which was perceived as a broader and stronger social contract.

In sub-Saharan Africa our sample contains South Africa and Namibia. The constitution of South Africa is internationally regarded as one of the most advanced in the world for the long and inclusive constitution-making process, finally approved by 85 per cent of the Constitutional Assembly, and for its strong focus on socio-economic rights, in particular for poor people (Ebrahim 1998; Sunstein 2001; van Rensburg 2008). This constitution, active since 1996, "has managed to survive difficult times and enabled the creation of a plural democratic system without racial prejudices" (Cordiero 2008, 28). The constitution of

Namibia is also considered advanced. Much of the South African constitution, in fact, builds on Namibia's (Erasmus 2000).

In Europe we focus mostly on Italy because, as discussed in detail in Burchi, De Muro, and Kollar (2014), its constitution meets all the conditions to be considered a suitable source of dimensions of poverty. It was the result of a long and widely participatory process and still enjoys wide consensus, as testified by the fact that the sections on 'Fundamental Principles' and on 'Rights and Duties of Citizens' have never been modified since 1948. The analysis of the Italian case was then integrated with a study of documents comparing constitutional norms in different countries in the first group of (15) countries of the European Union (e.g. Bauer 2000).

In Central America we examined the constitutions of Mexico and Costa Rica because these are the countries with more durable constitutions in a context in which countries very frequently change them (Negretto 2008). It is interesting to highlight that in Mexico CONEVAL—an institution in charge of providing the official measure of multidimensional poverty in the country—has identified the dimensions of poverty based on the national constitution.[9]

Brazil and Peru compose our sample of countries in South America. While Brazil has been through a number of changes in constitutions in the past, the current one, in place since 1988, enjoys wide consensus and covers a large spectrum of socio-economic rights (do Valle 2014). The political constitution of Peru was promulgated in December 1993. Since then, many amendments have been introduced in a continuous struggle, typical of the country, to improve constitutional norms (Sobrevilla Perea 2010). The amendments, however, have only minimally modified the section on social and economic rights. From this point of view, the constitution is viewed as a modern one. Moreover, human dignity and respect for others are a central principle in the Constitution of Peru, as well as in those of other Latin American countries such as Mexico, Colombia and Brazil.

Table 1. List of constitutions used as sources of dimensions of poverty

World region	Country
East Asia	Japan, Korea
South Asia	India, Bhutan
Central Asia	Mongolia
North Africa	Egypt, Tunisia
Sub-Saharan Africa	South Africa, Namibia
Europe	Italy (in detail), EU-15 (in general)
Central America	Mexico, Costa Rica
South America	Brazil, Peru

b) Public consensus approach

The international agreements/processes that we included in our analysis are: the MDGs, the Sustainable Development Goals (SDGs), the International Covenant on Social and Economic Rights (ICSECR) and the International Covenant on Civil and Political Rights (ICCPR). The MDGs were proposed as a result of the Millennium Declaration, signed in 2000 by 189 world leaders. They contributed substantially to shaping the agenda of governments, policymakers

and international organisations. The SDGs, instead, are the results of a longer debate on the post-MDGs agenda. Commentators agree that the consultations for the current 2030 Agenda are much better than those that took place for the MDGs at the beginning of the 2000s (e.g. Klasen 2015). However, the fact that multiple players were allowed to provide inputs, without a clear, coherent framework, led to a very long list of goals and targets, which is not very useful in identifying relevant dimensions of poverty (Loewe and Rippin 2015).

The ICSECR and the ICCPR are two multilateral treaties adopted by the United Nations General Assembly in December 1966, and in force since 1976.[10] At the moment the first Covenant has 71 signatories and 164 parties, while the second has 74 signatories and 168 parties.

c) Existing participatory studies

As highlighted by Pogge and Rippin (2013), two large participatory studies have been conducted. The first is the 'Voices of the Poor' initiative, launched by the World Bank at the end of the 1990s (Narayan et al. 2000). This study employed open-ended participatory methods to involve more than 20,000 poor people in 23 countries. The objective was to understand how poor people themselves perceive poverty, and which they perceive to be the constitutive domains of poverty. The second study was conducted by researchers at the Australian National University together with international and national partners within the project 'Assessing Development: designing better indices for poverty and gender equality'. This research was carried out at 18 sites across 6 countries: Angola, Fiji, Indonesia, Malawi, Mozambique and the Philippines (Wisor et al. 2016). One of the purposes of the participatory activity was to identify the relevant dimensions of poverty as perceived by poor people. Moreover, participants in the focus groups were divided into different groups based on gender and age; this allows seeing in particular if values change according to gender and age (in addition to location). It is worth highlighting that both the initiatives leave the identification of relevant dimensions of poverty to poor people.

d) Surveys

The list of surveys includes, first, a recent large, cross-country survey called 'My World', carried out as a preparation for the SDG consultation (United Nations Development Group 2013). More than 1 million people in 88 countries around the globe were asked about the world they want. The predefined list of dimensions includes 16 items. We also cross-referred the results with those of the latest wave (2010–2014) of the World Values Survey, which covers 57 countries but contains information on only a few, highly aggregated, dimensions (e.g. work and family relations). We then examined other surveys which have been conducted on a smaller scale in South Africa (Clark 2005), Brazil (Comim et al. 2007; Portella 2013), The Maldives (de Kruijk and Rutten 2007), Italy (CNEL and Istat 2011) and the UK (Barrett and Clothier 2013).

The findings are striking (see Table 2). Regardless of which of the four approaches we follow, we discover that three capabilities are valued much more than the others: *holding a "fulfilling job"* (Sen 1999), *being educated/knowledgeable*, and *being in good health*.[11] The only

exception is when we use the participatory approach, in which case education is the fourth most valued dimension, preceded by access to food/nutrition. The direct implication is that a multidimensional indicator of poverty should ideally always incorporate these dimensions.

Larger differences across the approaches exist with regard to the ranking of the other dimensions. Overall, we can identify a second group of dimensions, which includes (more or less in the following order): decent housing, access to food/nutrition, access to water, social security (proxied by access to social protection), political participation, access to sanitation, and living in a good environment.[12] Participatory and survey-based approaches assign more relevance to housing than the other two methods (e.g. housing is not addressed in the MDGs), and less to social security. Constitutions and surveys, however, assign less weight to access to food. The approach to selecting dimensions of poverty has a significant effect on the ranking of political participation: this is a fundamental capability using the constitutional approach,[13] less relevant using the public consensus approach, and much less using the other two approaches. Also, living in a good environment is considered more important under the constitutional approach. Finally, access to sanitation is not frequently mentioned in the constitutions, whereas it plays a more relevant role when we employ the other methods.

We can then identify a third group of dimensions, consisting of: economic security (security of livelihoods and income), physical safety, participation in community life and social relations. Social relations have a high ranking if we use surveys or participatory methods to detect basic capabilities, but a very low ranking if we use the constitutional approach or look at international consensus-building processes. This is because it is difficult to address social relations with policy instruments. Social relations, therefore, might be of "special attention", but not "socially influenceable" (Sen 2004b). Finally, the last group contains culture, emotional well-being and decision-making.

Table 2. List of relevant dimensions of poverty based on the combination of four approaches

Group	Dimensions
1	Fulfilling work, education, health
2	Decent housing, access to food/nutrition, social security, access to water, political participation, access to sanitation, living in a good environment
3	Economic security, safety, participation in community life, social relations
4	Culture, emotional well-being, decision-making

The list of dimensions of poverty discussed so far is the *ideal* list. We then have to identify a *feasible* one on the basis of the objective and data constraints. Given our data (see Section 3) and given the objective of measuring poverty to compare countries across the globe, we finally selected three dimensions: 1) education/knowledge; 2) fulfilling work/employment; and 3) access to drinkable water and sanitation. This allows us to include three valuable dimensions and at the same time cover a large number of countries.

This approach enables us to incorporate two of the three main dimensions of poverty. Unfortunately, direct information on health in many countries is missing and, where present, is collected in different ways. However, access to drinkable water and sanitation is also taken as a proxy for health (see below). More than 70 surveys conducted since 2000, taking only the latest for each country, contain information on housing, in particular on property ownership. The major problem is that in some contexts this indicator can be a good proxy for shelter and security, while not in others (e.g. more affluent countries). Its interpretation, therefore, varies from country to country, making international comparisons impossible. As a consequence, we need to exclude this dimension from the Global Index, but we are going to retain it for specific country analysis. Similar problems concern social security, when measured by access to social protection. Social protection measures, in fact, vary greatly across countries, and in some cases they could be bad proxies for social security. Finally, data on other important capabilities, such as political participation and environment, are lacking. Below we elaborate further on the justification for the dimensions selected.

Fulfilling work

Having 'fulfilling' work or, as highlighted by the International Labour Organization, 'decent work' is intrinsically as well as instrumentally important for well-being and poverty. All the constitutions considered here recognise the importance of work, which goes beyond wages. This is particularly the case for India, South Africa, Italy (and 11 of the other 14 European Union countries) and the four Latin American countries. Using the public consensus approach, the initial formulation of the MDGs did not cover employment in any goal or target. As highlighted by Van der Hoeven (2014), there are three main reasons for its exclusion in 2000: a) lack of a measurable indicator of productive employment; b) little attention, at that time, to employment by the development community; and c) a low level of political lobbying by the International Labour Organization, the UN organisation with the mission to promote decent work for all, in the MDG negotiations. It was in 2007 that a new target (1.B) appeared: "Achieve full and productive employment and decent work for all, including women and young people." Since then, the international community has put work at the centre of the development agenda, as confirmed by the post-2015 debate. SDG 8, in fact, reads "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all."

Employment is also considered a fundamental dimension—and often the most highly valued one—in participatory studies and international and national surveys.[14] To further validate the inclusion of this dimension in our index, decent work is also one of the basic capabilities identified, on the basis of the normative assumption approach, by Finnis (1980), Maslow (1948) and Nussbaum (2010).

Good education/knowledge

All the constitutions emphasise the importance of education and recognise the role of the State in promoting the right to education. In some cases—such as Bhutan, Egypt, Tunisia, Brazil and Peru—the constitutions go far beyond the view of education as an instrument for the economy. For example, the Constitution of the Kingdom of Bhutan refers directly to

"knowledge", and states that education should be "directed towards the full development of the human personality" (Royal Government of Bhutan 2008, Art. 15). Similarly, the Constitution of Peru recognises that "The aim of education is the comprehensive development of the human being" (Congress of the Republic of Peru 2006, Art. 13) and that "Education promotes knowledge, learning and practice of the humanities, science, technology, the arts, physical education and sports. It prepares for life and work and furthers solidarity" (Art. 14). Many constitutions—India, Bhutan, Japan, Italy, Egypt, Tunisia, Mexico and Peru—also contain norms regarding free and mandatory access to education up to a certain level. Interestingly, the constitutions of Egypt and Brazil also contain a guarantee of minimum government spending in the sector.

Education is also fundamental in the MDG and SDG frameworks. MDG 2 deals explicitly with education, while MDG 3 focuses mainly on gender equality in this field. SDG 4 also deals with education. It is possible to notice a change in the approach to education from the MDGs to the SDGs: the emphasis has moved from schooling to knowledge (and productive skills) (Burchi and Rippin 2015).

Slightly less importance is given to education in the participatory exercises, in particular in the 'Voices of the Poor' initiative in some countries. By contrast, this dimension ranks first in all surveys, in particular in the global survey 'My World'.

Access to safe, drinkable water and adequate sanitation

Indicators of access to water and sanitation lie in between a commodity and a functioning (Qizilbash 1998); therefore, these dimensions have an intrinsic relevance. Access to water is a direct measure of 'freedom from thirst'. International treaties and consensus-building processes emphasise the importance of water and sanitation. MDG 7, Target 10 is about halving "the proportion of people without sustainable access to safe drinking water and basic sanitation". SDG 6 reads: "Ensure availability and sustainable management of water and sanitation for all."

Combined access to water and sanitation is the fifth dimension in the 'My World' global survey and is often mentioned in national and local surveys. Four constitutional texts (in Egypt, Tunisia, South Africa and Mexico)[15] and one interpretative norm (in India)[16] mention explicitly the value of access to water, and less to sanitation. This is partly because these very basic needs are satisfied in higher-income countries (e.g. Italy, Republic of Korea, Japan) and are, therefore, not explicitly mentioned in the constitution. Finally, there is large variance in the importance that people assigned to these dimensions in the participatory studies. They are highly valued in most of the national exercises within the 'Voices of the Poor' initiative, but less so in the six-country research project conducted by Wisor et al. (2014).

These two dimensions of poverty were included in this work because they are also instrumentally relevant and closely related to health—the crucial dimension for which we have no data—and, to a lesser extent, nutrition. In particular, we argue that the *lack* of access to drinkable water and adequate sanitation can be a good proxy of health *deprivations*.

How is access to water and sanitation connected to health? It is estimated that every day about 5 million people, predominantly children, die from diseases caused by poor-quality water supplies (Fogden 2009). According to the World Health Organization, 88 per cent of diarrhoeal disease is attributed to unsafe water supply, bad sanitation and poor hygienic conditions.[17] Given that diarrhoea is the second most common cause of death for preschool children, these figures are remarkable. Other studies (Checkley et al. 2004; Fink et al. 2011; Fogden 2009) point to the key role played by access to safe drinking water and adequate sanitation in preventing several other diseases, including water-related diseases such as cholera, typhoid, malaria and dengue, and in reducing mortality rates.

Using the 2012 data from the World Development Indicators database for 80 low -and middle-income countries, we analysed the correlation between the proportion of the population with access to an improved water source and life expectancy at birth, and between the proportion of the population with access to improved sanitation facilities and life expectancy at birth.[18] In both cases the Pearson coefficient is very high: 0.60 and 0.72, respectively. This is yet another confirmation of the assumption that we can use our indicators as a proxy for the capability 'being free from preventable diseases'.

Finally, we decided to combine access to water and access to sanitation in one single dimension based on existing evidence which shows that access to drinkable water has only a limited impact when there are poor sanitation facilities (Esrey 1996; VanDerslice and Briscoe 1995; Gundry et al. 2004). For instance, though the effect of access to drinkable water on child diarrhoea is significant and negative, having access to both drinkable water and improved sanitation reduces child diarrhoea significantly more (Fuller et al. 2014).

5. Weights

Two very different approaches exist when it comes to the choice of weights for the different dimensions of poverty. One approach uses statistical techniques, such as principal component analysis, factor analysis or other latent variables models, that have been employed by several scholars to identify the weights of dimensions (and indicators) of well-being or poverty (e.g. Nolan and Whelan 1996; Klasen 2000; Ray 2008; Krishnakumar and Ballon 2007). However, these methods are entirely data-driven. The principal component analysis, for instance, chooses weights on the basis of how much of the total variance of the phenomenon (poverty) is explained by a single dimension based on the data used. If, for example, we include in our index the extensive list of dimensions illustrated in Table 2 and run a principal component analysis, we could easily obtain higher scores for dimensions such as participation in community life or emotional well-being. These are, however, among the lowest-ranked dimensions according to the different methods for selecting dimensions highlighted in Section 4.

For our analysis, we prefer to use a normative approach over a data-driven approach, as, unlike the latter, the former requires that the weights that are assigned to the different dimensions of poverty reflect their relevance for multidimensional poverty.

Were citizens socialised in a country where certain values were deemed more important than others? Do the citizens of a country value education, health or political participation more? These are the types of questions we have in mind when reflecting on the weighting exercise. There are some examples of attempts to set weights based on survey-based methods (e.g. Comim et al. 2007; CNEL and ISTAT 2012), participatory methods (Wisor et al. 2014) or the constitutional approach (Burchi, De Muro, and Kollar 2018).

Like many other studies, our starting point is equal weights for the three dimensions. Setting equal weights is not a choice free from value judgements: it implies assuming that these dimensions are all of the same importance for poverty. In this case the choice can be easily justified: all the methods that we employed to derive our dimensions of poverty show that education, employment and health are deemed significantly more important than other dimensions, while there is no clear evidence of which of them is the most relevant. However, this hypothesis works only as long as we consider access to safe drinking water and good sanitation as proxies for health rather than dimensions *per se*. For this reason, in the section on the sensitivity analysis, we use alternative weighting schemes, where education and employment are the most important dimensions, while access to drinkable water and sanitation is of less relevance. One example of such an alternative weighting scheme is the following: 0.40 (education), 0.40 (employment) and 0.20 (access to water and sanitation), but we also use other weighting schemes to check the robustness of our findings in general.

6. Indicators, thresholds and treatment of missing values

In line with the capability approach, the dimensional indicators should ideally measure poverty outcomes; only when this type of indicator is missing could one rely on output indicators (Burchi and De Muro 2016a). This is because functionings reflect what people ultimately do and are in their life, and not what they own or possess.

Input indicators should be avoided for multiple reasons, including: (1) they reflect the means for alleviating poverty: using them implies assuming a univocal relationship between the means and the outcomes, neglecting the role of the conversion factors (see Section 2); (2) their use undermines policymakers' potential to identify which policies to implement to eradicate poverty (Chibber and Laajaj 2007). The inclusion of input indicators in a composite index provides policymakers with the information that their actions will be evaluated on the basis of the use of that instrument, which is not necessarily the best to alleviate poverty; and (3) there is currently widespread consensus in the scientific community—though many empirical works do not comply with this rule—that input, output and outcome measures should not be combined in a composite index (Nardo et al. 2008).

Taking these considerations into account, the following section describes the dimensional indicators and thresholds used in this paper. As for our handling of missing values, as a general rule we consider information on an indicator as sufficient whenever we have information on this indicator for at least two thirds of the individuals in the sample. Also, we took a very restrictive approach by removing any sample for which we did not have sufficient information for all indicators in all three dimensions of poverty entirely from our calculations.

6.1 Indicators of 'fulfilling work'

For the calculation of the Global CSPI, we measure this dimension by mixing information on two variables available in the I2D2 datasets: one indicating labour status and one indicating employment status. Based on the first one, in line with the International Labour Organization's (2018) definition, people are classified as 'employed' if they worked during the seven days preceding the survey for a minimum of at least one hour, regardless of whether this work happened in the formal or informal sector and was paid or unpaid. They are defined as 'unemployed' if in the week preceding the survey they were not working but were actively seeking a job.[19] The last category comprises people who are not in the labour force—i.e. those without a job and who are not actively seeking a job.

We classified as poor in the employment dimension all 'unemployed' individuals, while those 'not in the labour force' were classified as non-poor, bearing in mind that our sample contains only individuals older than 15 and younger than 65. For the 'employed' individuals, we then looked at their employment status. The dataset distinguishes between five categories: paid employee, unpaid employee, employer, self-employed and other worker. By construction, in all surveys, individuals classified as 'unpaid employees' or 'self-employed' are those with lower pay and lower-quality employment. Therefore, also these individuals were classified as poor in the employment dimension.

For the sensitivity analysis, we combine information on labour status with that on type of occupation. The latter, which allows a more differentiated picture of the quality of employment, is unfortunately only available for a smaller sample of countries. Based on type of occupation, employed individuals are classified in 11 different categories.[20] By construction, people involved in 'elementary occupations' and in 'skilled agriculture, forestry and fishery' have lower-quality jobs. Therefore, together with those who are 'unemployed', they were classified as poor in the employment dimension under this different specification.

The rich I2D2 dataset contains further information on other relevant issues, such as working hours, wage and duration of unemployment. However, these data are missing for many sub-Saharan African countries and, to a lesser extent, for Asian countries. For the sake of a larger sample of countries, we excluded these variables from the elaboration of the Global CSPI. This additional information will, however, be incorporated in future studies to analyse the performance of specific countries, in particular the trends in multidimensional poverty in Latin America.

6.2 Indicators of 'good knowledge'

The minimum outcome of a good education system is to have a large proportion of the population that is literate. People who are able to both read and write with understanding are considered literate (or non-poor in the knowledge dimension), while those who cannot perform at least one of the two activities are classified as illiterate (or poor in the knowledge dimension).[21]

For a few countries in our final sample, however, we do not have sufficient information on literacy, but we do have information on people's completed years of formal education. We analysed the number of years of schooling that are necessary for a person to be literate for a sample of countries with data on both literacy and years of schooling. The results show that in 92 per cent of the cases people with at least four years of education are also literate. We therefore used this four-year threshold to create a new variable for those cases in which we do not have direct information on literacy: all individuals with less than four years of schooling are classified as poor, while all those with at least four years of schooling are classified as non-poor in the knowledge domain. Finally, a very few countries in our sample lack sufficient information on both literacy status and years of schooling. In those cases, we used the variable 'educational level': an individual who has not attended primary education is considered poor in the educational dimension.

To summarise, we measured deprivation in education with a flexible approach. We used literacy whenever we had information on that variable for at least two thirds of the respective sample. For those surveys where information on literacy was insufficient but there was sufficient information on years of schooling, we used the latter. Finally, if the first two options were not available, we used the variable educational level whenever we had sufficient information on that variable in the respective sample. Clearly, when even this option was unavailable, we could not calculate educational poverty or, consequently, overall multidimensional poverty.

6.3 Indicators of 'access to safe drinkable water and adequate sanitation'

In Section 4, we argued in favour of combining the variables on access to drinkable water and adequate sanitation. The existing empirical studies, in fact, show the strong interaction between the two variables to improve people's health status (e.g. Fuller et al. 2014). Therefore, we treat as poor in this dimension all individuals without access to either of the two facilities. Conversely, all people with access to at least one of them are considered non-poor. To see how sensitive the final figures for multidimensional poverty are with regard to the construction of this variable, we additionally calculated multidimensional poverty with a less restrictive approach by additionally considering all those who have access to only one facility as poor.

7. Aggregation function

7.1 Dashboard and composite indices

Two basic approaches exist to measure poverty in a multidimensional way. The first is the *dashboard approach*, which compiles indicators for the various dimensions of poverty, without any attempt at weighting, let alone aggregating, them. The dashboard thus provides a comprehensive overview of the different dimensions of poverty, each measured with the best data available for that task. Prominent examples of the dashboard approach are the MDGs and their successors, the SDGs.

The second approach to measure poverty in a multidimensional way is the calculation of *composite indices*. Composite indices assign weights to the indicators for the various

dimensions of poverty and then aggregate them into a single number. This enables us to compare multidimensional poverty rates within countries, across countries and over time. Prominent examples of composite indices are the Human Development Index and the MPI. Both approaches to measure multidimensional poverty have their advantages and disadvantages.

Ravallion (2011) vividly compares the dashboard approach with a car's dashboard with all its dials, providing information on various topics such as speed, fuel, temperature and the like. He then continues to point out that no one would buy a car that collapses all the information of the different dials into a single number. Because how should the driver know what to do? Slow down, speed up, refuel?

Consequently, proponents of the dashboard approach argue that composite indices are nothing but "Mashup Indices" (Ravallion 2010) that aggregate indicators that are based on different units of measurement (adding 'apples and pears'), make highly problematic weighting choices and conceal the very information that they are supposed to provide—i.e. information about achievements in the different dimensions of poverty.

Proponents of composite indices, on the other hand, argue that the dashboard approach is nothing but a 'silo approach' that neglects the crucial linkages that exist between the different dimensions of poverty, and makes it impossible to compare the achievements of different countries and regions in reducing multidimensional poverty. Furthermore, most of the existing composite indices can be decomposed according to dimensions—i.e. despite their composite character, they are very well able to provide information on achievements in the different dimensions of poverty.

To summarise, both approaches have advantages and disadvantages, and it is impossible to say that one is better than the other. Rather, the choice for one or the other depends on the purpose for which they are used. For the purpose of this paper—an international comparison of poverty figures—composite indices are the better choice.

7.2 Notation and theoretical background

Let $\mathbb{R}_k$ denote the Euclidean *k*-space, $\mathbb{R}_+^k \subset \mathbb{R}^k$ the non-negative *k*-space, and $\mathbb{N}$ the set of positive integers. $\mathrm{N} = \{1, \dots, n\} \subset \mathbb{N}$ represents the set of n individuals, and $\mathrm{D} = \{2, \dots, d\} \subset \mathbb{N}$ the set of d dimensions of poverty. w_j is the weight of dimension j with $w_j > 0 \; \forall j = 2, \dots, d$ and $\sum_{j=1}^{d} w_j = 1$—i.e. the sum of the weights equals 1.

$\mathbf{x} = \{x_{ij}\}$ denotes the $n \times d$ matrix of achievements, where $x_{ij} \geq 0$ is the achievement of individual $i = 1, \dots n$ in dimension $j = 2, \dots d$. Consequently, $\mathbf{X} = \{\mathbf{x} \in \mathbb{R}_+^{nd} : n \geq 1\}$ describes the domain of matrices under consideration. Further, z_j denotes the poverty threshold of dimension j so that individual i is deprived in dimension of poverty j whenever his or her achievement falls short of the respective threshold—i.e. whenever $x_{ij} < z_j$. $\mathbf{z} \in \mathbb{R}_{++}^d$ represents the vector of chosen poverty thresholds, and $\mathbf{Z}$ the set of all possible vectors of poverty thresholds.

In this paper we measure multidimensional poverty with ordinal data, as it is the only approach that makes sense for the dimensions that we selected earlier (a person is either literate or not, has access to safe drinking water and adequate sanitation or not etc.). Due to the ordinal approach, we are able to simplify our notations by focusing directly on deprivations rather than achievements. This transforms our achievement matrix **x** into a *weighted deprivation matrix* that we will denote with $\mathbf{g}^0 = \left[g_{ij}^0\right]$. Thus, $\mathbf{g}^0$ denotes the $n \times d$ matrix of weighted deprivations, where $g_{ij}^0 = w_j$ in case $x_{ij} < z_j$, and $g_{ij}^0 = 0$ otherwise. In other words, the *ij*th entry of the deprivation matrix is equal to the weight of dimension *j* in case individual *i* is deprived in dimension *j* and 0 if individual *i* is not deprived in dimension *j*. From $\mathbf{g}^0$ we can define the *weighted deprivation counts* vector **c** so that $c_i = \sum_{j=1}^{d} g_{ij}^0$ provides the sum of weighted deprivations suffered by individual *i*.

The calculation of multidimensional poverty follows a two-step procedure: the identification step identifies those individuals or households who are poor, and the aggregation step aggregates individual poverty characteristics into one single indicator. The two main methods that are used for the identification step are the aggregate poverty line approach and the component poverty approach.[22] As the former requires a cardinal dataset, the only approach that is feasible within the framework of our paper is the *component poverty approach*, which is an evaluation of poverty based on attributes. All attributes are considered essential, in the sense that a failure to achieve the threshold level automatically implies deprivation, regardless of the achievements in other dimensions—i.e. compensation is restricted to attributes below threshold levels (Strong Focus axiom).

Let $\varphi: \mathbb{R}_+^d \times \mathbb{R}_{++}^d \to [0,1]$ denote the identification function that maps individual *i*'s achievement vector $\mathbf{x}_{ij} \in \mathbb{R}_+^d$ and the threshold vector $\mathbf{z} \in \mathbb{R}_{++}^d$ to an indicator variable that can take any value between 0 and 1 depending on the weighted deprivations suffered by individual *i*. In their well-known paper on counting and measuring multidimensional poverty, Alkire and Foster (2011) introduce the following identification function for any $k \in]0,1]$: $\varphi_k(x_i, z) = 1$ if $c_i \geq k$. In other words, the *dual cut-off method* of identification φ_k identifies individual *i* as poor whenever the sum of his/her weighted deprivations is at least *k*; if, however, his/her sum of weighted deprivations falls below the poverty cut-off *k*, then *i* is not poor according to φ_k. The dual cut-off method includes two other prominent identification methods as special cases: the *union method* of identification, which considers any individual poor who is deprived in at least one dimension ($\varphi_{un}(x_i, z) = 1$ if $c_i > 0$), and the *intersection method* of identification, which considers only those individuals as poor who are deprived in all dimensions ($\varphi_{in}(x_i, z) = 1$ if $c_i = 1$).

It can easily be seen that the union method, which considers every dimension of poverty essential in the sense that insufficiency in one single dimension is enough to be considered poor, usually leads to impracticably high poverty figures. The intersection method and its assumption that sufficiency in one single dimension is enough to avoid poverty altogether usually leads to impracticably low poverty figures. Consequently, the dual cut-off method is a very practical method that usually generates poverty figures that lie between these two extremes. The practicality of the method, however, comes at a rather high cost. First, no

method exists from which *k* could be derived; its choice is completely arbitrary. The usual way to deal with this problem is to calculate poverty rates for different values of *k*, to test the robustness of the results with regard to the choice of the cut-off. However, no robustness tests can eradicate the problem that poverty figures and country rankings change with a choice that is, ultimately, arbitrary. Second, the introduction of the cut-off *k* implies a rather strange assumption regarding the correlation among the different poverty indicators. Poverty indicators are considered perfect substitutes as long as their weighted sum is below *k*. However, once their weighted sum exceeds *k*, the very same poverty indicators are considered perfect complements. There is absolutely no theoretical explanation for this strange relationship.

In response to the problems of the existing identification methods, Rippin (2014; 2017) introduces a new identification method that is in a way a fuzzy identification method: instead of merely differentiating between poor and non-poor people, the new method differentiates between different degrees of poverty. Like the union method, every individual who suffers from at least one deprivation is considered poor. However, exactly how poor that person is depends on two things: first, the number of weighted deprivations that this person suffers from, and, second, the way in which these deprivations are correlated. The resulting fuzzy identification method φ_f is a multiple-step function whose shape depends on the correlation among dimensions of poverty. If dimensions of poverty are substitutes (complements), the function takes a convex (concave) shape. The fuzzy identification method has three main strengths. First, it keeps the strength of the union method's argument that all dimensions of poverty are essential. If some of them were not, why would they be included in the poverty measurement exercise in the first place? This is the very argument of the Strong Focus axiom that Alkire and Foster (2011) require their M_0 class of poverty indices to satisfy. Second, it allows for clear and consistent assumptions regarding the correlation between the dimensions of poverty. Third, it does not rely on an additional cut-off *k* that ushers in additional—and arbitrary—choices (and additional robustness exercises).

Once the choice of φ has been made, the aggregation step establishes a functional relationship $P: \mathbf{X} \times \mathbf{Z} \rightarrow \mathbb{R}$ that is called a multidimensional poverty measure (or index). For any poverty threshold vector $\mathbf{z} \in \mathbf{Z}$, society $\mathcal{A}$ has a higher poverty level than society $\mathcal{B}$ if and only if $P(\mathbf{X}^{\mathcal{A}}; \mathbf{z}) \geq P(\mathbf{X}^{\mathcal{B}}; \mathbf{z})$ for any $\mathbf{X}^{\mathcal{A}}, \mathbf{X}^{\mathcal{B}} \in \mathbf{X}$.

7.3 Axiomatic foundation of ordinal multidimensional poverty measures

A first step to select the functional relationship $P: \mathbf{X} \times \mathbf{Z} \rightarrow \mathbb{R}$ could be to start with a list of desirable properties (or axioms) that any reasonable poverty measure should satisfy. This approach is known as the axiomatic approach. The core axioms that have been defined so far can be differentiated into non-distributional and distributional axioms. Whereas the former are usually uncontested, the same is not true for the latter.

Most of the multidimensional poverty measures that have been introduced so far share a weakness that is related to the two concepts of distributive justice and allocation efficiency (or correlation-sensitivity). Inequality across dimensions is defined as: i) the distribution of simultaneous deprivations across the population, captured by a multidimensional adaptation of

the majorisation axiom originally introduced by Kolm (1977) (e.g. Chakravarty and D'Ambrosio 2006; Jayaraj and Subramanian 2010; Seth 2011; Datt 2018), capturing distributive justice; or ii) the correlation-sensitivity, captured by a multidimensional adaptation of an idea originally introduced by Atkinson and Bourguignon (1982) (e.g. Tsui 1999; 2002; Bourguignon 1999; Bourguignon and Chakravarty 2003; Decancq and Lugo 2009), capturing allocation efficiency.

Both approaches are usually considered as being opposed to each other when, in fact, they ought to be brought together. Datt (2018),[23] for instance, criticises the class of multidimensional poverty indices introduced by Rippin (2014; 2017) for not excluding cases that violate distribution-sensitivity. However, this supposed failure was actually done on purpose. Already in 1995, Sen argued that it is one of the strengths of the capability approach that it explicitly accounts for the tension between the two concepts of distributive justice and efficiency rather than focusing on one or the other. An illustrative example is provided by Duclos, Sahn, and Younger (2006), who observe that complementarities exist between the two dimensions of poverty of education and nutrition, as better-nourished children learn better. The authors argue that if the degree of this complementarity is strong enough it might even overcome the 'usual ethical judgement' that favours those deprived in more dimensions, so that overall poverty would actually decrease if education were to be transferred from those who are poorly to those who are better nourished.

Thus we follow Rippin (2014; 2017) by defining inequality across dimensions of poverty as the correlation-sensitive spread of simultaneous deprivations across the population, an approach that ensures that any evaluation of changes in a poverty measure takes into account whether the changes have been: i) *just*, as more priority is given to those who suffer higher deprivation; and ii) *allocation-efficient*, as there is no waste of scarce resources.

In the context of ordinal poverty measures, Rippin (2017) derives a new axiom that is based on the more holistic approach to inequality across dimensions of poverty and ensures the efficiency and distributive justice of the resulting poverty measures: the Sensitivity to Inequality Increasing Switches (SIIS). The idea is that a switch of attributes that increases (reduces) the number of deprivations suffered by the individual with higher (lower) initial deprivation should not decrease poverty if the attributes are substitutes. However, in the case of complements, the concepts of distributive justice and efficiency work in different directions. Thus, the final effect of an inequality-increasing switch on the poverty index should depend on the importance attributed to distributive justice considerations as well as on the degree of complementarity between the respective attributes.

By comparing some of the best-known multidimensional poverty measures in the ordinal context (the multidimensional Bossert, Chakravarty and D'Ambrosio class of poverty measures, the multidimensional Chakravarty and D'Ambrosio class of poverty measures, the multidimensional Alkire and Foster class of poverty measures and Rippin's multidimensional correlation-sensitive class of poverty measures), Rippin (2014; 2017) demonstrates how only the latter class of indices satisfies the core axioms defined in the multidimensional context as well as the SIIS (Table 3).

Table 3. Axiomatic foundation of selected ordinal poverty measures

Axiom	M_0	P_{CD}	P_{BCD}	P_{CS}
Anonymity (AN)	✓	✓	✓	✓
Monotonicity (MN)	✓	✓	✓	✓
Principle of Population (PP)	✓	✓	✓	✓
Strong Focus (SF)	✓	✓	✓	✓
Normalisation (NM)	✓	✓	✓	✓
Subgroup Decomposability (SD)	✓	✓	×	✓
Factor Decomposability (FD)	✓	×	×	✓
Sensitivity to Inequality Increasing Switches (SIIS)	×[24]	(✓)	(✓)	✓

Source: Rippin (2017, 47).

Anonymity (AN) requires that any characteristic of persons apart from the poverty indicators *j* are irrelevant for poverty measurement.

Monotonicity (MN) requires poverty measures not to increase if, *ceteris paribus*, the condition of a poor individual improves.

Principle of Population (PP) ensures that poverty measures do not depend on population size, thereby allowing comparisons across populations and across time.

Strong Focus (SF) requires that giving a person more of an attribute in which this person is not deprived will not change the poverty measure, even if the person is deprived in other attributes.

Normalisation (NM) is a technical property that simply requires poverty measures to be equal to 0 if all individuals are non-poor and equal to 1 if all individuals are completely deprived.

Subgroup Decomposability (SD) requires overall poverty to be expressible as the population share weighted average of subgroup poverty levels. It, therefore, allows the decomposition of overall poverty into the poverty levels of population subgroups.

Factor Decomposability (FD) facilitates the decomposition of poverty measures according to dimensions of poverty—i.e. providing information on the extent to which each dimension contributes to overall poverty.

Sensitivity to Inequality Increasing Switches (SIIS) requires the sensitivity of poverty measures to switches that reduce the number of deprivations suffered by an individual with lower initial deprivation at the expense of a respective increase in the number of deprivations suffered by a person with higher initial deprivation.

Since the decomposability of the multidimensional poverty measures according to dimensions of poverty is a very important feature for our empirical analysis, the remainder of this paper will focus on the comparison of the two indices that are decomposable—i.e. M_0 and CSPI, a representative of the P_{CS} class of poverty measures.

7.4 The multidimensional Alkire and Foster class of poverty measures (M_0)

As has been pointed out before, composite multidimensional poverty indices received strong criticism from some scholars. Ravallion (2010) in particular attacked this approach to poverty measurement as a "mashup" approach that conceals the very information that it is supposed to provide. In view of this criticism, Alkire and Santos (2010) justify the most prominent representative of their M_0 class of poverty measures, the MPI, with three main arguments.

The first argument is based on *considerations of efficiency*. The authors point to some of the key findings of two flagship reports by the United Nations[25]—i.e. that all issues around poverty are interconnected, creating synergistic and multiplier effects that demand cross-cutting solutions (Alkire and Santos 2010, 6).

The second argument is based on *considerations of distributive justice*. Here the authors repeat a statement by Sen (2010), who observes that people suffer from very different kinds of deprivations simultaneously (Alkire and Santos 2010, 6).

As a third argument, the authors stress two properties of the MPI that make it especially appealing to policymakers: the very simple and easily comprehensible way in which their poverty measure is calculated and its decomposability according to population subgroups as well as the contributions of the different dimensions to overall poverty (Alkire and Santos 2010).

M_0 is indeed very easy to calculate (Alkire and Foster 2011): it is the sum of weighted deprivations suffered by poor people divided by the maximum possible number of deprivations (i.e. if all individuals (n) are deprived in all dimensions of poverty ($c_i = 1\ \forall i = 1, \dots, n$))[26]:

$$M_0 = \frac{\sum_{i=1}^{n}\sum_{j=1}^{d} g_{ij}^{0}(k)}{n} = \frac{\sum_{i=1}^{n} c_i(k)}{n} \quad (1)$$

It is easy to see that due to the simplicity of its calculation, M_0 can be decomposed into the product of the (censored) poverty *incidence*—i.e. the (censored) headcount ($\tilde{H}$)—and the (censored) average poverty *intensity*—i.e. the (censored) average deprivation share among the poor population ($\tilde{A}$):[27]

$$M_0 = \frac{q}{n}\,\frac{\sum_{i=1}^{n} c_i(k)}{q} = \tilde{H}\tilde{A} \quad (2)$$

with q being the number of those individuals who are poor (i.e. those for which the sum of weighted deprivations is at least k).

There are, however, at least two problems connected with this decomposition. First, the average poverty intensity $\tilde{A}$ is truncated from below, as it must, by definition, be larger than the cut-off k.[28] This way to measure $\tilde{A}$ is rather problematic, especially since any choice of the

cut-off is clearly arbitrary and controversial. Moreover, the truncation implies that any variation in M_0 between countries and over time is mainly driven by the headcount and much less by the average poverty intensity (Dotter and Klasen 2014, 12). In other words, not much information is gained through the way in which M_0 calculates average poverty intensity.

Second, already in 1976, Amartya Sen required good poverty indices to be decomposable in the three components of poverty that Jenkins and Lambert (1997) call the "three I's": poverty *incidence*, *intensity* and *inequality* (Sen 1976). M_0, however, is not decomposable according to inequality.[29] In fact, as is plainly obvious from formula (2), by simply counting the weighted deprivations of the poor population, M_0 is not only unable to capture inequality, it is also unable to capture any kind of interconnection/correlation between the different dimensions of poverty. In other words, M_0 is unable to account for efficiency and distributive justice, even though these two issues served as justification for this very poverty measure in the first place (Alkire and Santos 2010, 6).

Usually the inability of M_0 to account for efficiency and distributive justice is justified by pointing out that any multidimensional poverty index that is able to account for these two important concepts inevitably fails to satisfy the important property Factor Decomposability. This property, so the argument goes, is so important for policymakers that it justifies the neglect of efficiency and distributive justice. But what if the claim that decomposable poverty indices are unable to account for distributive justice and efficiency were not true?

7.5 The Correlation Sensitive Poverty Index

The Correlation Sensitive Poverty Index (CSPI) is a very simple representative of the P_{CS} class of multidimensional poverty indices introduced above. To be precise, it is based on the following simple representative of the fuzzy identification method φ_f: $\hat{\varphi}_f(x_i, z) = \sum_{j=1}^{d} g_{ij}^0 = c_i$. In other words, the degree of an individual's poverty is simply the sum of his/her weighted deprivations. Consequently, the CSPI is the squared sum of weighted deprivations suffered by poor people divided by the maximum possible number of weighted deprivations:[30]

$$CSPI = \frac{\sum_{i=1}^{n} \hat{\varphi}_f(x_i,z) \sum_{j=1}^{d} g_{ij}^0}{n} = \frac{\sum_{i=1}^{n} \left[\sum_{j=1}^{d} g_{ij}^0\right]^2}{n} = \frac{\sum_{i=1}^{n} c_i^2}{n} \qquad (3)$$

The fact that the sum of weighted deprivations suffered by poor people enters the equation with a square implies that the CSPI accounts for distributive justice and that it assumes a weak substitute relationship between dimensions of poverty (an assumption that can easily be altered by choosing a different identification function φ_f). Yet, since the squaring and the affiliated sensitivity with regard to distributive justice and the correlation between dimensions of poverty is achieved in two subsequent steps (identification and aggregation), the CSPI is still as decomposable as M_0, also with regard to Factor Decomposability (Silber 2011; Dotter and Klasen 2014; World Bank 2015; Rippin 2014; 2017).

It can easily be demonstrated that the CSPI can be decomposed into *all three I's* of poverty: *incidence* (expressed by the headcount *H*), *intensity* (expressed by the average deprivation share among poor people *A*) and *inequality* (expressed by a Generalised Entropy measure of inequality *GE*):[31]

$$CSPI = \frac{q}{n}\left[\frac{\sum_{i=1}^{n} c_i}{q}\right]^2\left[1 + 2\left[\frac{1}{2q}\ \frac{\sum_{i=1}^{n} c_i}{\frac{1}{q}\sum_{i=1}^{n} c_i}\right]\right] = HA^2[1 + 2GE] \qquad (4)$$

The theoretical differences between the CSPI and M_0 have significant implications (please refer to Rippin (2017) for a detailed discussion and proof of all statements):

First, M_0 is more sensitive to the controversial choice of weights than the CSPI.

Second, any transfer from a poor to a less poor household neither changes (if both households remain poor after the transfer) nor even decreases (if the receiving household falls below the cut-off level *k*) poverty according to M_0. Since M_0 considers all dimensions of poverty to be entirely independent (at least in the aggregation step), this behaviour violates some of the fundamental properties that, according to Sen (1976), any reasonably poverty index should satisfy. The CSPI, on the other hand, increases whenever there is a transfer from a poor to a less poor household—just the way any reasonable poverty index should respond (based on the assumption that no complementary relationship exists between dimensions of poverty).

Third, the range of poverty rates is broader for M_0 than it is for the CSPI. Due to the additional threshold, M_0 discards deprivations, which has a two-fold effect on resulting poverty rates. In richer countries, most deprived people are not deprived enough to be considered poor, leading to very low poverty rates in richer countries. In poorer countries, on the other hand, most deprived people are deprived in enough dimensions to be considered poor, with no further differentiation made between the number of deprivations from which they actually suffer. Thus, the dual cut-off method converges to the union method. This fact is quite pernicious from a policy perspective: in the poorest countries with the most severe budget constraints, targeting the neediest would be of utmost importance, while the more affluent countries actually do have the budget to fight all deprivations in their countries. Since the CSPI does not discard any information on deprivations, it allows for better targeting of poverty reduction policies.

Fourth, the CSPI is often criticised for yielding an overall headcount that is rather high, as—just as in the case of the union identification method—each individual who is deprived is considered poor. However, what is disregarded is the fact that, unlike the union identification approach, poor people are differentiated according to their degree of poverty. This differentiation can easily be used to introduce a classification of poor people based on their respective sum of weighted deprivations. One could, for instance, differentiate between those who are *deprivation affected* (sum of weighted deprivations below 33 per cent), *poor* (sum of weighted deprivations between 33 per cent and 66 per cent) and *extremely poor* (sum of weighted deprivations between 66 per cent and 100 per cent). The advantage of such a classification for international comparisons of poverty rates has been acknowledged by UNDP (2013, 3), which now uses the MPI to calculate headcounts for the: i) "share of the poor

people in the population"; ii) "share of severely poor in the population"; and iii) "share of vulnerable in the population". Unlike the MPI, however, the choice of the thresholds for the classification in the case of the CSPI serves for descriptive purposes only; it does not affect the poverty rates.

Fifth, the average poverty intensity as derived by M_0 is truncated from below. As a consequence, any variation between countries and over time is mainly driven by the headcount and much less by the average poverty intensity (Dotter and Klasen 2014, 12). In other words, not much information is gained through the way in which M_0 calculates average poverty intensity. The average poverty intensity as derived by the CSPI, on the other hand, is not truncated and provides much more variation and, consequently, much more information.

Sixth, unlike M_0, the CSPI can be decomposed into all three I's of poverty, which means that any poverty reduction policy that targets the CSPI has to automatically deal with all three I's of poverty. The fact that inequality can be calculated for M_0 separately only means that it is possible to retrieve the *information* on inequality that is discarded in the calculation of M_0. It is not a natural product of the index, implying that the CSPI is able to provide a much more detailed and distinct picture of poverty than M_0. It is also able to simultaneously identify the best and worst performers with regard to all three poverty components, allowing for more informed and detailed policymaking.

For all the above reasons, we employ the CSPI to aggregate our three dimensions of poverty into one single multidimensional poverty index.

8. Empirical results

In this section we present the estimates of multidimensional poverty, and compare them with the official estimates of income poverty provided by the World Bank's PovcalNet database. We also decomposed multidimensional poverty figures by rural/urban area, gender of the individual, age (five categories), household size (three categories), gender of the household head and literacy status of the household head. However, given space constraints, we do not present this set of results in this paper.

Before moving into the analysis of the results, it is important to stress that our estimates, contrary to those of M_0, refer to individuals (aged 15–65), rather than households. Table 4 summarises the dimensions, weights, indicators and thresholds used for our main calculations and, later, for the sensitivity analysis.

Table 4. Summary of choices for the estimates of CSPI

	Main analysis		
Dimension	**Weight**	**Indicator(s)**	**Poor if…**
Fulfilling work	1/3	Employment status	Person is unemployed and seeking a job, or is employed in a low-paid/low-quality sector
Adequate knowledge	1/3	Literacy (< 68% responses)	Person is unable to read, write or both
		Years of education (< 68% responses)	Person has less than four years of schooling
		Educational level	Person has no education
Access to water and sanitation (health)	1/3	Access to safe, drinkable water and adequate sanitation	Person has no access to drinkable water or adequate sanitation

To properly compare poverty across countries, we retained only surveys conducted since 2000; in cases of multiple surveys in one country we retained only the latest. This allowed us to calculate the CSPI for 102 countries.[32] As reported in Table 5, more than 93 per cent of the surveys were carried out after 2004, and nearly 65 per cent very recently. Based on the World Bank classification, all the countries except for three were either low- or middle-income countries in the year the survey was conducted (Table 6). The sample covers predominantly countries from sub-Saharan Africa (39.2 per cent), followed by Europe and Central Asia (20.6 per cent) and Latin America and the Caribbean (17.6 per cent). Given the focus on extreme poverty, however, our sample does not include many other countries from the latter two regions (Table 7). Six of the eight countries located in South Asia are part of the sample. By contrast, the Middle East and North Africa region is relatively under-represented, given that we were able to calculate multidimensional poverty for only 5 of the 21 countries in this region.

Table 5. Number of countries used for the calculation of the CSPI, by year of the survey

Year of survey	Number of countries	Percentage of the sample	Cumulative distribution
2000	1	0.98	0.98
2001	1	0.98	1.96
2003	2	1.96	3.92
2004	3	2.94	6.86
2005	5	4.9	11.76
2006	5	4.9	16.67
2007	6	5.88	22.55
2008	5	4.9	27.45
2009	8	7.84	35.29
2010	10	9.8	45.1
2011	13	12.75	57.84
2012	14	13.73	71.57
2013	10	9.8	81.37
2014	14	13.73	95.1
2015	5	4.9	100
Total	102	100	

Table 6. Economic profile of the countries used for the calculation of the CSPI

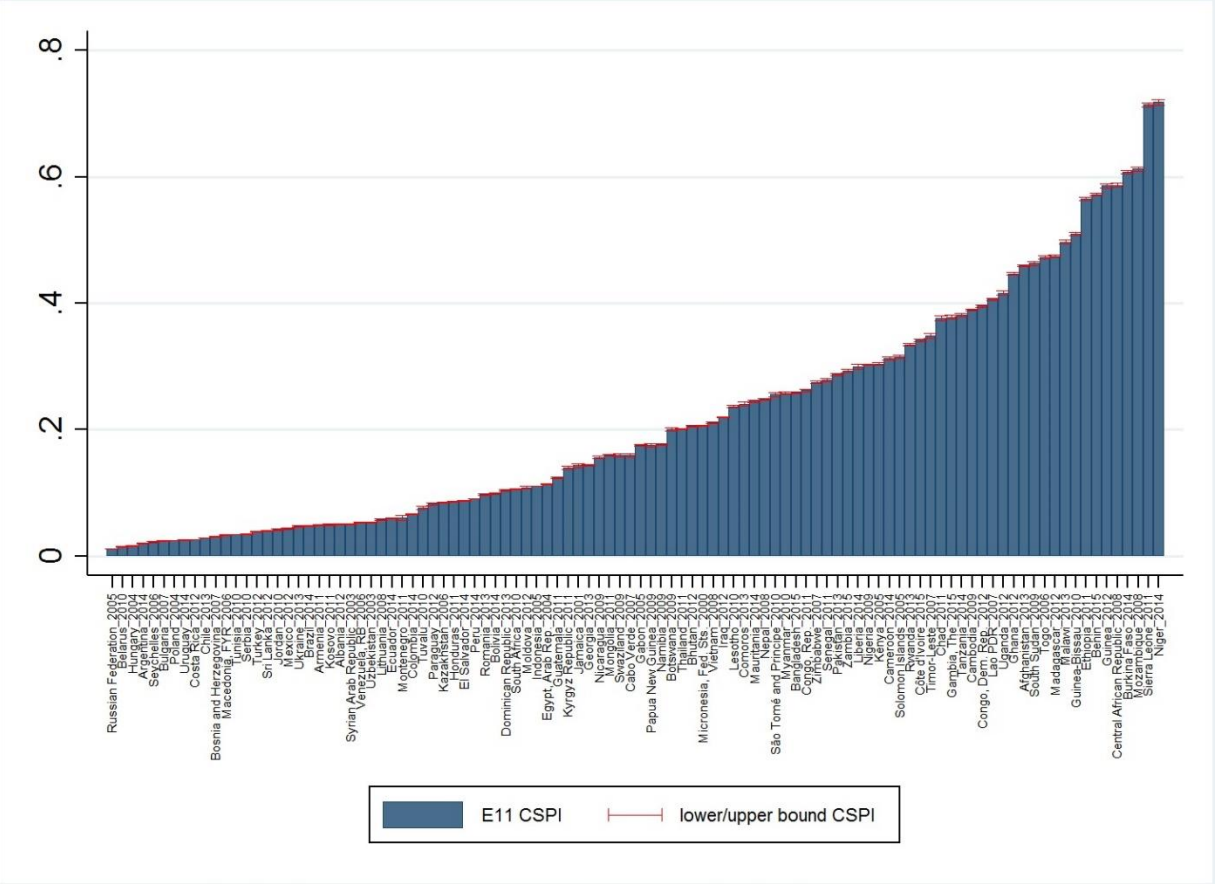
Income classification	Number of countries	Percentage of the sample
High income	3	2.94
Low income	32	31.37
Lower middle income	38	37.25
Upper middle income	29	28.43
Total	102	100

Table 7. Geographical coverage of the countries used for the calculation of the CSPI

World region	Number of countries	Percentage of the sample
East Asia & Pacific	12	11.76
Europe & Central Asia	21	20.59
Latin America & Caribbean	18	17.65
Middle East & North Africa	5	4.9
South Asia	6	5.88
Sub-Saharan Africa	40	39.22
Total	102	100

The values of the CSPI are reported in Figure 1. The graph reports also the 95 per cent confidence intervals (the upper and lower bounds) of the CSPI values for each country: this shows us how much each point estimate can vary. As for M_0 (Alkire et al. 2015), these intervals were calculated using a bootstrapping technique, with 100 repetitions for each country. As expected, the countries with the highest levels of multidimensional poverty are highly fragile States: namely, Niger, Sierra Leone and the Central African Republic, together with other low-income countries from sub-Saharan Africa, such as Mozambique, Guinea, Benin and Ethiopia. By contrast, the lowest values in our sample are found in Latin America, Eastern Europe and the Middle East.

Figure 1. CSPI values with lower and upper bounds (confidence interval: 95 per cent), by country

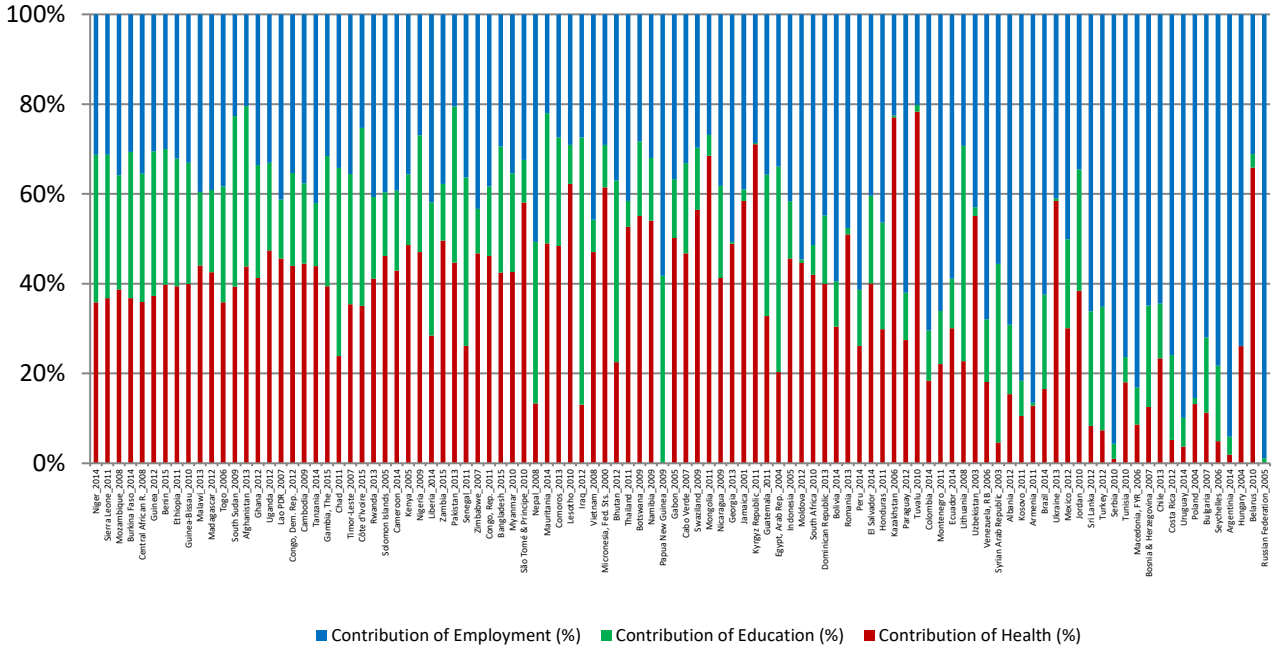


Source: Authors' elaborations using data from the I2D2 database.

One of the advantages of the CSPI is its decomposability according to the contribution of the different dimensions to overall poverty. Figure 2 highlights the relative contribution of the three dimensions to poverty. Overall, the lack of decent work is the main factor responsible, followed by the lack of access to adequate sanitation and safe drinking water, a proxy for health deprivations. Lack of education plays a more marginal role. However, the figure clearly shows different patterns among countries. In low- and lower-middle-income countries—which account for 70 out of the 102 countries—health deprivations are slightly more important than work deprivations. By contrast, in more advanced economies, which are often those with

lowest levels of multidimensional poverty, such as Argentina, Chile, the Russian Federation, Belarus or Hungary, the lack of decent employment is sometimes almost the only form of deprivation.

Figure 2. Percentage contribution of dimensions of poverty to CSPI, by country (descending order based on CSPI)



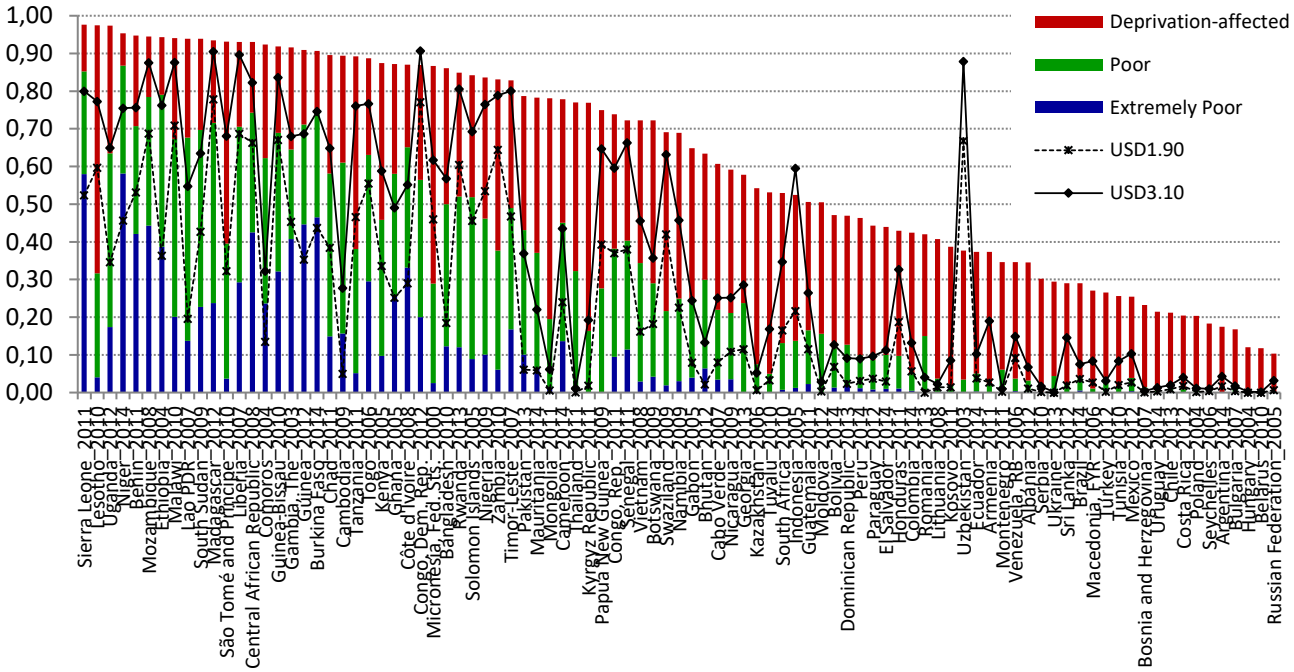
Source: Authors' elaborations using data from the I2D2 database.

In the poorest countries, the contribution of the three dimensions of poverty to the CSPI is almost the same. However, with decreasing CSPI poverty rates, the contribution of the employment dimension gains significantly in importance. Interesting exceptions are Mongolia, the Kyrghyz Republic, Kazakhstan, Tuvalu, Uzbekistan, Ukraine and, in particular, Belarus—mostly former Soviet Union countries. In those countries, the health dimension is the main contributor to overall poverty. These findings are in line with the literature, which points to the problem of access to drinkable water and sanitation, especially in rural areas of former Soviet Union countries (McKee et al. 2006; WHO and UNICEF 2012). With decreasing CSPI poverty, the education dimension loses importance, generally being the weakest contributor to overall poverty. The greatest exception is Iraq, where education contributes 59.57 per cent to overall poverty. Other countries in which education contributes comparatively more to overall poverty are Lithuania, Egypt, Chad, Papua New Guinea, Bhutan, the Syrian Arab Republic, Côte d'Ivoire, South Sudan, Senegal, Nepal, Afghanistan and Pakistan. Many of these countries have a majority Muslim population and are characterised by particularly low educational attainment among girls.

For the comparison with income poverty we were able to rely on data for 92 countries.[33] Our calculations enable us to investigate for the first time how much income poverty and multidimensional poverty rates actually diverge. To generate the graph in Figure 3, we

calculated the headcount ratios of the CSPI (differentiated according to severity of poverty into those who are deprivation affected, poor and extremely poor) and the headcount ratios for the USD1.90 and the USD3.10 poverty lines.[34] These figures are entirely comparable for the first time, as they were calculated for exactly the same survey conducted in the very same year for each country.

Figure 3. CSPI and income headcounts, by country



Source: Authors' elaborations using data from the I2D2 database and the PovcalNet database.

Figure 3 clearly shows that there are huge differences between the poverty headcounts according to income poverty and multidimensional poverty. In general, the overall headcount—i.e. the proportion of people deprived in at least one dimension of poverty—is higher than even the USD3.10 headcount ratio. Insightful mismatches are the Democratic Republic of the Congo, Indonesia and, in particular, Uzbekistan. The USD1.90 headcount ratio usually leads to higher poverty rates than the multidimensional headcount ratio of people living in extreme poverty—i.e. those individuals who are deprived in all three dimensions of poverty (health, education and employment). Interesting exceptions are Sierra Leone, Niger, Guinea, Burkina Faso, Cambodia, Pakistan and Bhutan. For these countries, the proportion of poor people according to the USD1.90 headcount ratio is lower than for the multidimensional headcount ratio of extremely poor people.

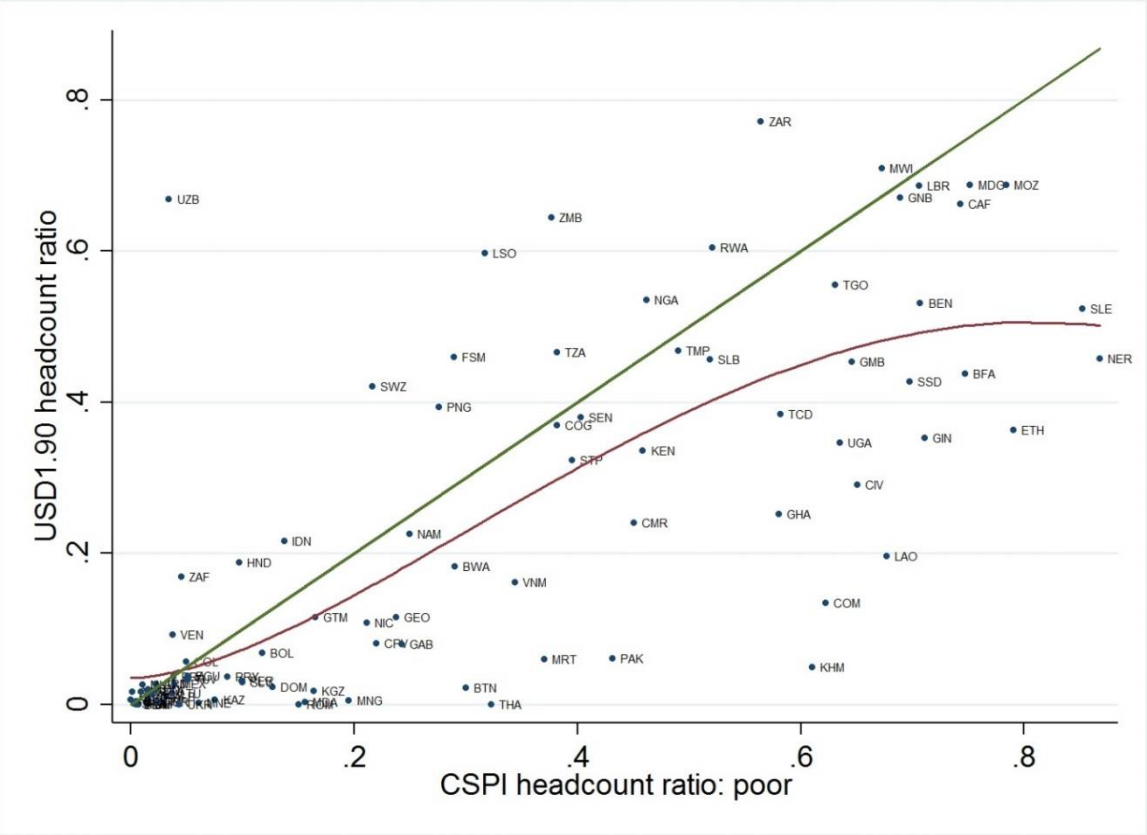
The scatter plot in Figure 4 shows the relationship between the prevalence of (extreme) monetary poverty based on the USD1.90/day purchasing power parity (PPP) line and the prevalence of multidimensional poverty, calculated by summing up the CSPI headcounts of poor and extremely poor people (i.e. the proportion of people deprived in at least two dimensions). The average headcount ratio, not weighted by country population size, is higher

for multidimensional poverty (0.30) than for extreme income poverty (0.22): in 67 countries, multidimensional poverty is greater than income poverty.

While a strong correlation exists between the two measures (Pearson rho = 0.76), we notice a number of outliers—i.e. countries which perform relatively better in one index than the other. One clear example is Uzbekistan, where almost 70 per cent of the population are living in extreme monetary poverty, while only 5 per cent are multidimensionally poor.[35] By contrast, countries such as Thailand, Cambodia and Pakistan experience much higher multidimensional poverty than monetary poverty. Moreover, the relationship is not linear. For very low multidimensional poverty rates the relationship is slightly convex. Yet for multidimensional poverty headcount ratios above 0.5–0.55 the relationship is concave—i.e. there is a decreasing marginal contribution of multidimensional poverty to income poverty.

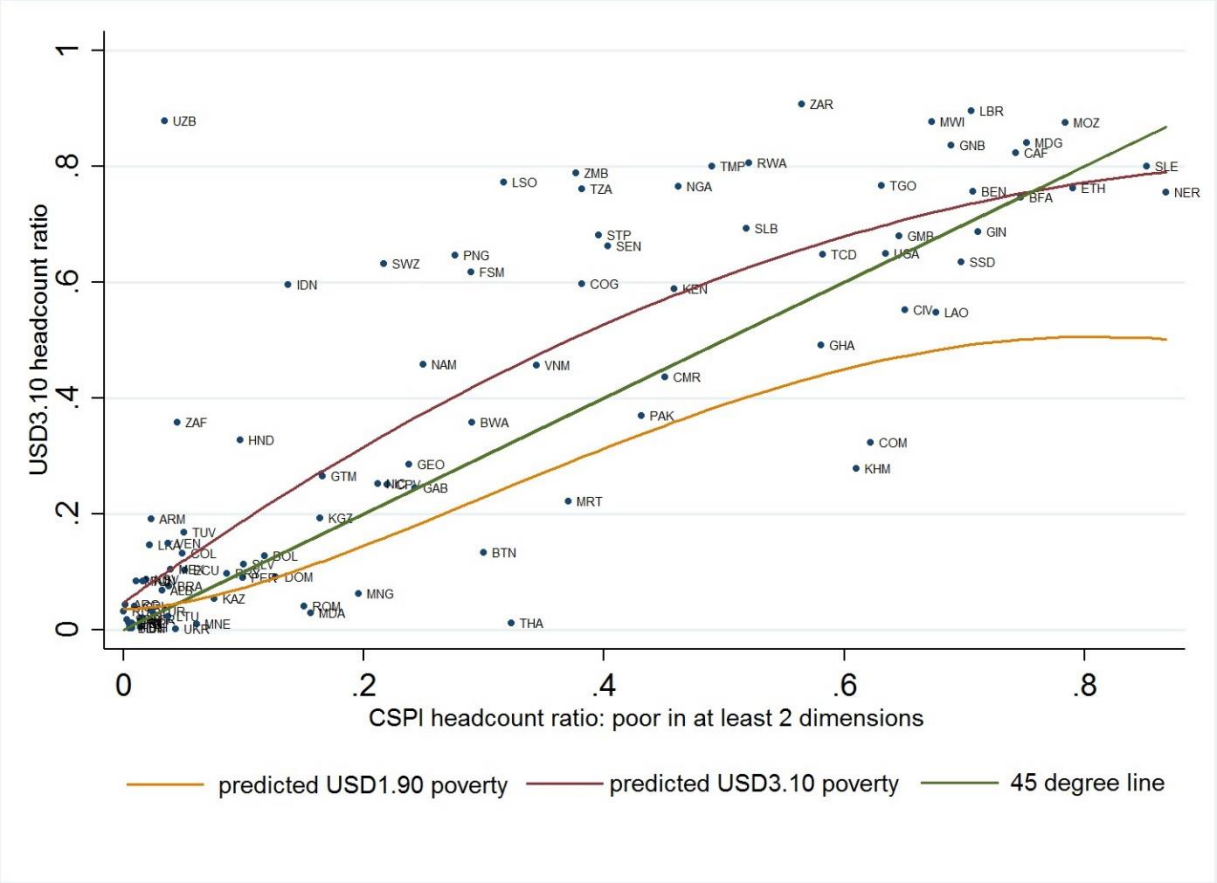
In Figure 5 we compare the headcount ratio of multidimensional poverty with that of moderate income poverty, based on the USD3.10/day PPP international poverty line. In the great majority of countries, moderate income poverty is more prevalent than multidimensional poverty. In this case, the relationship is positive and strong (Pearson rho = 0.82), but non-linear.

Figure 4. Scatter plot of CSPI vs. USD1.90/day headcount ratio



Source: Authors' elaborations using data from the I2D2 database and the PovcalNet database.

Figure 5. Scatter plot of CSPI vs. USD1.90/day and USD3.10/day headcount ratio



Source: Authors' elaborations using data from the I2D2 database and the PovcalNet database.

The picture that emerges from the last two graphs is clear: there is a positive correlation between income and multidimensional poverty, but the nature of the relationship is non-linear, and many outliers were detected. Therefore, if poverty is conceived as a multidimensional phenomenon—and we tried to provide several arguments in support of this statement in the first sections of this paper—income poverty is not a good enough proxy measure.

9. Sensitivity analysis

Are the results robust to different specifications of the variables, different thresholds or different weighting schemes? In line with the work of Alkire et al. (2010) for M_0 and the MPI, this section tests this by means of different correlation coefficients and concordance measures.

9.1 Analysis of sensitivity to different variable specifications and thresholds

For the sensitivity analysis, we first modified the measurement of health deprivations by changing the dimensional poverty line compared to the main estimates. All people without access to drinkable water or sanitation are now considered poor in this dimension; therefore, multidimensional poverty increases for all countries. As highlighted in Table 8, the correlation in both CSPI values (Pearson) and rankings (Spearman) between main and alternative

measures is very high, around 0.96. A bit lower (0.84) is the Kendall Tau-b coefficient, which is computed by comparing each pair of countries in a pair of rankings.

The revised education variable is obtained with the same (flexible) approach used for the main estimates by using a more stringent condition on population coverage: information on literacy or, alternatively, years of schooling or, finally, educational level should be available for 80 per cent of the sample population (instead of 66.66 per cent). Due to this, the sample of countries falls from 102 to 83. All the correlation coefficients indicate a very high correlation between the main CSPI value and the value of the CSPI with the revised education variable.

Finally, the alternative indicator of fulfilling work is constructed by combining information on labour status with information on the type of occupation (instead of employment status). All people unemployed or employed in 'elementary occupations' or in 'skilled agriculture, forestry and fishery' were considered poor in this dimension. The adjusted CSPI was calculated for 85 countries, and the correlation with the main CSPI is very high (0.970) based on Pearson and Spearman coefficients, and slightly below 0.9 based on the Kendall Tau-b coefficient. In conclusion, we can safely state that the CSPI estimates are robust to different measures of dimensional poverty and, in particular, that the country rankings do not change significantly.

Table 8. Correlations between main CSPI and CSPI with alternative variables

Pair of rankings compared	Type of correlation coefficient	Value	Number of countries
Main CSPI value vs. CSPI with revised health variable	Pearson	0.963	102
	Spearman	0.960	102
	Tau-b	0.840	102
Main CSPI value vs. CSPI with revised education variable	Pearson	0.995	83
	Spearman	0.988	83
	Tau-b	0.980	83
Main CSPI value vs. CSPI with revised labour variable	Pearson	0.969	85
	Spearman	0.970	85
	Tau-b	0.884	85

Source: Authors' elaborations.

9.2 Analysis of sensitivity to different weighting schemes

In Section 5 we justified the use of an equal weighting scheme, as the three dimensions of poverty (decent work, education and health) are recognised as being of the same importance in the constitutional approach. However, to test the sensitivity of our index, we tried to change the weights. First, we assigned a lower weight (0.2) to access to drinkable water and sanitation than to decent work (0.4) and education (0.4). It was argued that this decision could also be justified if we do not assume that access to water and sanitation is a proxy for health. Then, we assigned a weight of 0.2 to decent work and 0.4 to the other two dimensions; finally, a weight

of 0.2 was given to education, and 0.4 to the other two dimensions. The results of the correlation analysis are provided in Table 9.

Regardless of the weighting scheme chosen, the Pearson and Spearman coefficients are at least 0.987, and Kendall's Tau-b is equal to 0.919 or higher, indicating an overall very strong correlation between the main estimate of CSPI and the alternative CSPIs. We also performed an analysis of concordance among the four rankings: the Kendall's coefficient of concordance is 0.986, and the Friedman's test rejects the null hypothesis of no concordance among the four CSPIs at 0.01 per cent level.

Table 9. Correlations between main CSPI and CSPI with alternative weights

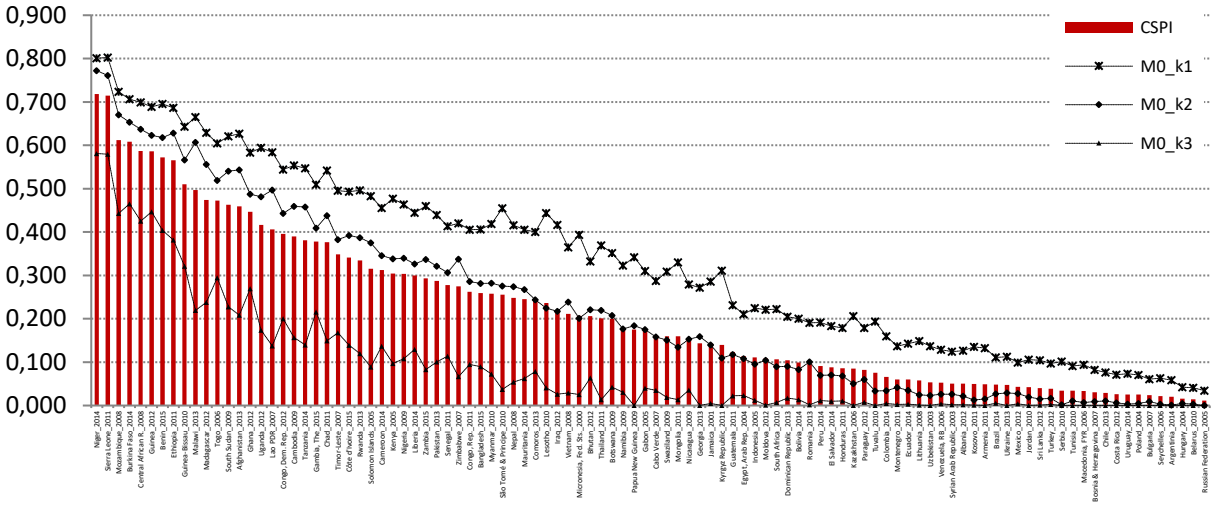
Pair of rankings compared	Type of correlation coefficient	Value	Number of countries
CSPI value with equal weights vs. CSPI weights: work (0.4), education (0.4), health (0.2)	Pearson	0.988	102
	Spearman	0.987	102
	Tau-b	0.919	102
CSPI value with equal weights vs. CSPI weights: work (0.2), education (0.4), health (0.4)	Pearson	0.994	102
	Spearman	0.992	102
	Tau-b	0.929	102
CSPI value with equal weights vs. CSPI weights: work (0.4), education (0.2), health (0.4)	Pearson	0.988	102
	Spearman	0.990	102
	Tau-b	0.923	102

Source: Authors' elaborations.

9.3 Analysis of sensitivity to different aggregation functions

All the calculations have also been done for the Alkire and Foster class of multidimensional poverty measures, M_0. Due to the dual cut-off method, all poverty rates had to be calculated based on the selected *k*-value. Since we are using three dimensions of poverty to calculate the multidimensional poverty rates, we have three different values for M_0: M_0 for a *k*-value of 1/3 (everyone deprived in at least one of the equally weighted dimensions is considered poor), a *k*-value of 2/3 (everyone deprived in at least two dimensions is considered poor) and a *k*-value of 1 (everyone deprived in all three dimensions of poverty is considered poor). Figure 6 compares the poverty rates according to CSPI, $M_0(k = 1/3)$, $M_0(k = 2/3)$ and $M_0(k = 1)$:

Figure 6. CSPI and M_0, by country, by descending CSPI poverty rates



Source: Authors' elaborations using data from the I2D2 database.

As explained in the theoretical part of our paper, the $M_0(k = 1/3)$ poverty rates rely on the union identification method and, as expected, lead to very high poverty rates. The $M_0(k = 1)$ poverty rates, on the other hand, rely on the intersection identification method and, also as expected, lead to very low poverty rates (in many cases zero). Thus, the only *k*-value that makes sense for the M_0 poverty measure is $k = 2/3$—i.e. the case in which every individual who is deprived in at least two dimensions of poverty is considered poor.

Comparing CSPI poverty rates and $M_0(k = 2/3)$ poverty rates reveals the trend that has been described in the theoretical part of the paper: due to the dual cut-off identification method, $M_0(k = 2/3)$ leads to higher poverty rates than the CSPI for the poorer countries and to lower rates than the CSPI in less poor countries, revealing the disadvantageous broader range of poverty rates of M_0 in comparison to the CSPI.

Figure 6 also shows that the two poverty measures CSPI and M_0 lead to very similar results, especially when compared to income poverty measures (Figure 6). The rankings according to the CSPI and $M_0(k = 2/3)$ are quite similar, with Malawi, South Sudan, Afghanistan, Lao People's Democratic Republic, Cambodia, Tanzania, Chad, Zimbabwe and Viet Nam being the strongest exceptions.

The figure already reveals some of the advantages of the CSPI, with its practicable poverty rates that only need to be calculated once, since they do not depend on the arbitrary choice of *k*. The greatest advantage of the CSPI, however, is its distribution sensitivity and its immediate result, the measure's decomposability according to all three I's of poverty. This advantage can best be demonstrated with poverty maps (compare Rippin 2014; 2017); however, the I2D2

dataset does not provide the necessary geographical data. Therefore, we have to rely on Table 10 to illustrate the additional differences between the CSPI and M_0.

Table 10. Decompositions of CSPI and M0_k2, descending CSPI poverty, by country

Country	Year	CSPI					M0_k=2/3	
		Headcount			Intensity	Inequality	Censored headcount	Censored intensity
		Deprivation affected	Poor	Extremely poor				
Niger	2014	0.086	0.287	0.581	0.840	0.034	0.868	0.890
Sierra Leone	2011	0.124	0.273	0.579	0.822	0.041	0.852	0.893
Mozambique	2008	0.161	0.341	0.443	0.766	0.052	0.784	0.855
Burkina Faso	2014	0.159	0.282	0.465	0.779	0.053	0.747	0.874
Central African R.	2008	0.187	0.317	0.425	0.=752	0.058	0.743	0.858
Guinea	2012	0.198	0.265	0.447	0.758	0.061	0.711	0.876
Benin	2015	0.233	0.320	0.404	0.726	0.067	0.724	0.853
Ethiopia	2011	0.175	0.370	0.382	0.741	0.056	0.751	0.836
Guinea-Bissau	2010	0.230	0.368	0.321	0.700	0.067	0.689	0.822
Malawi	2013	0.175	0.582	0.219	0.682	0.048	0.801	0.758
Madagascar	2012	0.219	0.477	0.238	0.673	0.060	0.715	0.777
Togo	2006	0.256	0.336	0.295	0.681	0.074	0.631	0.822
South Sudan	2009	0.241	0.470	0.228	0.662	0.063	0.697	0.775
Afghanistan	2013	0.251	0.502	0.208	0.652	0.062	0.711	0.764
Ghana	2012	0.289	0.326	0.270	0.660	0.081	0.596	0.817
Uganda	2012	0.339	0.461	0.174	0.610	0.074	0.635	0.758
Lao PDR	2007	0.262	0.539	0.137	0.622	0.058	0.677	0.734
Congo, Dem. Rep.	2012	0.305	0.364	0.200	0.627	0.080	0.564	0.785
Cambodia	2009	0.284	0.454	0.157	0.619	0.068	0.610	0.752
Tanzania	2014	0.267	0.477	0.140	0.619	0.064	0.617	0.742
Gambia, The	2015	0.301	0.290	0.216	0.632	0.088	0.506	0.809
Chad	2011	0.314	0.432	0.149	0.605	0.073	0.582	0.752
Timor-Leste	2007	0.338	0.322	0.168	0.598	0.088	0.490	0.781
Côte d'Ivoire	2015	0.304	0.379	0.139	0.600	0.077	0.518	0.756
Rwanda	2013	0.328	0.400	0.120	0.585	0.076	0.520	0.744
Solomon Islands	2005	0.324	0.429	0.089	0.574	0.070	0.518	0.724
Cameroon	2014	0.328	0.314	0.137	0.585	0.087	0.450	0.768
Kenya	2005	0.416	0.361	0.097	0.545	0.085	0.459	0.737
Nigeria	2009	0.372	0.348	0.108	0.560	0.085	0.456	0.746
Liberia	2014	0.356	0.295	0.129	0.570	0.092	0.424	0.768
Zambia	2015	0.371	0.381	0.083	0.552	0.078	0.463	0.726
Pakistan	2013	0.355	0.331	0.101	0.559	0.084	0.431	0.744
Senegal	2011	0.320	0.289	0.114	0.572	0.088	0.403	0.761
Zimbabwe	2007	0.249	0.406	0.067	0.582	0.061	0.473	0.714
Congo, Rep.	2011	0.357	0.287	0.095	0.549	0.090	0.382	0.750
Bangladesh	2015	0.374	0.288	0.089	0.541	0.090	0.378	0.746
Myanmar	2010	0.408	0.315	0.073	0.526	0.086	0.387	0.729
São Tomé & Principe	2010	0.536	0.358	0.037	0.488	0.077	0.395	0.698
Nepal	2008	0.427	0.330	0.054	0.513	0.080	0.384	0.714
Mauritania	2014	0.412	0.308	0.062	0.518	0.084	0.371	0.723
Comoros	2013	0.469	0.248	0.078	0.503	0.098	0.326	0.747
Lesotho	2010	0.658	0.276	0.041	0.456	0.085	0.317	0.710
Iraq	2012	0.597	0.287	0.026	0.457	0.077	0.313	0.694
Viet Nam	2008	0.379	0.315	0.029	0.505	0.072	0.344	0.695
Micronesia, Fed. Sts.	2000	0.578	0.264	0.025	0.454	0.078	0.289	0.696
Bhutan	2012	0.334	0.236	0.064	0.525	0.090	0.300	0.738
Thailand	2011	0.448	0.309	0.014	0.479	0.068	0.323	0.681
Botswana	2009	0.432	0.247	0.042	0.487	0.086	0.290	0.716
Namibia	2009	0.439	0.219	0.030	0.469	0.083	0.250	0.707
Papua New Guinea	2009	0.473	0.276	0.000	0.456	0.062	0.276	0.667
Gabon	2005	0.406	0.203	0.040	0.479	0.090	0.243	0.722
Cabo Verde	2007	0.387	0.185	0.035	0.473	0.089	0.220	0.720
Swaziland	2009	0.475	0.197	0.019	0.447	0.078	0.216	0.696
Mongolia	2011	0.585	0.182	0.014	0.423	0.072	0.195	0.690

Nicaragua	2009	0.380	0.176	0.035	0.473	0.090	0.212	0.723
Georgia	2013	0.341	0.237	0.001	0.471	0.061	0.238	0.668
Jamaica	2001	0.438	0.202	0.005	0.443	0.067	0.207	0.674
Kyrgyz Republic	2011	0.605	0.164	0.000	0.404	0.057	0.164	0.667
Guatemala	2011	0.340	0.143	0.022	0.457	0.085	0.165	0.712
Egypt, Arab Rep.	2004	0.308	0.127	0.023	0.460	0.089	0.150	0.719
Indonesia	2005	0.387	0.125	0.012	0.428	0.076	0.137	0.696
Moldova	2012	0.349	0.155	0.001	0.437	0.063	0.156	0.668
South Africa	2010	0.398	0.124	0.007	0.420	0.069	0.131	0.684
Dominican Republic	2013	0.343	0.110	0.017	0.436	0.084	0.127	0.712
Bolivia	2014	0.353	0.104	0.013	0.426	0.079	0.118	0.705
Romania	2013	0.270	0.149	0.002	0.454	0.064	0.150	0.670
Peru	2014	0.364	0.088	0.011	0.413	0.075	0.099	0.705
El Salvador	2014	0.340	0.090	0.010	0.417	0.075	0.100	0.700
Honduras	2011	0.333	0.086	0.011	0.417	0.076	0.097	0.704
Kazakhstan	2006	0.467	0.075	0.000	0.380	0.046	0.075	0.667
Paraguay	2012	0.357	0.078	0.008	0.404	0.069	0.086	0.697
Tuvalu	2010	0.481	0.050	0.000	0.365	0.036	0.050	0.667
Colombia	2014	0.375	0.045	0.005	0.376	0.052	0.049	0.697
Montenegro	2011	0.286	0.058	0.003	0.395	0.059	0.061	0.682
Ecuador	2014	0.323	0.048	0.003	0.381	0.053	0.051	0.687
Lithuania	2008	0.370	0.036	0.001	0.364	0.038	0.037	0.677
Uzbekistan	2003	0.343	0.034	0.000	0.364	0.035	0.034	0.669
Venezuela, RB	2006	0.309	0.033	0.004	0.373	0.050	0.037	0.700
Syrian Arab Republic	2003	0.295	0.037	0.002	0.373	0.046	0.039	0.680
Albania	2012	0.314	0.030	0.002	0.366	0.042	0.032	0.688
Kosovo	2011	0.368	0.018	0.001	0.351	0.026	0.019	0.690
Armenia	2011	0.351	0.023	0.000	0.354	0.026	0.023	0.667
Brazil	2014	0.252	0.033	0.006	0.383	0.063	0.038	0.715
Ukraine	2013	0.251	0.044	0.000	0.383	0.048	0.044	0.667
Mexico	2012	0.216	0.035	0.004	0.389	0.062	0.039	0.699
Jordan	2010	0.259	0.029	0.000	0.368	0.039	0.029	0.671
Sri Lanka	2012	0.269	0.021	0.001	0.359	0.033	0.022	0.679
Turkey	2012	0.242	0.022	0.002	0.366	0.044	0.024	0.697
Serbia	2010	0.299	0.003	0.000	0.336	0.004	0.003	0.667
Tunisia	2010	0.241	0.015	0.001	0.355	0.028	0.016	0.677
Macedonia, FYR	2006	0.260	0.010	0.000	0.347	0.019	0.011	0.677
Bosnia & Herzegovina	2007	0.218	0.013	0.001	0.354	0.028	0.014	0.681
Chile	2013	0.197	0.015	0.001	0.359	0.033	0.015	0.681
Costa Rica	2012	0.195	0.009	0.000	0.349	0.021	0.009	0.675
Uruguay	2014	0.210	0.004	0.000	0.341	0.011	0.005	0.677
Poland	2004	0.196	0.007	0.000	0.345	0.016	0.007	0.667
Bulgaria	2007	0.154	0.013	0.001	0.362	0.037	0.014	0.682
Seychelles	2006	0.178	0.005	0.000	0.342	0.012	0.005	0.667
Argentinia	2014	0.173	0.001	0.000	0.336	0.004	0.001	0.670
Hungary	2004	0.113	0.007	0.000	0.353	0.025	0.007	0.667
Belarus	2010	0.113	0.005	0.000	0.346	0.018	0.005	0.667
Russian Federation	2005	0.104	0.000	0.000	0.333	0.000	0.000	0.667

Source: Authors' elaborations.

The first thing that is plainly obvious from Table 10 is that, since the censored average intensity of $M_0(k = 2/3)$ is truncated from below, there is little variation in the censored average intensity across countries, ranging from 0.667 (measured in 12 countries) to 0.893 (Sierra Leone). Average poverty intensity according to the CSPI has much more flexibility and ranges from a low of 0.333 (Russian Federation) to 0.840 (Niger). Comoros is a very interesting example of the important additional information that is gained through the decomposability of the CSPI. With 0.747 it shows a medium censored average intensity, with 0.503 it is at the lower end regarding uncensored average intensity, but with 0.098 it has the highest inequality rate, which ranges from almost 0 (Russian Federation) to 0.098 (Comoros). This is very important information for policymaking that is entirely disguised if the M_0 measure is used instead of the CSPI.

10. Conclusions

These days more than ever poverty is considered a multidimensional phenomenon. This is confirmed by the formulation of the first SDG of the 2030 Agenda, which calls for ending "poverty in all its forms everywhere". However, there is still a lot of disagreement as to whether an income-based measure of poverty can sufficiently capture poverty in other dimensions. Unfortunately, the available international indicators of multidimensional poverty suffer from several weaknesses, feeding the criticism of those who are in favour of the income poverty approach. In particular, the global MPI has drawbacks that range from the lack of theoretical foundations for the selection of dimensions to the impossibility of taking into account inequality among poor people.

In this paper we present a new international indicator of multidimensional poverty, the Global CSPI, and discuss in great detail all the steps followed to construct the index. The main features of our index are the following:

- It is theoretically grounded in Amartya Sen's capability approach, which is justified as the most adequate conceptual framework for conceptualising and measuring poverty.
- It encompasses three dimensions of poverty: decent work, education and access to safe drinking water and adequate sanitation (also as a proxy for health). These three dimensions largely overlap with the list of ideal dimensions of poverty obtained by endorsing an innovative approach for the selection of dimensions, called the constitutional approach.
- The identification of poor people in each dimension is as follows. Illiterate people are deprived in the educational dimension, unemployed people and people employed in low-paid and low-qualification jobs are classified as poor in the decent work dimension, and people with access to neither safe drinking water nor adequate sanitation are considered poor in the last dimension.
- Deprivations in the three dimensions are aggregated through the CSPI. This aggregation function does not require the identification of an arbitrary second cut-off and accounts not just for the incidence and intensity of poverty (as the MPI does) but also for inequality among poor people. Moreover, like the MPI, it can be decomposed by dimension as well as region, gender, social group, household size and so on.
- The unit of analysis is the individual (and not the household) among people aged 15–65.

Thanks to the massive I2D2 database of harmonised household surveys, we were able to compute the G-CSPI for more than 500 surveys, including nearly 108 countries. In this paper we concentrated on the latest survey conducted in each country after 1999. This allowed us to look at the CSPI value and the contribution of each dimension for 102 countries. The results highlight that, as expected, mostly fragile States are among those with the highest rates of multidimensional poverty. In the overall sample, deprivations in decent wok, immediately followed by those in health, contributed the most to overall poverty.

In this paper, for the first time, we were able to use the same dataset to calculate and conduct a comparative analysis between income and multidimensional poverty. Previous cross-country evidence has used very different surveys, even conducted in different years, to compute income and multidimensional poverty. Our analysis, based on 92 countries, shows that the

headcount ratio of extreme monetary poverty (USD1.90/day) is highly correlated with that of the CSPI (for two or more deprivations), but that the relationship is clearly non-linear. Thus we have provided the first theoretically sound evidence of the fact that income poverty is not a sufficiently good proxy for multidimensional (capability) poverty.

We then examined the stability and robustness of the CSPI measure. First, we calculated the lower and upper bounds of the CSPI using a bootstrapping procedure with 100 repetitions. As the two values are very close to the central value of the CSPI, the measure is quite stable. Then we checked the sensitivity of the results to changes in the measurement in each variable and to changes in the weighting schemes by means of correlation and correspondence analysis. The coefficients were always very high, supporting the robustness of the index.

Finally, we compared our index with another one with the same dimensions, indicators, cut-offs and weights, but obtained with the Alkire–Foster method as an aggregation function. The findings reveal that the results of the two multidimensional poverty measures, the G-CSPI and M_0 are closely related, much closer than the G-CSPI and the income poverty measures. They also support our theoretical arguments that: i) the CSPI provides additional policy-relevant information due to its distribution-sensitivity: information on inequality as well as information on different headcounts as well as average poverty intensity that are not truncated as in the case of M_0; and ii) the CSPI immediately provides a classification of the headcount ratio into those who are 'deprivation affected', 'poor' and 'extremely poor'—something that M_0 can only provide through multiple calculations.

In conclusion, we believe that this new index provides a substantial contribution to the literature on poverty measurement and assessment, and that the considerable amount of information generated in the empirical exercise allows other important research questions to be answered. These range from verifying whether the trends in multidimensional poverty and income poverty follow similar patterns and re-assessing the relationship between growth and poverty from a multidimensional perspective, to the (static and dynamic) analysis of horizontal inequalities in poverty. The latter is made possible by the extensive data on poverty by rural/urban area, gender, age, household size, and gender of the household head, calculated but not examined in this paper.

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ANNEX A. Surveys used for calculation of the CSPI, by CSPI value (descending order)

Country	Year	Region	Income classif.	CSPI	Lower bound CSPI	Upper bound CSPI	CSPI: health contrib.	CSPI: education contrib.	CSPI: work contrib.	Headcount ratio deprived	Headcount ratio >=2 deprivations	Poverty intensity	Poverty inequality
Niger	2014	SSA	L	0.718	0.713	0.723	0.359	0.329	0.313	0.954	0.868	0.840	0.034
Sierra Leone	2011	SSA	L	0.714	0.711	0.718	0.368	0.320	0.313	0.976	0.852	0.822	0.041
Mozambique	2008	SSA	L	0.612	0.609	0.615	0.387	0.255	0.359	0.945	0.784	0.766	0.052
Burkina Faso	2014	SSA	L	0.608	0.605	0.611	0.368	0.326	0.306	0.906	0.747	0.779	0.053
Central African Rep.	2008	SSA	L	0.587	0.583	0.591	0.360	0.285	0.355	0.930	0.743	0.752	0.058
Guinea	2012	SSA	L	0.586	0.583	0.589	0.372	0.323	0.305	0.909	0.711	0.758	0.061
Benin	2015	SSA	L	0.572	0.570	0.575	0.397	0.303	0.300	0.958	0.724	0.726	0.067
Ethiopia	2011	SSA	L	0.565	0.563	0.568	0.394	0.284	0.322	0.927	0.751	0.741	0.056
Guinea-Bissau	2010	SSA	L	0.510	0.507	0.513	0.399	0.270	0.331	0.919	0.689	0.700	0.067
Malawi	2013	SSA	L	0.497	0.494	0.501	0.441	0.164	0.395	0.976	0.801	0.682	0.048
Madagascar	2012	SSA	L	0.474	0.472	0.476	0.425	0.184	0.391	0.935	0.715	0.673	0.060
Togo	2006	SSA	L	0.473	0.470	0.476	0.358	0.258	0.383	0.887	0.631	0.681	0.074
South Sudan	2009	SSA	L(?)	0.463	0.460	0.467	0.393	0.380	0.227	0.939	0.697	0.662	0.063
Afghanistan	2013	SA	L	0.459	0.458	0.461	0.439	0.357	0.204	0.961	0.711	0.652	0.062
Ghana	2012	SSA	LM	0.447	0.445	0.449	0.413	0.251	0.336	0.885	0.596	0.660	0.081
Uganda	2012	SSA	L	0.416	0.414	0.419	0.474	0.195	0.331	0.974	0.635	0.610	0.074
Lao PDR	2007	EAP	L	0.406	0.404	0.408	0.456	0.131	0.413	0.939	0.677	0.622	0.058
Congo, Dem. Rep.	2012	SSA	L	0.396	0.394	0.398	0.440	0.207	0.353	0.869	0.564	0.627	0.080
Cambodia	2009	EAP	L	0.390	0.388	0.391	0.445	0.179	0.376	0.894	0.610	0.619	0.068
Tanzania	2014	SSA	L	0.381	0.379	0.384	0.439	0.141	0.420	0.884	0.617	0.619	0.064
Gambia, The	2015	SSA	L	0.378	0.375	0.382	0.394	0.290	0.316	0.806	0.506	0.632	0.088
Chad	2011	SSA	L	0.376	0.373	0.380	0.239	0.420	0.342	0.896	0.582	0.605	0.073
Timor-Leste	2007	EAP	LM	0.349	0.344	0.353	0.354	0.290	0.356	0.828	0.490	0.598	0.088
Côte d'Ivoire	2015	SSA	LM	0.342	0.340	0.343	0.351	0.396	0.253	0.822	0.518	0.600	0.077
Rwanda	2013	SSA	L	0.334	0.333	0.336	0.411	0.182	0.407	0.849	0.520	0.585	0.076
Solomon Islands	2005	EAP	L	0.316	0.313	0.319	0.462	0.141	0.396	0.842	0.518	0.574	0.070
Cameroon	2014	SSA	LM	0.313	0.310	0.315	0.429	0.178	0.393	0.779	0.450	0.585	0.087
Kenya	2005	SSA	L	0.304	0.302	0.306	0.486	0.158	0.356	0.875	0.459	0.545	0.085
Nigeria	2009	SSA	LM	0.304	0.302	0.304	0.443	0.285	0.272	0.836	0.462	0.558	0.082
Liberia	2014	SSA	L	0.300	0.296	0.304	0.285	0.297	0.419	0.780	0.424	0.570	0.092
Zambia	2015	SSA	LM	0.293	0.291	0.295	0.496	0.126	0.378	0.835	0.463	0.552	0.078
Pakistan	2013	SA	LM	0.287	0.286	0.289	0.447	0.348	0.205	0.787	0.431	0.559	0.084
Senegal	2011	SSA	LM	0.278	0.276	0.280	0.262	0.375	0.363	0.723	0.403	0.572	0.088
Zimbabwe	2007	SSA	L	0.275	0.273	0.277	0.468	0.099	0.433	0.722	0.473	0.582	0.061
Congo, Rep.	2011	SSA	LM	0.262	0.260	0.264	0.462	0.154	0.384	0.739	0.382	0.549	0.090
Bangladesh	2015	SA	LM	0.259	0.258	0.260	0.425	0.281	0.294	0.751	0.378	0.541	0.090
Myanmar	2010	EAP	L	0.258	0.256	0.259	0.426	0.220	0.354	0.796	0.387	0.526	0.086
São Tomé & Principe	2010	SSA	LM	0.256	0.253	0.259	0.581	0.095	0.325	0.931	0.395	0.488	0.077
Nepal	2008	SA	L	0.248	0.246	0.250	0.134	0.360	0.507	0.811	0.384	0.513	0.080
Mauritania	2014	SSA	LM	0.245	0.243	0.247	0.490	0.290	0.220	0.783	0.371	0.518	0.084
Comoros	2013	SSA	L	0.241	0.237	0.244	0.484	0.242	0.275	0.795	0.326	0.503	0.098
Lesotho	2010	SSA	LM	0.237	0.234	0.239	0.622	0.087	0.291	0.975	0.317	0.456	0.085
Iraq	2012	MENA	UM	0.220	0.219	0.221	0.130	0.596	0.274	0.910	0.313	0.457	0.077
Viet Nam	2008	EAP	L	0.211	0.210	0.212	0.471	0.072	0.457	0.723	0.344	0.505	0.072
Micronesia, Fed. Sts.	2000	EAP	LM	0.207	0.206	0.208	0.615	0.094	0.291	0.867	0.289	0.454	0.078
Bhutan	2012	SA	LM	0.206	0.204	0.208	0.225	0.405	0.370	0.634	0.300	0.525	0.090
Thailand	2011	EAP	UM	0.201	0.200	0.202	0.527	0.058	0.416	0.770	0.323	0.479	0.068
Botswana	2009	SSA	UM	0.201	0.198	0.203	0.551	0.167	0.283	0.722	0.290	0.487	0.086
Namibia	2009	SSA	UM	0.177	0.175	0.178	0.540	0.140	0.320	0.689	0.250	0.469	0.083
Papua New Guinea	2009	EAP	LM	0.175	0.173	0.178	0.000	0.418	0.582	0.749	0.276	0.456	0.062

Gabon	2005	SSA	UM	0.175	0.173	0.177	0.502	0.131	0.367	0.648	0.243	0.479	0.090
Cabo Verde	2007	SSA	LM	0.160	0.157	0.163	0.467	0.201	0.331	0.607	0.220	0.473	0.089
Swaziland	2009	SSA	LM	0.160	0.157	0.162	0.565	0.138	0.297	0.691	0.216	0.447	0.078
Mongolia	2011	EAP	LM	0.159	0.158	0.161	0.685	0.046	0.268	0.781	0.195	0.423	0.072
Nicaragua	2009	LAC	LM	0.156	0.154	0.158	0.413	0.206	0.382	0.591	0.212	0.473	0.090
Georgia	2013	ECA	LM	0.144	0.143	0.145	0.489	0.004	0.507	0.578	0.238	0.471	0.061
Jamaica	2001	LAC	LM	0.143	0.140	0.147	0.584	0.026	0.389	0.645	0.207	0.443	0.067
Kyrgyz Republic	2011	ECA	L	0.140	0.138	0.142	0.711	0.003	0.286	0.769	0.164	0.404	0.057
Guatemala	2011	LAC	LM	0.124	0.122	0.125	0.328	0.315	0.357	0.506	0.165	0.457	0.085
Egypt, Arab Rep.	2004	MENA	LM	0.114	0.113	0.115	0.203	0.458	0.339	0.459	0.150	0.460	0.089
Indonesia	2005	EAP	LM	0.111	0.111	0.111	0.456	0.128	0.416	0.525	0.137	0.428	0.076
Moldova	2012	ECA	LM	0.109	0.107	0.110	0.446	0.008	0.546	0.505	0.156	0.437	0.063
South Africa	2010	SSA	UM	0.107	0.106	0.107	0.420	0.066	0.514	0.530	0.131	0.420	0.069
Dominican Republic	2013	LAC	UM	0.104	0.103	0.106	0.400	0.152	0.448	0.469	0.127	0.436	0.084
Bolivia	2014	LAC	LM	0.099	0.098	0.100	0.304	0.101	0.594	0.471	0.118	0.426	0.079
Romania	2013	ECA	UM	0.098	0.097	0.099	0.510	0.014	0.476	0.420	0.150	0.454	0.064
Peru	2014	LAC	UM	0.091	0.090	0.091	0.262	0.125	0.614	0.463	0.099	0.413	0.075
El Salvador	2014	LAC	LM	0.088	0.087	0.089	0.400	0.196	0.404	0.440	0.100	0.417	0.075
Honduras	2011	LAC	LM	0.086	0.085	0.087	0.299	0.237	0.464	0.430	0.097	0.417	0.076
Kazakhstan	2006	ECA	UM	0.085	0.085	0.086	0.770	0.004	0.225	0.542	0.075	0.380	0.046
Paraguay	2012	LAC	LM	0.082	0.081	0.084	0.274	0.106	0.620	0.443	0.086	0.404	0.069
Tuvalu	2010	EAP	LM	0.076	0.073	0.078	0.783	0.015	0.201	0.531	0.050	0.365	0.036
Colombia	2014	LAC	UM	0.066	0.066	0.067	0.184	0.112	0.704	0.424	0.049	0.376	0.052
Montenegro	2011	ECA	UM	0.060	0.057	0.064	0.221	0.119	0.660	0.346	0.061	0.395	0.059
Ecuador	2014	LAC	UM	0.060	0.060	0.061	0.301	0.110	0.589	0.374	0.051	0.381	0.053
Lithuania	2008	ECA	UM	0.058	0.057	0.059	0.227	0.480	0.293	0.407	0.037	0.364	0.038
Uzbekistan	2003	ECA	L	0.053	0.053	0.054	0.551	0.019	0.430	0.377	0.034	0.364	0.035
Venezuela, RB	2006	LAC	UM	0.053	0.053	0.053	0.181	0.140	0.679	0.346	0.037	0.373	0.050
Syrian Arab Republic	2003	MENA	LM	0.051	0.050	0.051	0.047	0.397	0.556	0.333	0.039	0.373	0.046
Albania	2012	ECA	UM	0.050	0.049	0.051	0.154	0.155	0.691	0.345	0.032	0.366	0.042
Kosovo	2011	ECA	LM	0.050	0.049	0.051	0.105	0.079	0.816	0.387	0.019	0.351	0.026
Armenia	2011	ECA	LM	0.049	0.049	0.050	0.128	0.007	0.865	0.373	0.023	0.354	0.026
Brazil	2014	LAC	UM	0.048	0.048	0.048	0.165	0.211	0.624	0.290	0.038	0.383	0.063
Ukraine	2013	ECA	LM	0.047	0.046	0.048	0.585	0.006	0.410	0.294	0.044	0.383	0.048
Mexico	2012	LAC	UM	0.043	0.042	0.044	0.301	0.198	0.501	0.255	0.039	0.389	0.062
Jordan	2010	MENA	UM	0.042	0.041	0.043	0.384	0.270	0.346	0.288	0.029	0.368	0.039
Sri Lanka	2012	SA	LM	0.040	0.040	0.040	0.083	0.255	0.661	0.290	0.022	0.359	0.033
Turkey	2012	ECA	UM	0.039	0.038	0.039	0.073	0.276	0.651	0.266	0.024	0.366	0.044
Serbia	2010	ECA	UM	0.034	0.034	0.035	0.010	0.034	0.957	0.302	0.003	0.336	0.004
Tunisia	2010	MENA	UM	0.034	0.034	0.035	0.180	0.056	0.764	0.256	0.016	0.355	0.028
Macedonia, FYR	2006	ECA	LM	0.034	0.033	0.035	0.086	0.083	0.831	0.271	0.011	0.347	0.019
Bosnia & Herzegovina	2007	ECA	LM	0.031	0.030	0.031	0.125	0.226	0.648	0.232	0.014	0.354	0.028
Chile	2013	LAC	H	0.029	0.029	0.029	0.234	0.121	0.645	0.212	0.015	0.359	0.033
Costa Rica	2012	LAC	UM	0.026	0.025	0.026	0.052	0.189	0.759	0.204	0.009	0.349	0.021
Uruguay	2014	LAC	H	0.025	0.025	0.026	0.037	0.064	0.899	0.215	0.005	0.341	0.011
Poland	2004	ECA	UM	0.025	0.025	0.025	0.132	0.014	0.855	0.204	0.007	0.345	0.016
Bulgaria	2007	ECA	UM	0.024	0.023	0.024	0.113	0.167	0.720	0.168	0.014	0.362	0.037
Seychelles	2006	SSA	UM	0.022	0.021	0.023	0.049	0.168	0.783	0.183	0.005	0.342	0.012
Argentina	2014	LAC	H	0.020	0.020	0.020	0.019	0.040	0.941	0.175	0.001	0.336	0.004
Hungary	2004	ECA	UM	0.016	0.015	0.016	0.261	0.000	0.739	0.121	0.007	0.353	0.025
Belarus	2010	ECA	UM	0.015	0.014	0.015	0.659	0.030	0.311	0.118	0.005	0.346	0.018
Russian Federation	2005	ECA	UM	0.012	0.011	0.012	0.000	0.011	0.989	0.104	0.000	0.333	0.000

1. Other scholars have treated capabilities as latent concepts and have applied econometric techniques, such as the structural equations models, to estimate capabilities from secondary data that contain only information on functionings and other socio-economic and demographic information (e.g. Krishnakumar 2007; Krishnakumar and Ballon 2008). We do not discuss this literature further because, in our view, it is based on a misleading interpretation of the capability approach, far from the one well represented in Robeyns (2005).
2. For a review of the weaknesses of a number of indicators, see, for example, Burchi and Gnesi (2016).
3. This point is discussed in detail in Sections 4 and 5.
4. For instance, the MICS has no information on BMI, thus all countries which are calculated with MICS datasets only use the nutrition data variable for children under 5 years old.
5. Like all international poverty comparisons, whether they are conducted by the World Bank or OPHI/UNDP, we also still have to deal with the fact that not all surveys have been conducted in the same year, a fact which has to be kept in mind for all poverty comparisons across countries. However, all comparisons with regard to different poverty measures *within* countries are all based on exactly the same dataset; thus, in these cases no discrepancies exist.
6. This point is also highlighted by Wisor et al. (2016, 6): "Although the creators claim that the MPI finds support in various participatory assessments, the three categories—health, education, and standards of living—were not selected over other potential dimensions on the basis of such participatory assessments but rather, selected based on the contingencies of data availability."
7. Those constitutions approved before the 20th century, such as the US Constitution—the oldest in the world—consist of very few articles and do not refer to social and economic rights; therefore, it is extremely difficult to use them to derive a list of dimensions of poverty (e.g. Sunstein 2001).
8. For an in-depth discussion of the findings from each source, please see Burchi, Rippin, and Montenegro (2018, forthcoming).
9, This list is based on a combination of monetary and social-rights approaches to poverty. Therefore, the final index contains both income and social indicators. Our list differs slightly from the one provided by CONEVAL, as we specifically adopt the capability approach as the lens through which to analyse countries' constitutions.
10. The use of the ICSECR as a source of an "authoritatively recognized", "legally significant" capability-based list of dimensions of poverty has been suggested by Vizard (2007).
11. For a detailed list of valuable dimensions obtained with the different approaches, see Burchi, Rippin, and Montenegro (2018, forthcoming).
12. Having decent housing, access to water, food and sanitation can be considered indicators of resources, therefore not fully in line with the capability approach. However, as stressed by Alkire (2008), these kinds of indicators can sometimes be used as a proxy for functionings. For example, in the case of housing, Qizilbash (1998, 9) argues: "Houses have the characteristic that they protect us and provide shelter, and this makes our lives go better."
13. However, in many constitutions political participation mainly consists of voting.
14. It is interesting to point out that employment does not appear in the tables of the most valued dimensions in the study by Wisor et al. (2016, 23, Table 5). This is because the study entails two phases. The first phase consists of group discussions, in which participants are asked which dimensions, or areas of life, they think are part of poverty. The main result of this activity is that employment and income are the main dimensions of poverty in almost all the sites. The second phase, instead, consists of group rankings of the most important dimensions identified in the first phase. The researchers decided to eliminate employment and income from the list of dimensions for the group ranking because they are highly correlated with the other dimensions (Wisor et al. 2016). This is why employment, though highly valued by people, is not present in the following tables.
15. Another case is Belgium, where in judgement 36/98 of 1 April 1998 the Constitutional Court subsumed the right to access to drinkable water into Article 23 (Rights to Water and Sanitation 2013).
16. In India, the Supreme Court's judgement in 1999 led to the inclusion of the right to access to water and sanitation as part of the right to life (Article 21 of the Constitution). It stated that "the right to access to clean drinking water is fundamental to life and there is a duty on the state under Article 21to provide clean drinking water to its citizens" (Civil Appeal Nos. 368–373 of 1999).
17. Source: http://www.who.int/water_sanitation_health/publications/factsfigures04/en/.
18. We did not include high-income countries in the sample of countries for the correlation analysis, as the assumption that these indicators can be used as a proxy for health is not realistic for high-income countries—for

which we will not compute poverty measures—where these basic needs are satisfied for almost the entire population.

19. The formal definition of 'unemployed' usually includes being 'able to accept a job'. This last question was asked only in a few surveys and is, thus, not incorporated in the present definition. A person presently not working but awaiting the start of a new job is considered unemployed.

20. The categories are: managers; professionals; technicians and associate professionals; clerical support workers; service and sales workers; skilled agricultural, forestry and fishery workers; craft and related trades workers; plant and machine operators and assemblers; elementary occupations; armed forces occupations; others.

21. In the case where the survey asks only whether a person can read but does not ask if they can write, literacy cannot be determined; thus these are considered missing.

22. For a brief description of the two methods, see Rippin (2017).

23. Please note that Datt (2018, 18) refers to Rippin (2014; 2017) with an incorrect formula for her index.

24. In a recent paper, Alkire and Foster (2016, 2) claim that their M_0 does satisfy the weak form of SIIS. It is obvious why the authors would like their class of poverty measures to satisfy SIIS, since its reasonability in the context of multidimensional poverty measurement is impossible to dismiss. However, it is very easy to see that M_0 does not satisfy SIIS even in its weakest form: due to the dual cut-off method, an inequality-increasing switch that reduces the sum of weighted deprivations of the less poor person below the level of *k* will *always* lead to a decrease in poverty rates, regardless of the relationship between attributes, thereby clearly violating SIIS. For a more detailed discussion of this issue, please refer to Rippin (2017).

25. Namely, United Nations. 2001. *Road map towards the implementation of the United Nations Millennium Declaration. Report of the Secretary-General*. Document A/56/326. New York: United Nations; and UNDP. 2010. *What will it take to achieve the Millennium Development Goals? An international assessment*. New York: United Nations Development Programme.

26. Please note that, unlike Alkire and Foster (2010), we do not make the assumption of equal weights, and we assume that the sum of the weights is 1 instead of *d*. Consequently, our definitions of $g_{ij}^0(k)$and $c_i(k)$ are not the same, and the denominator in (1) is *n* instead of *nd*.

27. Both the headcount $(\tilde{H})$ and the average deprivation share among the poor $(\tilde{A})$ are censored, as they are only calculated for those individuals who are considered poor according to the dual cut-off method—i.e. those whose sum of weighted deprivations is at least *k*.

28. In the case of the MPI, for example, the average poverty intensity must, by definition, be larger than 33 per cent, as any individual whose sum of weighted deprivations is less than 33 per cent will not be considered poor and thus will be disregarded in the poverty calculations.

29. Of course, inequality can be calculated separately for M_0, but this is not the point. The decomposability of poverty measures according to inequality is not only important to receive information about inequality. It is crucial for an inequality measure to *be part of* the poverty measure, as only in this case is it ensured that poverty reduction policies that target the reduction of the poverty measure do not address the least-deprived individuals first (i.e. follow considerations of distributive justice).

30. Please note that g_{ij}^0 and c_i no longer depend on *k*, as the fuzzy identification method is used instead of the dual cut-off method.

31. Please note that the decompositions are no longer censored, as the fuzzy identification method does not disregard any individual that is deprived (though each individual receives a weight according to the severity of their poverty).

32. The full list of surveys used is given in Annex A.

33. For some of the surveys used to generate Figure 3, PovcalNet did not estimate income poverty at the international poverty lines or used other surveys. When information on both income and multidimensional poverty was available for a previous survey in the period 2000–2015 we used this other survey. For 10 countries, such information was not available, and we had to exclude them.

34. The PovcalNet data were downloaded in May 2017.

35. Uzbekistan stands as a clear outlier also when OPHI's MPI is compared with extreme monetary poverty (OPHI 2018).