Oxford Poverty & Human Development Initiative (OPHI)
Oxford Department of International Development
Queen Elizabeth House (QEH), University of Oxford

OPHI WORKING PAPER NO. 82

Multidimensional Poverty Measurement and Analysis: Chapter 1 – Introduction

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December 2014

Abstract

This working paper presents the normative, empirical, and policy motivations for focusing on multidimensional poverty measurement and analysis in general, and one measurement approach in particular. The fundamental normative motivation is to create effective measures that better reflect poor people's experience, so that policies using such measures reduce poverty. Such measures are needed because, empirically, income-poor households are (surprisingly) not well-matched to households carrying other basic deprivations like malnutrition; also the trends of income and non-income deprivations are not matched, and nor does growth ensure the reduction of social deprivations. And, a dashboard overlooks the interconnection between deprivations, which people experience and policies seek to address. Turning to policy, we close by discussing how the Alkire-Foster methodology we present in

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1. Introduction

'I live under the roof of falling tiles.' This self-description of poverty, tucked away in Victor Hugo's *Les misérables*, is by a character called Bossuet, who was, it seems, both merry and unlucky. Yet 'he accepted ill-luck serenely, and smiled at the pin-pricks of destiny like a man who is listening to a good joke. He was poor, but his wallet of good-temper was inexhaustible … When adversity entered his room he bowed to his old acquaintance cordially; he tickled catastrophes in the ribs, and was so familiar with fatality as to call it by a nick-name. These persecutions of fate had rendered him inventive …' (Vol. 2: 136–7).

Hugo's delicate portraits render the 'multidimensionality' of poverty with rather greater colour than economists and statisticians tend to indulge. Yet many of these are converging on a similar assessment. Their characteristically parsimonious description stretches to a mere three words: 'poverty is multidimensional'. Nonetheless this recognition has far-reaching implications for diverse fields of study that intersect with poverty reduction, including our focal area: poverty measurement.

Poverty is a condition in which people are exposed to multiple disadvantages – actual and potential. In Bossuet's case, the disadvantages encompassed homelessness, landlessness, joblessness, and health catastrophes as well as low income. In other cases violence, humiliation, and poor education contribute. Across many developing countries, the pioneering *Voices of the Poor* study, completed shortly before the Millennium, conveyed poor people's own vision of their condition, forcefully delineating its multidimensionality:

> Poverty consists of many interlocked dimensions. [First,] although poverty is rarely about the lack of one thing, the bottom line is lack of food. Second, poverty has important psychological dimensions such as powerlessness, voicelessness, dependency, shame, and humiliation … Third, poor people lack access to basic infrastructure—roads … transportation, and clean water. Fourth … poor people realize that education offers an escape from poverty.… Fifth, poor health and illness are dreaded almost everywhere as a source of destitution. Finally, the poor people rarely speak of income, but focus instead on managing assets—physical, human, social, and environmental—as a way to cope with their vulnerability. In many areas this vulnerability has a gender dimension. (Narayan *et al.* 2000: 4–5).

One great merit of the Millennium Declaration and specifically the Millennium Development Goals has been to flag the multidimensionality of poverty, and incentivize concrete action. A broader view of poverty is also held in Europe, where Nolan and Whelan observed that, 'It can be argued with some force that the underlying notion of poverty that evokes social concern itself is (and has always been) intrinsically multidimensional' (2011: 17). Philosophically, Amartya Sen (2000) observes that 'human lives are battered and diminished in all kinds of different ways'—a situation Wolff and De-Shalit (2007) call 'clustered disadvantage'. Bossuet's phrase about living 'under the roof of falling tiles' thus aptly describes multidimensional poverty, whose protagonists know that, in their condition, multiple disadvantages are going to keep striking, although they may not know which problems will strike when, or how.

In consequence, multidimensional poverty measurement and analysis are evolving rapidly. The field is being carried forward by activists and advocates, by political leaders, firms, and international assemblies, and by work across many disciplines, including quantitative social scientists working in both research and policy. As a contribution to this polycephalous endeavour, this book provides a systematic conceptual, theoretical, and methodological introduction to quantitative multidimensional poverty measurement and analysis.

Our focal methodology, the Alkire–Foster (AF) counting approach, is a straightforward multidimensional extension of the 1984 Foster–Greer–Thorbecke (FGT) approach, which had a significant and lasting impact on income poverty measurement. Although quite recent, this particular methodology of measuring multidimensional poverty has generated some practical interest. For example, estimates of a Multidimensional Poverty Index (MPI) are published and analysed for over 100 developing countries in the United Nations Development Programme's (UNDP) *Human Development Reports*.[1] Governments of countries that include Mexico, Colombia, Bhutan, and the Philippines use official national multidimensional poverty measures that rely on this methodology,[2] and other

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[1] UNDP (2010a); Alkire and Santos (2010, 2014); Alkire, Roche, Santos, and Seth (2011); Alkire, Conconi, and Roche (2013), Alkire et al. (2014a).

[2] See, for example, *Social Indicators*, special issue, 112 (2013); *Journal of Economic Inequality*, 9 (2011); Arndt et al. (2012); Duclos et al. (2013); Ferreira (2011); Ferreira and Lugo (2013); Foster et al. (2010); Ravallion (2011b); Batana (2013); Battiston et al. (2013), Betti et al. (2012); Callander et al. (2012a-d, 2013ab); Cardenas and Carpenter (2013); Castro et al. (2012); Gradín (2013); Larochelle et al. (2014); Mishra and Ray (2013), Nicholas and Ray (2012); Siani (2013), Siegel and Waidler (2012); Callander et al. (2012a, 2012d), Notten and Roelen (2012); Roche (2013); Trani and Cannings (2013), Trani et al. (2013); Alkire and Seth (2013a, 2013b); Azevedo and Robles (2013); Alkire et al. (2013); Beja and Yap (2013); Berenger

regional, national, and subnational measures are in progress.[3] Adaptations of the methodology include the Gross National Happiness Index of the Royal Government of Bhutan (Ura et al. 2012) and the Women's Empowerment in Agriculture Index (Alkire, Conconi and Roche 2013). Academic articles engage, apply, and develop further this methodology as we document in Chapter 5. Thus the book aims to articulate the techniques of multidimensional poverty measurement using the AF methodological approach, and situate these within the wider field of multidimensional poverty analyses, thereby also crystallizing the value-added of an array of alternative approaches.

While subsequent chapters are mainly concerned with quite technical matters, the book keeps a window open to policy. For example, it assesses properties of measures alongside their feasibility (given data constraints), communicability, and policy relevance. Indeed it was Atkinson's (2003) call for policy-relevant, analytically specified multidimensional poverty measures that motivate our own and many other works. And this brings us back to *Les Miserables* one last time.

Hugo's perceptive character sketches did not always step so lightly over poverty's grim despair as the opening quotes suggest. Taken together, his characters were intended to unveil the intricacy of lives affected by misery, to elicit and educate disquiet, and to spur political action. Similarly, while the proximate objective of poverty measurement is rigour and accuracy, an underlying objective must also be to use well-crafted measures to give a different kind of voice to concerns with injustice—to document raw disadvantage, to order complexity, monitor and evaluate advances, and mark routes for tangible policy responses. So without sacrificing rigour, our underlying hope is that as the field of multidimensional poverty measurement advances, both methodologically and practically, it may contribute more effectively to the reduction or eradication of multidimensional poverty.

This chapter presents the motivation for focusing on multidimensional poverty measurement and analysis. Our motivation essentially comes from three sources: normative arguments, empirical evidence, and a policy perspective. We end this chapter by presenting how this book can be used.

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et al. (2013); Foster et al. (2012); Tonmoy (2014); Mitra, Posarac and Vick (2013); Mitra et al. (2013), Nussbaumer et al. (2012); Peichl and Pestel (2013a, 2013b); Siminski and Yerokhin (2012); Smith (2012); Wagle (2014).
[3] CONEVAL (2009, 2010), Angulo et al. (2013), National Statistics Bureau, Royal Government of Bhutan (2014), and Balisacan (2011), respectively.

Normative Motivation

One key motivation for measuring multidimensional poverty is ethical, and that is to improve the fit between the measure and the phenomenon it is supposed to approximate. Poverty measures, to merit the name, must reflect the multifaceted nature of poverty itself. The characteristics poor people associate with poverty have been well documented (Narayan *et al.* 2000; Leavy and Howard 2013, see Table 1, ch. 6), as have the hopes of a million for a fairer world (UNDP 2013). Such insights must affect tools to study poverty. Amartya Sen's quote continues, 'Human lives are battered and diminished in all kinds of different ways, and the first task … is to acknowledge that deprivations of very different kinds have to be accommodated within a general overarching framework' (2000).

Conceptually, many frameworks for multidimensional poverty have been advanced, from Ubuntu (Metz and Gaie 2010) to human rights (CONEVAL 2010), livelihoods (Bowley and Burnett-Hurst 1915) to social inclusion (Atkinson and Marlier 2010), *Buen Vivir* (Hidalgo-Capitán et al. 2014) to basic needs (Hicks and Streeten 1979; Stewart 1985), from the Catholic social teaching (Curran 2002) to social protection (Barrientos 2010 and 2013) to capabilities (Sen 1993; Wolff and De-Shalit 2007), among others. If poverty is understood to be a shortfall from well-being, then it cannot be conceptualized or measured in isolation from some concept of well-being.[4] This is not to say that a fully specified concept of welfare is required to measure poverty, only that these endeavours are inherently connected. Box 1.1 explores options for linking these two concepts.

Box 1.1 Poverty, welfare, and policy

How are poverty and welfare measures linked? Poverty measures could be explicitly linked to particular **functions** of welfare in order to facilitate interpretation.[5] This approach is quite demanding, because a welfare function must be able to make meaningful evaluations at all levels of achievements across all persons, and this requires strong assumptions about the measurement scales of data[6] as well as the functional form. Additionally, there will likely be a plurality of plausible welfare functions. Even if a unique welfare function could be agreed upon, there may be no unique transformation from welfare function to poverty measure.

An alternative way of linking poverty and welfare is to follow a more conceptual approach and consider whether the various trade-offs implied by a poverty measure are broadly consistent with

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[4] Note that when referring to welfare here (and throughout the book) we do not refer to any particular so-called welfare programme, but rather to the concept of well-being. We do so because a body of economic literature developed in the twentieth century, namely 'welfare economics', is a conversation partner for multidimensional poverty measurement (Atkinson 2003).

[5] For example, the Watts unidimensional poverty measure is related to the geometric mean—one of Atkinson's social welfare functions. See Alkire and Foster (2011b); cf. Foster et al. (2013).

[6] See section 6.3.7 and section 2.3.

some underlying notion of social welfare. This is indeed a reasonable route, but one whose conclusions are often ignored in practice. For example, the so-called headcount ratio, which is simply the proportion of people considered poor in a population, is the most commonly used measure in traditional poverty measurement exercises (income approach) as well as in the basic needs tradition (direct approach). However, such a measure has the interesting property that a decrease of any size in the income (or unmet basic needs) of a poor person paired with a corresponding increase for a non-poor person will leave poverty unchanged. This, of course, is rather untenable from many welfare perspectives. Likewise, a decrease in the income of a poor person (no matter how large the decrease) paired with an increase in the income of another poor person sufficient to lift that person to the poverty line income (no matter how small the increase) will decrease poverty. Again, this would appear to be inconsistent with any reasonable welfare function censored at the poverty line.

Note, though, that the fact that these trade-offs are not justified in welfare terms has not forced the removal of the headcount ratio income poverty measure from consideration. This brings us to the third consideration of policy. For in fact other considerations also apply—such as comprehensibility, which a measure needs in order to advance welfare in practice. The level and composition of poverty must be communicated relatively accurately to journalists, non-specialist decision-makers, activists, and disadvantaged communities to motivate action. The headcount ratio is a remarkably intuitive, if somewhat crude, measure that takes the identification process very seriously and reports a meaningful number: the incidence of poverty. The fact that it is at odds with notions of welfare appears to be of second-order importance, because users have not found a comparably meaningful number with better welfare properties to highlight as the 'headline' statistic. So the welfare implications of poverty measures need to be considered *alongside* political economy and operational considerations of such measures, such as their communicability. We adopt this wider approach—which considers properties of measures alongside their truthfulness, ease of understanding, and policy salience—and understand such a wider set of considerations to be consistent with Sen's capability approach which we discuss subsequently.[7]

Multiple concepts of poverty will continue to be used to inform multidimensional poverty design.[8] The remainder of this section as well as parts of Chapter 6 illustrate how such concepts inform measurement, by drawing upon one particular approach: Amartya Sen's *capability approach*. The capability approach has been key in prompting a 'fundamental reconsideration of the concepts of poverty' (Jenkins and Micklewright 2007: 9), particularly in economics broadly conceived. Building upon line of reflection advanced by Aristotle, Adam Smith, Karl Marx, John Stuart Mill, and John Hicks, the capability approach sees human progress, ultimately, as 'the progress of human freedom and capability to lead the kind of lives that people have reason to value' (Drèze and Sen 2013: 43).

Sen argues that well-being should be defined and assessed in terms of the *functionings* and *capabilities* people enjoy. Functionings are beings and doings that people value and have reason to value, and capabilities represent 'the various combinations of functionings …

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[7] Such considerations also pertain to measures of welfare and inequality (section 6.2).
[8] Ruggeri-Laderchi, Saith, and Stewart (2003), Deutsch and Silber (2005, 2008).

that the person can achieve' (Sen 1992: 40). In *The Idea of Justice*, Sen describes them thus: 'The various attainments in human functioning that we may value are very diverse, varying from being well nourished or avoiding premature mortality to taking part in the life of the community and developing the skill to pursue one's work-related plans and ambitions. The capability that we are concerned with is our ability to achieve various combinations of functionings that we can compare and judge against each other in terms of what we have reason to value' (Sen 2009: 233).

Assessing progress in terms of valuable freedoms and capabilities has implications for measurement. All multidimensional measures need to define the focal space of measurement. Whereas economics assessed well-being in the space of utility, and latterly of resources, the capability perspective—in line with human rights approaches—defines and in some cases measures well-being in capability space. Capabilities are defined to have *intrinsic* value as well as *instrumental* value—to be ends rather than merely means. Hence, the capability approach 'proposes a serious departure from concentrating on the *means* of living to the *actual opportunities* of living' (Sen 2009: 233).

Moving now to poverty, Sen argues that poverty should be seen as capability deprivation (Sen 1992, 1997, 1999, 2009—Box 1.2 presents a succinct overview of related considerations). Defining poverty in the space of capabilities (as Sen does) has multiple implications for measurement. The first is *multidimensionality*: 'the capability approach is concerned with a plurality of different features of our lives and concerns' (2009: 233). This plurality applies also to poverty measurement: 'The need for a multidimensional view of poverty and deprivation guides the search for an adequate indicator of human poverty' (Anand and Sen 1997).

Box 1.2 Capabilities, Resources and Utility

Sen's capability approach comprises opportunity freedoms, evaluated in the space of capabilities and functionings, as defined just above, and process freedoms, ranging from individual agency to democratic and systemic freedoms. This box reviews the value-added of capabilities in comparison with a focus on resources or utility.[9]

Sen proposes that poverty should be considered in the space of capability and functionings (they

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[9] For introductions to Sen's capability approach see Sen (1999), Atkinson (1999), Alkire (2002), Anand (2008), Alkire and Deneulin (2009), Basu and López-Calva (2010), and Nussbaum (2011) among many others.

are the same space), rather than in the space of income or resources, Rawlsian primary goods, utility, or happiness. Sen has persuasively set out the advantages of doing so—rather than measuring poverty in the space of resources or utility—along the following lines.[10]

The traditional approach to measuring poverty focuses on the **resources** people command. The most common resource measures by far are monetary indicators of income or consumption. In some approaches resources are extended to include social primary goods.[11]

While resources are clearly vital and essential instruments for moving out of poverty, Sen's and others' arguments against measuring resources alone continue to be relevant.[12] First, many resources are not intrinsically valuable; they are instrumental to other objectives. Yet, '[t]he value of the living standard lies in the living, and not in the possessing of commodities, which has derivative and varying relevance' (Sen 1987). This would not be problematic if resources were a perfect proxy for intrinsically valuable activities or states. But people's ability to convert resources into a valuable functioning (personally and within different societies) actually varies in important ways. Two people might each enjoy the same quality and quantity of food every day. But if one is sedentary and the other a labourer, or one is elderly and one is pregnant, their nutritional status from the same food basket is likely to diverge significantly. Functionings such as nutritional status provide direct information on well-being. This remains particularly relevant in cases of disability. Also, while resources appear to refrain from value judgements or a 'comprehensive moral doctrine' (Rawls 1993), the choice of a precise set of resources is not value-free.

Although resources may not be sufficient to assess poverty, *indicators* of resources—of time, of money, or of particular resources such as drinking water, electricity, and housing—remain important and are often used to proxy functionings (at times adjusted for some interpersonal variations in the conversion of resources into functionings) and to investigate capability constraints (Kuklys 2005, Zaidi and Burchardt 2005). Thus a conceptual focus on capability poverty may still employ information on resources, alongside other information.

Utility, happiness, and subjective well-being form another and increasingly visible source of data and discussion on many topics, including poverty.[13] The welfare economics advanced by Bentham, Mill, Edgeworth, Sidgwick, Marshall, and Pigou relied on a utilitarian approach. Sen criticized the regnant version of utilitarianism in economics for relying solely upon utility information (rather than seeing well-being more fully), for focusing on average utility, ignoring its distribution, and for ignoring process freedoms. These criticisms were powerful because, as Sen observed, 'utilitarianism was for a very long time the "official" theory of welfare economics in a thoroughly unique way' (2008).

Taking psychic utility as a sufficient measure of well-being (and its absence to measure poverty) has practical problems for poverty measurement. Sen observed that happiness could reflect poor people's ability to adapt their preferences to long-term hardships. Adaptive preferences may affect 'oppressed minorities in intolerant communities, sweated workers in exploitative industrial arrangements, precarious share-croppers living in a world of uncertainty, or subdued housewives in deeply sexist cultures'. The measurement issue is that these people may (rather impressively), 'train themselves to take pleasure in small mercies'. This could mean that their happiness metrics would not proxy capabilities and functionings: 'In terms of pleasure or desire-fulfilment, the disadvantages of the hopeless underdog may thus appear to be much smaller than what would emerge on the basis of a more objective analysis of the extent of their deprivation and unfreedom' (2009: 283).[14]

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[10] A recent treatment is in Sen (2009: chs 11–13).

[11] Rawls (1971, 1993); Rawls and Kelly (2001). For a very useful update of the capability approach vs social primary goods, see Brighouse and Robeyns (2010).

[12] These arguments appear, for example, in Sen (1984, 1985, 1987, 1992, 1993, 1999).

[13] The literature is vast: see Layard (2005); Fleurbaey (2006b).

[14] On adaptation, see also Burchardt (2009) and Clark (2012).

Recent empirical research on happiness has enriched the field of measurement, and Sen's work developed accordingly. Put simply, he argues that happiness is clearly 'a momentous achievement in itself'—but not the only one.

Happiness, important as it is, can hardly be the only thing that we have reason to value, nor the only metric for measuring other things that we value. But when being happy is not given such an imperialist role, it can, with good reason, be seen as a very important human functioning, among others. The capability to be happy is, similarly, a major aspect of the freedom that we have good reason to value (2009: 276).

This discussion is of direct relevance to measures of well-being, perhaps more so than poverty measurement. For example, the Stiglitz–Sen–Fitoussi Commission Report (2009) included subjective well-being as one of the eight dimensions of quality of life proposed for consideration.

While a complete analysis of poverty and well-being requires insights on people's resources and psychological states as well as their functionings and capabilities, the oversights that purely resource-based or purely subjective measures have for such analyses remain salient, and will be further discussed in Chapter 6.

A second salient implication of viewing multidimensional poverty as deprivations in valuable capabilities is that *value judgements* are required—for example, in order to select which dimensions and indicators of poverty to use, how much weight to place on each one, and what constitutes a deprivation. By facing ethical value judgements squarely, rather than confining attention to technical matters, the capability approach has at times created consternation among quantitative social scientists. Sen reassures readers that addressing such value judgements is not an insurmountable task: 'the presence of non-commensurable results only indicates that the choice-decisions will not be trivial (reducible just to counting what is "more" and what is "less"), but it does not at all indicate that it is impossible—or even that it must always be particularly difficult' (2009: 241). Chapter 6 points out some practical ways forward.

These value judgements are to reflect capabilities that people value and have reason to value. This has implications for the *processes* of measurement design. In order to reflect people's values, such judgements might be made through participatory or deliberative processes, perhaps supplemented by other inputs to guard against distortions (Wolff and De-Shalit 2007). At a minimum, Sen has argued, the final decisions should be transparent and informed by public debate and reasoning: 'The connection between public reasoning and the choice and weighting of capabilities in social assessment is important to emphasise' (2009: 242).

Another critical issue is how to reflect the freedom aspect of capabilities. For example, in selecting the indicators of capability poverty it is normally more possible to measure or proxy achieved functionings than capabilities (opportunity freedoms). While initially this was considered a severe shortcoming there are also well-developed arguments for doing

so. For example, Fleurbaey (2006b) observes that group differences in functionings may suggest inequalities in capabilities (cf. Drèze and Sen 2013). Also, functionings may be particularly relevant for some people such as small children and those with intellectual disabilities. Measuring capabilities could require counterfactual information on 'roads not chosen', and may depend in part on families and social forces, both of which complicate the empirical task.[15] However, Chapter 6 suggests conditions under which a multidimensional poverty measure using functionings data may be interpreted as a measure of capability deprivation or unfreedom (Alkire and Foster 2007). So, multiple empirical routes to considering freedom may be explored.

Using the capability approach to motivate poverty measurement also draws attention to aspects beyond capability deprivations such as agency and process freedoms, and plural principles (Sen 1985, 2002). For example, the capability approach sees poor people as actors, so poverty measurement must be compatible with, if not actively facilitate, their agency in their own lives as well as in the struggle against poverty. An example of plural principles is how Sen urges a reformulation of *sustainable development*, so that the environment is not only valued as a means to human survival (although it is that) but also as a location of beauty, of commitment, and of responsibility to future generations and to other life forms (2009: 251–2).

In sum, as we stated earlier, multidimensional poverty measurement engages, fundamentally, a normative motivation that is shared across a wide range of conceptual frameworks. The capability approach is a prominent framework among them. Considering multidimensional poverty to be capability deprivation has a number of implications for measurement, which we have sketched here.

1.2. Empirical Motivations

We now turn to consider various empirical arguments why poverty measurement should be multidimensional. Nolan and Whelan (2011), observing the rise of multidimensional approaches in Europe, observe three reasons that non-monetary as well as monetary indicators have come to be used: meaning, identification, and multidimensionality. The first observes that non-monetary deprivations 'play a central role in capturing and conveying the realities of the experience of poverty, bringing out concretely and graphically what it *means* to be poor' (2011: 16). Non-monetary indicators may also

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[15] See Fleurbaey (2006a) and Robeyns and van der Veen (2007).

improve identification in two ways. One is by helping 'in arriving at [and justifying] the most appropriate income threshold'. Second, empirical studies motivated a critique that low income, surprisingly, 'fails in practice to identify those unable to participate in their societies due to lack of resources' (2011: 16), and that non-monetary deprivation indicators were more reliable tools for identification. This may be due to differences in people's different abilities to convert income into resource-based outcomes, or due to challenges such as equivalence scales. In the third situation, poverty itself is defined as multidimensional, and measured directly using multiple indicators.

Nolan and Whelan very helpfully observe that in all three of these cases, and particularly the last, 'The need for a multidimensional measurement approach in identifying the poor/excluded is an *empirical* matter, rather than something one can simply read off from the multidimensional nature of the concepts themselves'. If, for example, poverty were defined as multidimensional but any single indicator, including household income, were sufficient to identify the poor and measure the level and trends of poverty in a society (including 'those other dimensions of deprivation and exclusion', p. 19), a multidimensional methodology would not be required for poverty measurement.

We explore whether various unidimensional measures accurately reflect the level and trend of multidimensional poverty and related questions. We first probe whether monetary poverty measures can be assumed to be a sufficient proxy to identify who is poor and proxy the level and trends of other dimensions of poverty. As evidence indicates this is not the case, we then ask whether some non-monetary indicator can play that role but again find large mismatches. So we enquire whether a single policy lever, such as GDP growth, has been shown to be sufficient to reduce poverty in its many dimensions, and again find a negative answer. Finally, we observe that a dashboard of single indicators overlooks clustered disadvantages, and that monetary measures do not necessarily identify the same group of people as poor in comparison with multidimensional measures. These reasons thus also point out the need for multidimensional poverty measures that reflect the joint distribution of disadvantages.

1.2.1   Monetary vs. Non-Monetary Household Deprivations

The prominent focus on income poverty reduction is built on the implicit assumption that monetary poverty measures adequately identify who is poor.[16] Yet an increasing empirical literature documents a mismatch between monetary and non-monetary deprivations. This leads to analysts to ask, 'what is the relationship between deprivation indicators and household income, how is that to be interpreted, and what conclusions can be drawn?' (Nolan and Whelan 2011: 31).

As we survey extensively in Chapter 4, in both Europe and developing countries, studies since the early 1980s have repeatedly documented the fact that income or consumption poverty measures identify different people as poor than other deprivation indicators.[17] Kaztman (1989) found that 13% of households in Montevideo, Uruguay, were income poor but did not experience unsatisfied basic needs, whereas 7.5% were in the opposite case. Ruggeri Laderchi (1997) concluded on the basis of Chilean data that 'income in itself is not … conveying all of the information of interest if the aim is to provide a comprehensive picture of poverty'. Franco (2002) found that 53% of malnourished Indian children in that study did not live in income-poor households and 53% of the children living in income-poor households were not malnourished. Bradshaw and Finch (2003) find that when 17–20% of people are income poor, and subjective poor, and materially deprived, only 5.7% of the population experience all three dimensions, leading them to conclude that 'it is not safe to rely on one measure of poverty—the results obtained are just not reliable enough'. Across nine European countries, Whelan, Layte, and Maître (2004) used panel data to compare the persistently income poor and the persistently materially deprived, and found that roughly 20% of people were persistently poor by each measure but only 9.7% were poor according to both measures. These and many other empirical studies show that in many cases there are large mismatches between income poverty and deprivations in other indicators: income does not accurately proxy non-monetary deprivations.

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[16] This assumption was supported by the evidence of association across national aggregates. For example, McGillivray (1991) referred to the Human Development Index (HDI) as 'redundant' based on the strong positive correlations that existed between the HDI and GNP per capita as well as between GNP per capita and other components indicators of the HDI.

[17] See Ruggeri Laderchi (1997); Klasen (2008); Whelan, Layte, and Maître (2004); Bradshaw and Finch (2003); Wolff and De-Shalit (2007); Nolan and Whelan (2011).

1.2.2   Trends in Monetary Poverty vs Trends in Non-Monetary Deprivations

But it may be that while the details differ, a decrease in income poverty heralds a decrease in other indicators also—that the trends will be similar. Yet using all presently available data across developing countries, there does not appear to be a high association when the *progress* shown in different indicators is compared."

Figure 1.1 Scatter plots comparing cross-country reductions in income poverty to progress in other MDG indicators
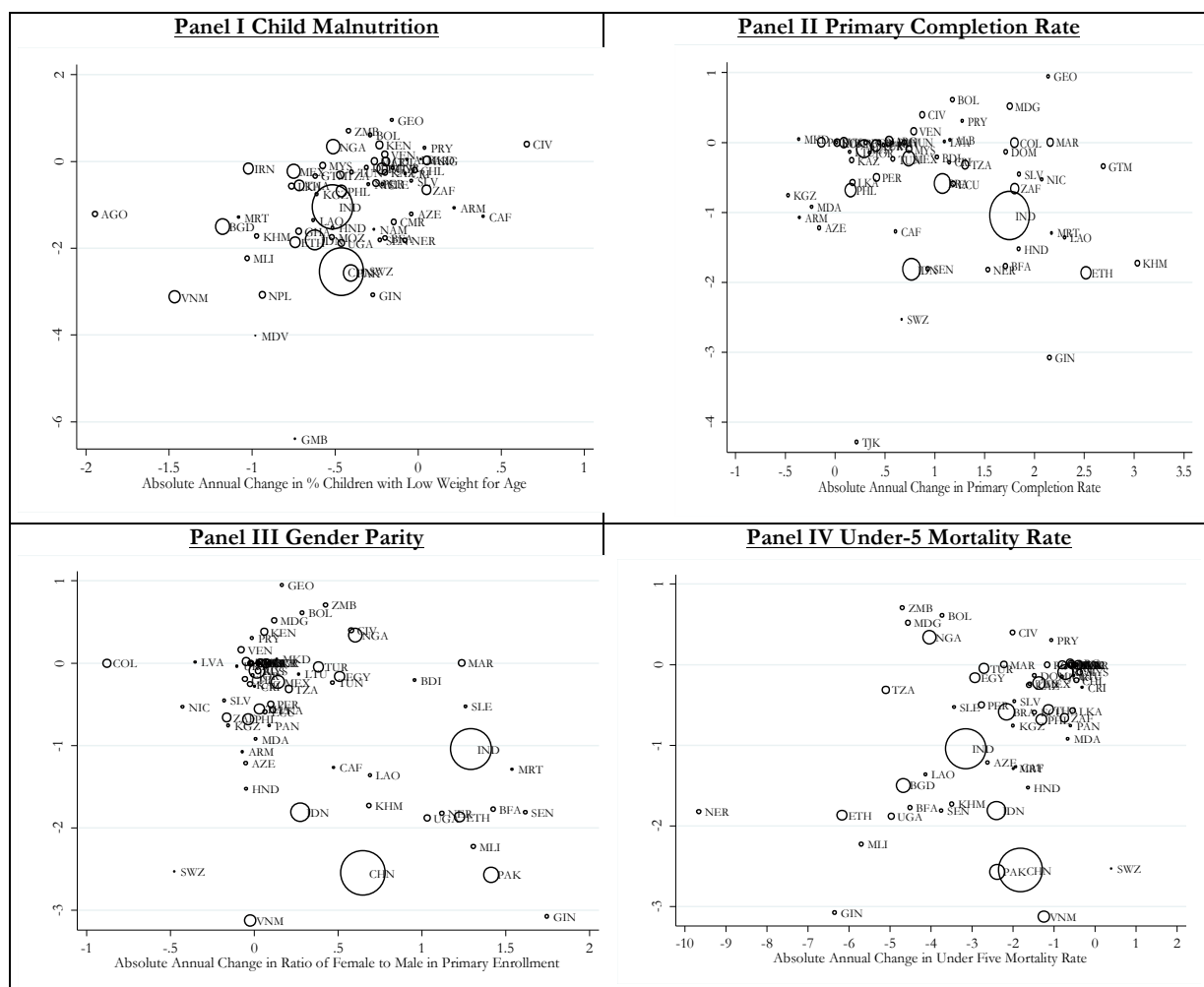
Source: Authors' elaboration using World Development Indicators (World Bank) 1990–2012.

Motivated by Bourguignon et al. (2010), we performed a very similar exercise using national aggregate data from 1990–2012.[18] Figure 1.1 depicts the association between the change in $1.25/day income poverty and the change in some non-income Millennium Development Goal (MDG) indicators, namely, the prevalence of underweight children, primary school completion rate, the ratio of female to male primary school enrolment, and under-five mortality during this period. The size of the bubble represents the

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[18] These results were completed by the authors with Mihika Chatterjee.

population size in the year 2000 (UN 2011).[19] Progress in these four indicators is not strongly associated with progress in $1.25/day income poverty reduction.[20]

To cross-check this finding, we investigate a raft of recent studies considering country trajectories in meeting the MDGs.[21] Figure 1.2 presents the share of countries that have met different MDG targets at the national level, where it is evident that although a number of countries have met the goal of extreme poverty reduction in terms of $1.25/day, these countries have largely failed to meet the goals in many non-income indicators. The emerging conclusion is that meeting the goal of income poverty reduction does not ensure reducing deprivations in non-income indicators.[22]

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[19] Given a variable y, observed in two time periods t^1 and t^2, the annual absolute growth rate is computed as $\left(y^2 - y^1 \right) / \left(t^2 - t^1 \right)$. In each case we consider countries satisfying the following requirements: (a) their initial observation was between 1990 and 2000, and there was a period of at least five years to the latest observation available; and (b) the distance between the initial observation in the considered non-income MDG indicator and the initial observation in $1.25/day poverty was not more than five years apart, and the same for the final observation. This allowed us to use sixty-three countries for underweight children, sixty for primary school completion rate, sixty-eight for female to male ratio in primary school enrolment, and sixty-three for under-five mortality rate.

[20] In order to show the strength of the association, we compute the Pearson's correlation coefficients between the changes in $1.25/day poverty and the changes of each non-monetary deprivation presented in Panels I–IV. The Pearson's correlation coefficients are only 0.40, -0.15, -0.46, and 0.37 for Panels I–IV respectively. Given the non-linear relationships in the scatter plots, we also compute the Spearman and Kendall's rank correlation coefficients. The Spearman's coefficient relaxes the non-normality assumption and Kendall's coefficient is a non-parametric estimate of correlation. The Spearman's coefficients for the four plots are 0.44, -0.16, -0.25, and 0.35, respectively; whereas Kendall's coefficients for the four plots are 0.30, -0.10, -0.17, and 0.26 respectively. For mathematical construction of Spearman's and Kendall's coefficients, see the discussions on section 8.1.2.

[21] World Bank (2013).

[22] Unfortunately as Figure 1.2 implies, MDG monitoring reports tend to count countries, not people. This convention implicitly considers the life of one person in a small country like Maldives to be thousands of times more important than the life of a person in India. From a human rights perspective this could hardly be acceptable.

Figure 1.2 Progress in different MDGs across countries
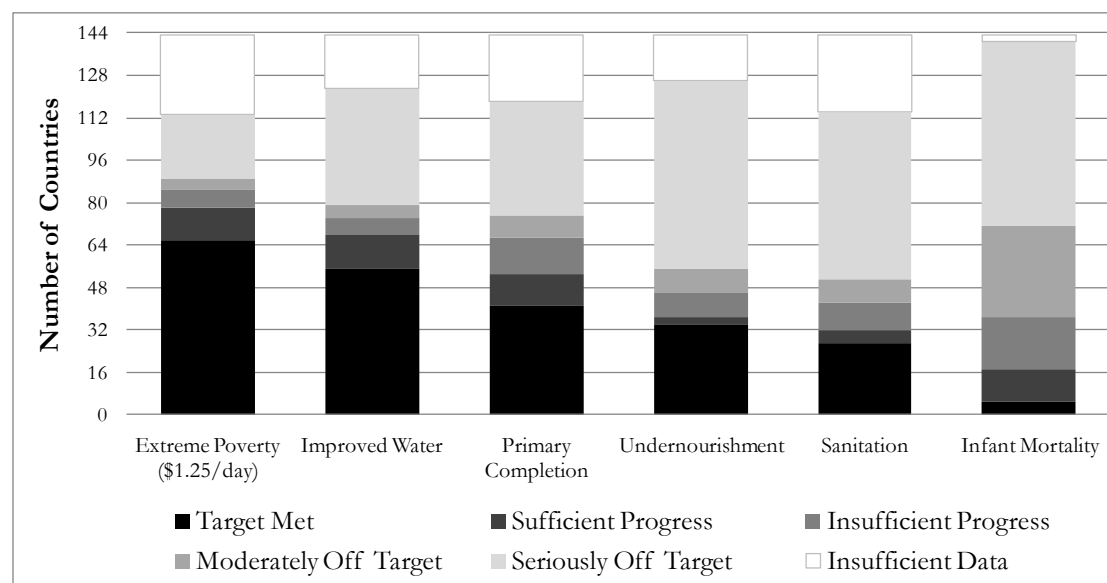
Source: *Global Monitoring Report 2013* (World Bank 2013). The data were downloaded from <http://data.worldbank.org/mdgs/progress-status-across-groups-number-of-countries>, accessed on 1 April 2014.

These two examples clearly suggest, as Bourguignon et al. (2010) concluded, that income poverty trends do not proxy trends in the reduction of non-income deprivations. The evidence and literature reviewed in this and the previous section suggest that whether information on multidimensional poverty levels or trends is required, or policy impacts on poverty are to be measured, income poverty measures must be complemented by measures reflecting other dimensions of poverty.

1.2.3   Associations across Non-Monetary Deprivations

If consumption and income do not map multidimensional poverty, perhaps another indicator could be identified that was highly associated in level and trend with deprivations in other non-monetary dimensions. Such a headline indicator could summarize progress in non-income spheres. Indicators like girls' education or malnutrition are often heralded as general-purpose measures. Yet to date, systematic cross-tabulations of deprivations or assessments of redundancy, which will be introduced in section 7.3, have not identified a bellwether indicator.

To give one example of one variable pair for one country, data from the National Family Survey 2005–6 of India shows that around 18% of the population live in a household in which no member has completed five years of schooling and, in 21% of the population, a child is not attending school up to the age at which he or she would complete class 10. With these two educational indicators, one might expect a high association, as educated

families should send their children to school. But only 7.4% of households experience both deprivations whereas 13.6% and 10.6% are deprived in one indicator but not in the other. This situation can be summarized by a simple cross-tabulation presented in Table 1.1 (section 2.2.3 discusses such tables containing joint distribution of deprivations).

Table 1.1 Cross-tabulation of deprivations in two indicators

		All Members Completed Five Years of Schooling		
		Yes	No	**Total**
All Children Attending School	Yes	68.4%	13.6%	**82%**
	No	10.6%	7.4%	**18%**
	Total	**79%**	**21%**	**100%**

This type of mismatch is repeated throughout many countries. In fact, we did a simple exercise using a sample of seventy-five developing countries and using the six of the ten indicators that form the Global Multidimensional Poverty Index (MPI).[23] We computed the proportion of people in these seventy-five countries who are deprived in each of the six indicators and report these in the second column and the second row of Table 1.2. The remaining entries show the proportion of the population who are simultaneously deprived in each pair of these indicators.[24] For example, 17.7% of the population live in households deprived in years of schooling and 19.3% of the population live in households where at least one school-aged child does not attend school. However, only 7.3% of the population live in households that are deprived in both indicators. This information thus summarizes the cross-tabulation between these two indicators as in Table 1.1 (but now using the population of all seventy-five countries).

Table 1.2 Average deprivation in pairwise indicators across seventy-five developing countries

		Years of Schooling	School Attendance	Child Mortality	Under-nutrition	Improved Drinking Water
Population Deprived in Indicator		**17.70%**	**19.30%**	**25.10%**	**31.80%**	**22.00%**
		Percentage of Population Simultaneously Deprived in the Column and Row Indicators				
School Attendance	**19.30%**	7.30%				
Child Mortality	**25.10%**	6.20%	8.20%			

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[23] We use countries for which information on all indicators is available for the global MPI 2014 (Alkire et al. 2014a).

[24] We use population-weighted country averages while computing the overall deprivation in each indicator as well as simultaneously deprivations in each pair of indicators.

Undernutrition	**31.80%**	7.80%	9.60%	11.40%	
Improved Drinking Water	**22.00%**	6.50%	6.50%	7.70%	8.10%
Asset Ownership	**35.20%**	12.50%	10.70%	11.40%	16.20%	11.80%

Overall, we find that the proportion of people in households with deprivation in these six indicators ranges from 17.7% to 35.2%, and deprivations in *both* indicators in each pair ranges from 6% to 16.2%. The size of the mismatch (i.e. the proportion of people in households with one deprivation but not the other) can be large. The highest match in this pair is between asset ownership and undernutrition – which match in just over half of the people; otherwise the matches are lower. Thus it is clearly not possible to infer deprivation in one indicator by observing deprivation in another.[25] If, as it seems, no single non-income deprivation reflects all others; multidimensional measures and analyses are required to make visible the highly differentiated profiles of interconnected deprivations that poor people experience.

1.2.4   Economic Growth and Social Indicators

Perhaps then we should move back from single indicators of human lives to more general-purpose indicators like economic growth, and ask whether growth in Gross National Income catalyzes reductions in various deprivations. This question coheres with a sentiment that growth clearly matters greatly—but growth *of what?*[26] Is it growth of average income or growth of incomes of the bottom 40%—or is it inclusive growth that reduces non-income dimensions? Despite differing ideological perspectives on this question, the question of how growth is associated with trends in non-income deprivations is fundamentally an empirical question, and one on which more data are available now than previously.

Drèze and Sen's *Uncertain Glory* (2013) provides a meticulous yet rousing documentation of the empirical disjunction between growth and progress in social indicators in India. After noting the environmental damage that accompanied India's growth, Drèze and Sen argue that 'the achievement of high growth—even high levels of *sustainable* growth— must ultimately be judged in terms of the impact of that economic growth on the lives and freedoms of the people' (2013: vii). And it is no mystery that this impact depends on

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[25] Chapter 7 presents measures of association and overlap between deprivations, and proposes a redundancy measure that is related to this table.
[26] Drèze and Sen (2013), Foster and Székely (2008), and Ravallion (2001).

public action: 'It is not only that the new income generated by economic growth has been very unequally shared, but also that the resources newly created have not been utilized adequately to relieve the gigantic deprivations of the underdogs of society' (p. 9).

Table 1.3 Comparison of India's performance with Bangladesh and Nepal

	Year	India	Bangladesh	Nepal
GDP per capita (PPP, constant 2005 international $)	1990	1,193	741	716
	2011	3,203	1,569	1,106
	Growth (p.a.)	*4.8%*	*3.6%*	*2.1%*
Under-Five Mortality Rate (per 1,000)	1990	114	139	135
	2011	61	46	48
	Change	*-53*	*-93*	*-87*
Maternal Mortality Ratio (per 100,000)	1990	600	800	770
	2010	200	240	170
	Change	*-400*	*-560*	*-600*
Infant Immunization (DPT) (%)	1990	59	64	44
	2011	72	96	92
	Change	*13%*	*32%*	*48%*
Female Literacy Rate, Age 15–24 Years (%)	1990	49	38	33
	2010	74	78	78
	Change	*25%*	*40%*	*45%*

Source: Drèze and Sen (2013) and World Bank Data Online accessed at
<http://data.worldbank.org/indicator>

As a concrete example, they compare India's advances in growth and social indicators 1990–2011 with those of Bangladesh and find that India's per capita GDP growth was much larger than that of Bangladesh between 1990 and 2011, and by 2011 its per capita GDP was about double that of Bangladesh. Yet Bangladesh, during the same period, has overtaken India in terms of a wide range of basic social indicators. In Table 1.3, we present India's performance, as well Bangladesh's and Nepal's, in GDP and certain not-income indicators. It is clear that India's GDP per capita was already much higher in 1990 and, because of a much higher growth rate, India became richer. However, India's improvements in some of the crucial selected non-income indicators have been much slower for the same period than both Bangladesh and Nepal.[27]

Looking internationally, other studies also did not find a strong association between economic growth and progress in non-income social indicators. For example, analysing the cross-country data from 1990–2008, Bourguignon et al. (2008, 2010) found a strong relation between economic growth and income poverty reduction. They found, however, 'little or no correlation' between growth and the non-income MDGs:

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[27] Nepal's strong reduction of multidimensional poverty is analysed in Section 9.2.

> The correlation between growth in GDP per capita and improvements in non-income MDGs is practically zero … [thereby confirming] the lack of a relationship between those indicators and poverty reduction … This interesting finding suggests that economic growth is not sufficient per se to generate progress in nonincome MDGs. Sectoral policies and other factors or circumstances presumably matter as much as growth.

1.2.5 The Value-Added of Joint Distribution of Deprivations: Clustering and Identification

If income poverty measures, and indeed any single non-income indicator, fail to predict the levels and trends of other deprivations, wouldn't a dashboard of indicators be sufficient? We address this question precisely in section 3.1 and observe that while dashboards will always be used, they fall short in key ways. Leaving aside other disadvantages, the fundamental reason is that they ignore what we call the 'joint distribution of deprivations', namely, that there are people who experience simultaneous deprivations.

To clarify the point, consider the case of Brazil between 1995 and 2006 (Figure 1.3). Panel I presents the percentage of the population deprived in six indicators in 1995 and 2006. The indicators were typically considered in the unsatisfied basic needs approach in Latin America. Note that all deprivation rates decreased over this period. For example, the percentage of the population living in households with incomes less than $2/day was reduced from 29% in 1995 to 13% in 2006. Panel B presents distinctive and important information that is *not possible* to infer from Panel A. Specifically, we see that in 1995, 28% of the population lived in households with just one deprivation, 21% in households with two deprivations, and so on. In 2006, the joint distribution of deprivations had improved. In fact, joint deprivations in two or more indicators went down, and the proportion of the population in households with just one deprivation increased to 32%. Tellingly, if we were only to make a conclusion based on a dashboard of indicators, we would have missed this information on the *multiplicity* of deprivations experienced. Thus, the consideration of joint distribution is crucial. But does it affect the *identification* of who is poor also?

Figure 1.3 The importance of understanding joint distribution of deprivations in Brazil
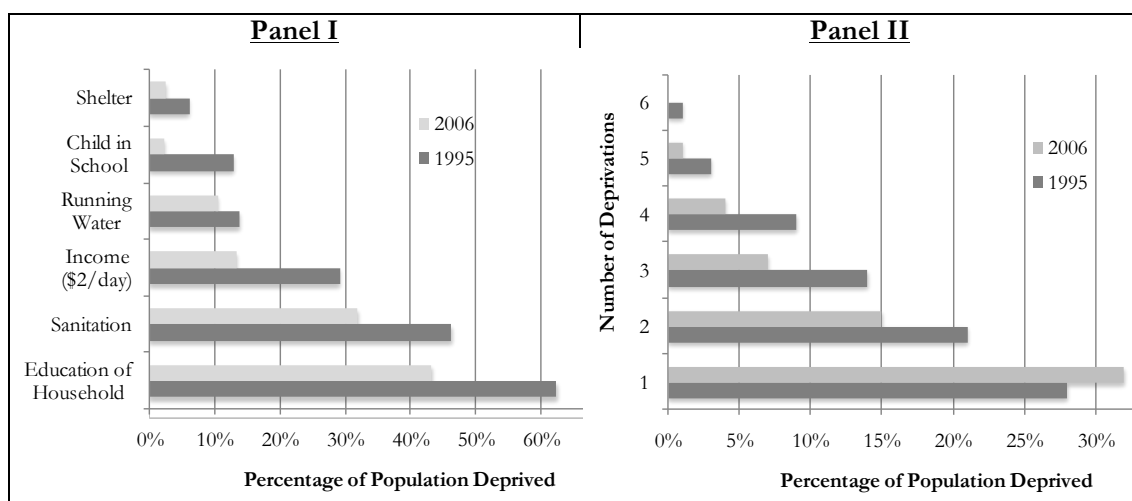
Source: Battiston et al. (2013).

We have already discussed evidence that income poverty is not necessarily associated with deprivations in other dimensions. Does this disjunction vanish when income or consumption poverty is compared to multidimensional poverty measures accounting for simultaneous deprivations? Or do both identify the same people as poor? Surprisingly, mismatches remain high. Klasen (2000: table 10) found large mismatches between income and multiple deprivations in South Africa. For example, when 20.3% of the population (7.7 million people) were identified as severely income poor, and 20.3% identified (7.7 million) as severely multiply deprived, only 2.9% of the population—1.1 million people—were *both* severely income poor and severely deprived. Moving to Bhutan, its official MPI and income poverty measure are both drawn from the same 2012 Bhutan Living Standards Survey dataset. About 12% of the population were income poor, and 12.7% of people were multidimensionally poor. Yet merely 3.2% of Bhutanese experienced both income and multidimensional poverty (National Statistics Bureau, Royal Government of Bhutan 2014).[28] Similarly high mismatches were found in studies using thirteen databases in eleven countries (Alkire and Klasen 2013).

And likewise in Europe—Nolan and Whelan list twenty-six European countries, and in none of them were more than half of the income-poor or materially deprived populations poor by both indicators, and in twelve countries less than one-third of the income poor also experienced deprivation (2011: table 6.2). Hence monetary measures

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[28] As we discuss in Chapter 7, this disjunction requires further research to ascertain the extent to which it might be influenced by survey issues such as the short recall period for consumption data.

do not necessarily identify the same group of people to be poor as multidimensional measures do.

1.2.6   Data and Computational Technologies

The measurement of multidimensional poverty reflecting the joint distribution of deprivations requires data to be available for the same unit of analysis in all dimensions. However, data on poverty are severely limited in coverage and frequency. While stock market data are available hourly, labour force surveys may be quarterly, and GNI data are annual, poverty data are often only available every three to ten years. The High Level Panel (2013) rightly demanded a 'data revolution'. Given a data deluge in many domains, the lack of up-to-date information on—and across—key dimensions of poverty like health, nutrition, work, wealth, and skills (as well as violence, decent work, and empowerment) has been rightly recognized as a travesty.[29] Such data is needed to design high-impact interventions and evaluate policy success.

Figure 1.4 Availability of developing country surveys: DHS, MICS, LSMS, and CWIQ
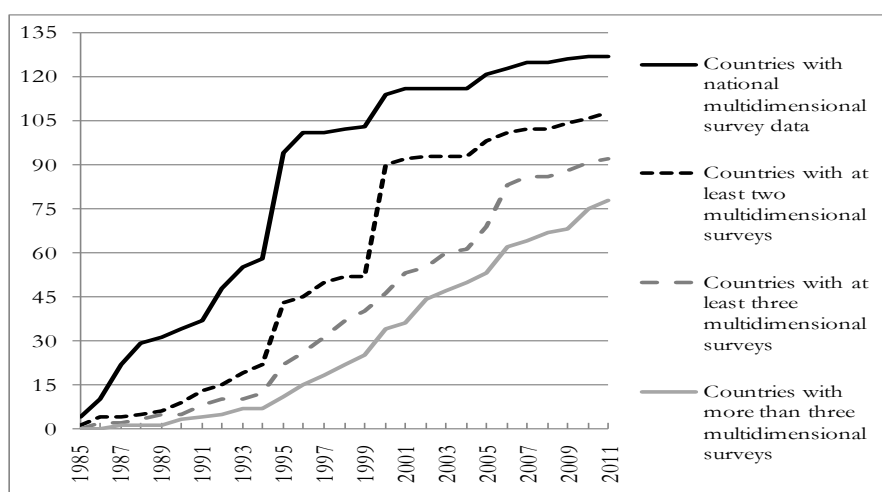
What is less recognized is that data on multidimensional poverty are already on the upswing (Alkire 2014). Much of the increase is occurring in national surveys. More easy to systematize are internationally comparable surveys, which may have a similar trend. For example, non-income MDG indicators are often drawn from four international household surveys: the Demographic and Health Survey (DHS), the Multiple Indicator Cluster Survey (MICS), the Living Standard Measurement Survey (LSMS), and the Core

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[29] For example, the splendid Demographic and Health Surveys (DHS) have been updated every 5.88 years across all countries that have ever updated them (across a total of 155 'gaps' between DHS surveys). If we drop all incidents where ten or more years have passed between DHS surveys, the average falls only to 5.31 years (Alkire 2013).

Welfare Indicators Questionnaire (CWIQ). Figure 1.4 shows that the number of countries which have fielded at least one of these surveys increased from five in 1985—the first year in which any was fielded—to 127 countries in 2010. By 2011, around ninety countries had completed at least three surveys. In Europe, a similar increase in household and registry data, and in harmonized data, has increased. For example, the EU-SILC survey, which began from the mid-2000s, now releases data annually across over thirty countries.

While the quality, periodicity, and range of data have increased dramatically there is still no one survey that collects all key dimensions of poverty in an internationally harmonized way and with sufficient frequency and quality (Alkire and Samman 2014). Nor indeed is there agreement on key poverty dimensions and periodicity. Despite these shortcomings, the quality, frequency, and range of data and of data sources have increased. Further increases in data availability, accompanied by powerful technologies of data processing and visualization, permit computations and analyses of multidimensional poverty measures that were not possible even twenty years ago. Box 7.1 discusses in more detail the different fronts on which data collection can be improved in the near future.

1.3   Policy Motivation

Numbers, as Székely (2005) observed, can move the world. Thus the third and equally central motivation for multidimensional poverty measurement is to inform policy - and thereby to join the struggle to confront and overcome the pressing hazards and disadvantages that blight so many lives. While a good poverty measure alone cannot manufacture potent policy, it can go some way in that direction. Naturally, some deprivations are intangible and others incomparable, so even good poverty measures are incomplete in many ways. Also, measures must be analysed with imagination and determination—and be complemented by strategic actions that go well beyond measurement.

Thus far we have observed the ethical or normative reasons to consider the many faces of poverty. These are echoed in the policy fields. Scouring many empirical studies, we have concluded that it does not seem possible to proxy multidimensional poverty levels or trends using a single indicator. Many important and informative measurement methodologies have been developed, and will continue to be used and advanced in appropriate contexts, and Chapters 3 and 4 discuss these in depth. Further, this area of

study is advancing rapidly. Still, in this last section, we mention why the AF methodology may add value empirically and theoretically, and in so doing open a window onto policy.

The building blocks of counting measures, including AF class, are individual deprivation profiles. These show what deprivations one particular person or household experiences. For example, we might find that someone called Miriam is deprived in nutrition, in housing, in sanitation, and clean fuel, and literacy. This is called Miriam's joint distribution of deprivations—the deprivations she experiences in that particular point in time. These are summed, with weights, to create Miriam's deprivation score. The AF class of measures is constructed from the deprivation scores of poor people. This basis for measurement has an ethical appeal, as mentioned above, but also a policy one. As articulated by the Stiglitz, Sen, and Fitoussi Commission, 'the consequences for quality of life of having **multiple disadvantages** far exceed the sum of their individual effects' (2009)—a point also underlined by Wolff and De-Shalit (2007). The Commission called for '[d]eveloping measures of these cumulative effects [using] information on the "**joint distribution**" of the most salient features'.

But would any measure do? A salient feature of the AF methodology is its properties—as described in Chapters 2, 3, and 5—which make it an attractive option for informing policy transparently. Among AF measures, the so-called Adjusted Headcount Ratio or M_0 measure is particularly suitable due to three properties: (a) its ability to use ordinal or binary data rigorously, given that poverty indicators regularly have such data; (b) its ability to be decomposed by population subgroups like states or ethnic groups, to understand disparities and address the poorest; and (c) its ability to be broken down by dimensions and indicators, to show the composition of poverty on aggregate and for each subgroup. To this we might add a non-formal feature, which is the intuition of the measure and its consistent partial indices, which include a familiar headcount ratio, and also a novel feature reflecting the intensity or average share of deprivations poor people experience.

Because of these properties an M_0 measure has been described as a high-resolution lens. The single index value gives an overview of poverty levels and how these rise or fall over time. But it can (and should) be unfolded in different ways—by groups and by dimensions; at a single point in time or across time—to inform various policy purposes. It can therefore been used:

- to produce the official measures of multidimensional poverty;
- to identify overall patterns of deprivation;
- to compare subnational groups, such as regions, urban/rural, or ethnic groups;
- to compare the composition of poverty in different regions or social groups;
- to report poverty trends over time, both on aggregate and by population subgroups;
- to monitor the changes in particular indicators;
- to evaluate the impact of programmes on multiple outcomes;
- to target geographical regions or households for particular purposes;
- to communicate poverty analyses broadly.

Initial applications of multidimensional measurement methods used individual- or household-level data. More recently, the methodology is being applied to different units of analysis and with respect to different focal areas such as women's empowerment, targeting, child poverty, governance, fair trade, energy, and gender, with other applications, including using mixed methods and participatory work, in progress. The policy avenues for these alternative applications are a bit different from those outlined above, but continue to draw on the policy-salient features of the methodology.

1.4   Content and Structure

This book aims (a) to introduce the AF methodology as one approach among a wider set of multidimensional techniques; (b) to provide a clear and systematic introduction to multidimensional poverty measurement in the counting and axiomatic tradition, with a specific focus on the AF Adjusted Headcount Ratio M_0; and (c) to address empirical and normative issues, as well as recent methodological extensions in distribution and dynamics.

The book may be divided into four parts, each containing two or three chapters. The first part introduces the framework for multidimensional measurement and systematically presents and critically evaluates different multidimensional methods that are frequently used for assessment of multidimensional poverty. The second part presents the counting-based measures that have been widely used in policy, and Alkire-Foster methodology which joins together the axiomatic and counting approaches. The third part addresses pre-estimation issues in poverty measurement—the normative and empirical aspects of constructing a poverty measure. The fourth and final part of the book deals with the post-estimation issues—analysis after the poverty measure is constructed.

In the first part, Chapter 2 presents the framework for the whole book, outlining the basics of unidimensional and multidimensional poverty measurement, introducing the terminology and notation to be used throughout the book, discussing the scales of measurement of indicators and comparability across dimensions, and describing with illustrations the properties of multidimensional poverty measures. Chapter 3 then provides an overview of a range of methods used for assessing and evaluating multidimensional poverty and assesses the scope as well as limitations of each. We cover the dashboard approach, composite indices, Venn diagrams, the dominance approach, various commonly used statistical approaches, the fuzzy sets approach, and axiomatic measures (which include measures from information theory).

In the second part, Chapter 4 reviews the counting approaches to multidimensional poverty measurement that have been widely applied and used for policy. Then Chapter 5 provides an in-depth account of one particular axiomatic and counting-type multidimensional poverty measurement methodology: the AF counting methodology. Specifically, the chapter presents the AF methodology of identification and presents the Adjusted Headcount Ratio or M_0 measure and its consistent partial indices.

In the third part, Chapter 6 clarifies and outlines the normative choices in measurement design, drawing on Sen's capability approach and applied literature; and Chapter 7 provides a synthetic overview of distinctive practical issues in multidimensional poverty measurement design and analysis. In the final part, Chapter 8 presents avenues for performing robustness analysis and statistical inference, and, finally, Chapter 9 discusses different methodologies for conducting distributional and dynamic analysis. Chapter 10 presents some relevant regression techniques for analysing the M_0 measures.

1.5   How to Use this Book

This book was written with academic researchers, technical staff in governments and international agencies, and graduate students in quantitative social sciences in mind. Readers are likely to have a quantitative interest or training and come from different disciplines, ranging from economics to statistics, sociology, social policy, gender studies, education, public health, development studies, and area studies.

Naturally, some sections will be of more relevance to each reader than others. Those who are interested in the practicalities of constructing poverty measures will want to learn the formulae and selection of parameters for immediate implementation; those

who are working in axiomatic traditions may wish to elaborate additional tools; and those in applied microeconomics or in sectoral or area studies may wish to adapt the methodologies to their own problems and contexts.

Also, readers will come to this book with varying degrees of familiarity with terms and operations. Some will have a deep familiarity with axiomatic approaches to poverty measurement; others with empirical operations such as bootstrapping, regression analysis, and robustness checks; whereas others might have greater familiarity with the choice of indicators and cutoffs. Still other readers will have knowledge of tests of indicator validity and reliability or may focus more on categorical and ordinal data analysis or on the link between measurement and policy processes. We have sought to explain key operations or to point researchers to background reading. Some content may seem rather basic but is included in order to be intelligible to others from different backgrounds. In addition, a substantial body of more intuitive and less technical materials that could not fit in the book are available on our associated website, <www.multidimensionalpoverty.org>. These online resources also include relevant software codes, training videos, and problem sets. The book, together with the online resources, thus provides a systematic introduction to the field for those learning these techniques and a set of reference materials for those implementing multidimensional measures.

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