MULTIDIMENSIONAL POVERTY MEASUREMENT: MOTIVATION, APPROACHES, METHODOLOGICAL ISSUES AND AXIOMATIC INDICES

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Contents

Summary

In recent years poverty measurement is experiencing a shift from a unidimensional to a multidimensional perspective. This chapter describes the motivation for this methodological shift and the measurement approaches that have emerged as a consequence. It focuses particularly on the axiomatic approach to multidimensional measurement and details the various decisions that need to be taken when constructing a multidimensional poverty measure. The chapter describes in an intuitive way the axiomatic properties defined for multidimensional poverty measures and reviews the different proposed measures, providing a hypothetical numerical example to compare them. It also describes one international and two national applications of multidimensional indices.

1. Introduction

In recent years poverty measurement is experiencing a shift from a unidimensional to a multidimensional perspective. This chapter describes the motivation for this methodological shift and the measurement approaches that have emerged as a consequence, with an emphasis on one in particular: the axiomatic framework.

The chapter is organized as follows. Section 2 briefly describes unidimensional poverty measurement and then reviews the main contributions that raised interest in a multidimensional perspective. Section 3 presents the different approaches that have been proposed to operationalize a multidimensional perspective in measurement. Section 4 describes the key decisions that need to be taken when constructing a multidimensional poverty measure. Section 5 presents the properties and measures of multidimensional poverty proposed by an axiomatic framework and includes real-world applications of multidimensional poverty measures. The section also contains a hypothetical numerical example for the reader interested in learning and comparing them. Finally, Section 6 concludes. .

2. Why Measure Poverty from a Multidimensional Perspective?

2.1. The Tradition of Income Poverty Measurement

Poverty measurement started to grow after World War II as a result of the implementation and improvement of modern household surveys supported by theoretical developments in poverty measurement. In line with the concept of development prevalent at the time, poverty was understood primarily as lack of income. Just as economic growth was *the* (sufficient) path to development, reaching the income level of the poverty line was *the* way out of poverty. India, Taiwan, the Republic of Korea, Britain and the US were at the fore of the collection of survey data. Most often, these surveys were intended to provide data on poverty and income distribution, although they also had other purposes (Deaton, 1997, p. 8). Over the 1980s and 1990s , more countries started to collect household surveys. This was fostered by the World Bank's Living Standards Measurement Study (LSMS) starting in 1985 as well as the MEASURE DHS (Demographic and Health Survey) project (funded mainly by the US Agency for International Development, USAID), which started in 1984, although the latter collects information on assets rather than income or consumption. Over the 1990s,

the rapid growth in information technologies facilitated even more data collection and analysis such that nowadays almost every country has a periodic household survey. In 1995 the United Nations Children's Fund (UNICEF) started its Multiple Indicators Cluster Surveys (MICS), also in a significant number of countries. As with DHS, it does not include a consumption or income module. By 2010 LSMS had been implemented in 36 countries, DHS in 84 countries and MICS in over 65 countries. Over all this time, survey design evolved and improved in efficiency and accuracy.

In turn, during the 1970s and 1980s, the literature on poverty measurement experienced a remarkable growth and reached a high degree of consensus regarding the steps and desirable axioms that an income poverty measure ought to satisfy (see Foster, 2006 for a recent survey and Foster and Sen, 1997 for a thorough overview). Sen (1976) conceptualized poverty measurement as composed of two steps: *identification*, by which the population is dichotomized into the poor – those who fall below the poverty line, and the non-poor, those at or above the poverty line, and *aggregation*, by which an index of poverty is constructed using the available information on the poor. Much earlier, a methodology on how to set the poverty line had been developed. In a pioneer empirical study, Rowntree (1901) had determined the poverty line as *the minimum necessaries for the maintenance of merely physical efficiency, and this were calculated by estimating the nutritional needs of adults and children and by translating such needs into quantities of different foods and hence into money terms, and by adding on to these figures certain minimum sums for clothing, fuel and household sundries, according to the size of family* (Townsend, 1954, p.131). Following on this and subsequent contributions, Orshansky (1965) developed the Cost of Basic Needs method by which the cost of the basic food basket is multiplied by the inverse of the Engel Coefficient in order to obtain the poverty line which covers food plus other basic needs. This has been called the absolute poverty line approach, because the poverty line is the cost of a normative list of items considered necessary to lead a non-impoverished life; this approach is common practice in developing countries. Absolute poverty lines contrast with relative poverty lines, which are typically some proportion of the mean or median income of the society, and these are common practice in developed countries.

In his paper, Sen took the identification step as given and drew attention to the aggregation problem, highlighting the limitations of the measure traditionally used in those days: the headcount ratio, which is the proportion of poor people in a given population. The limitations were clearly expressed in two axioms the headcount ratio fails to satisfy: monotonicity and transfer. *A sharp rise in the extent of the shortfall of income from the poverty line may go with an unchanged number of people below the poverty line, violating monotonicity; a pure transfer of income from the poorest poor to those who are better off will either keep the headcount ratio unchanged, or make it go down – surely a perverse response, violating transfer* (Sen, 1976, p. 219). From then onwards, the literature on poverty measurement adopted the axiomatic approach and several poverty indices were proposed which satisfied the two main axioms introduced by Sen as well as alternative additional ones.

One set of proposed indices was the Foster, Greer and Thorbecke (1984) – FGT from now onwards – class of poverty measures. As the authors describe it in their "*Twenty-Five Years Later*" paper (Foster, Greer and Thorbecke, 2010, p. 495), the class is based

on the normalized gap $g_i = (z - y_i)/z$ of a poor person i, with y_i being the income of poor person i and z the poverty line. The normalized gap is the income shortfall expressed as a share of the poverty line. Define g_i^α with $\alpha \geq 0$ as the measure of *individual poverty* for a poor person, and 0 as the respective measure for non-poor persons. Parameter $\alpha \geq 0$ is a '*poverty aversion*' parameter. Then, the class of measures is defined as $P_\alpha = \sum_{i=1}^n g_i^\alpha / n$. In other words, P_α is simply the average poverty in the population. When $\alpha = 0$, P_α is the headcount ratio: all the poor have a value of 1 and all the non-poor have a value of 0. When $\alpha = 1$, P_α uses the normalized gap g_i as a poor person's poverty level, so now the distance to the poverty line matters; the average becomes the poverty gap measure P_1. P_1 satisfies monotonicity but violates transfer. When $\alpha = 2$, P_α uses the squared of the normalized gap: the bigger the gap, the higher the weight they receive. P_2 satisfies both monotonicity and transfer. Higher α values can be applied, which will give even higher weight to the poorest, but in practice these have rarely been used. All the measures in the P_α class satisfy an additional convenient property, additive decomposability: each P_α can be expressed as the population weighted average of subgroup poverty levels.

The FGT class became the most widely used measures of poverty by international organizations such as the World Bank and UN agencies, national governments, researchers and practitioners. Ravallion (1992) offers an early guidebook on the wide range of possible uses of the FGT measures, and Foster, Greer and Thorbecke (2010) provide a detailed retrospective account of the use and extensions that this class of measures has had.

However, although the poverty line is supposed to reflect all the necessary means to lead a non-impoverished life, several arguments both conceptual and empirical emerged, highlighting the limitations of measuring poverty from a unidimensional income perspective.

2.2. Arguments for a Broader Perspective and Pioneering Multidimensional Measures

2.2.1. The Basic Needs Approach

In the mid 1970s, in view of the rising inequalities between and within countries, a different approach to development emerged: the Basic Needs Approach.

Human beings have basic needs: food, shelter, clothing, health, education. Any process of growth that does not lead to their fulfilment- or, even worse, disrupts them-is a travesty of the idea of development. We are still in a stage where the most important concern of development is the level of satisfaction of basic needs for the poorest sections in each society(...) Development should not be limited to the satisfaction of basic needs. There are other needs, other goals, and other values. Development includes freedom of expression and impression, the right to give and to receive ideas and stimulus. (...) Above all, development includes the right to

work, by which we mean not simply having a job but finding self-realization in work, the right not to be alienated through production processes that use human beings simply as tools. (UNEP - UNCTAD, The Cocoyoc Declaration, 1974, p. 896-897.)

The Cocoyoc Declaration was echoed in 1976 by the Swedish Dag Hammarskjöld Foundation Report *What Now-Another Development*; by the book *Catastrophe or New Society?*, written by the Fundación Bariloche in Argentina; and by the book *Employment, Growth and Basic Needs: A One-World Problem*, the unanimous recommendation adopted by the International Labour Organisation (ILO) after the annual World Conference on Employment.

In 1978, the World Bank started to foster the basic needs approach and conducted a number of case studies in different developing countries. Paul Streeten, S. Javed Burki, Mahubub Ul Haq, Norman Hicks and Frances Stewart were key promoters and contributors to this new approach to development (see Streeten et al., 1980, 1981).

The Basic Needs Approach had a practical influence on poverty measurement: in many countries where household surveys were not implemented on a regular basis, poverty started to be measured in terms of people's failures to access basic needs (Unsatisfied Basic Needs, UBN) using census data. This practice became particularly popular in Latin American countries, fostered by the Economic Commission for Latin America and the Caribbean (ECLAC) during the 1980s and still continues. The UBN approach can be considered a pioneer method in multidimensional measurement.

However, the UBN index has been criticized from different angles (Santos et al. 2010). In the first place, although the basic needs approach was quite ample in its original formulation, in the practice of poverty measurement, it was severely constrained by the information censuses could offer. In fact, it was typically reduced to about five indicators of housing characteristics and household members' education. Thus, as a measure of poverty the UBN index is quite limited and usually associated to the so-called 'structural poverty', with little variation over short periods of time, and disproportionate weight over certain aspects, particularly housing. Secondly, the aggregation measure used – the headcount ratio of people in households with at least one UBN – is crude, being insensitive to the depth and number of deprivations experienced by the poor. Thus, as household surveys became available which collected information on income, the income approach overtook the UBN method in academic discussions as well as in public debate. This was because it allowed capturing other aspects of poverty, to be more sensitive to changes in short periods of time and because the poverty gap and the square poverty gap (FGT measures) could be applied. However, both the UBN and income measures continued to coexist in official statistics.

2.2.2. The Physical Quality of Life Index

Inspired by the basic needs approach, Morris (1978) proposed a composite index: the Physical Quality of Life Index (PQLI), which combined information on life expectancy, infant mortality and literacy. It was a precursor to the Human Development Index, introduced twenty years later.

The Physical Quality of Life Index (PQLI) is an attempt to create a practical measure of social distribution that will avoid the limitations of the GNP, that will minimize cultural and developmental ethnocentricity, and that will be internationally comparable. (Morris 1978, p.225)

The PQLI remained as an interesting proposal but did not gain widespread use, maybe because it lacked an institutional push (as the HDI had later on), but also perhaps because it did not include any measure of economic performance which, while agreed to be limited, still provides useful information.

Other composite indices of development were proposed, before and after the HDI. For a review of this literature see Booysen (2002).

2.2.3. The Capability Approach

Sen's capability approach (Sen 1979, 1992, 1999, 2009) has been fundamental in moving towards a multidimensional perspective. It offers more articulated and solid philosophical arguments than predecessor approaches.

The capability approach focuses on human lives, and not just on the resources people have (…) By proposing a fundamental shift in the focus of attention from means of living to actual opportunities a person has, the capability approach aims at a fairly radical change in the standard evaluative approaches widely used in economics and social studies. (Sen 2009, p. 253) (Emphasis added)

In 'resources' Sen also includes 'primary goods', the focus of Rawls' (1971) theory of justice, in that they are not valuable in themselves but rather means to valuable ends. There are clear conceptual links between 'primary goods' and the basic needs approach.

Capabilities are defined as the various combinations of functionings (beings and doings) that a person can achieve. Capability is, thus, a set of vectors of functionings, reflecting a person's freedom to lead one type of life or another... to choose from possible livings. Sen 1992, p. 40

The concept of *functioning* might be difficult to grasp. In a more direct language:
...functionings are valuable activities and states that make up people's well-being – such as being healthy and well-nourished, being safe, being educated, having a good job, and being able to visit loved ones. They are also related to goods and income but describe what a person is able to do or be with these. For example, when people's basic need for food (a commodity) is met, they enjoy the functioning of being well-nourished. (Alkire and Deneulin, 2009, p. 31)

Thus, under this framework, poverty is fully redefined:
In this perspective, poverty must be seen as the deprivation of basic capabilities, rather than merely as lowness of incomes. (Sen 1999, p.87)

And why is it that we need to look at actual functionings rather than at the resources such as income or primary goods which can help to pursue those functionings? There

are several reasons. The first one is conceptual: resources are means, not ends. Thus it is natural to evaluate well-being or poverty in the space of the things that are intrinsically valuable. Second, income does not always guarantee the successful achievement of functionings, or at the very least, it does so to varying extents. Many factors affect the ability of households and people to convert income into functionings. In particular, Sen (1999, p. 70-71) emphasizes five:

1. Personal heterogeneities (age, gender, disability, propensity to illness, etc) such that some people may need more income (or more hours of education, and so on) than others to achieve the same functioning.
2. Diversities in the physical environment, such as environmental conditions (temperature and climate for example).
3. Variations in social climate: the extent and quality of public facilities (which very often provide goods and services that markets fail to provide) and the nature of community relationships.
4. Differences in relational perspectives: established patterns of behavior.
5. Distribution within the family: distributional rules within the family (for example, related to gender or age).

The five aspects that affect conversion factors of income into functionings also apply in many ways to the ability to make effective use of primary goods. Sen also remarks that people may experience simultaneous deprivations, which can be critically important in understanding poverty and making public policy (Sen, 2009, p. 256).

2.2.4. The Human Development Reports: HDI and HPI

Echoing Sen's ideas of human development, the United Nations Development Programme (UNDP) launched in 1990 the first Human Development Report (HDR).

Human development is a process of enlarging people's choices. The most critical ones are to lead a long and healthy life, to be educated and to enjoy a decent standard of living. Additional choices include political freedom, guaranteed human rights and self respect –what Adam Smith called the ability to mix with others without being 'ashamed to appear in public' (...) This way of looking at development differs from the conventional approaches to economic growth, human capital formation, human resource development, human welfare or basic human needs. (UNDP, 1990, p . 10-11)

In this way, the Report set out a key difference from the growth-focused approaches followed by the World Bank's World Development Reports, and intended to shift the thinking and agenda of international organizations towards a multidimensional perspective on development. From 1990 onwards, there has been an annual global report. The 1990 Report also introduced the Human Development Index (HDI) (Anand and Sen, 1994), what we will call in this chapter a *composite index*. It considered life expectancy at birth as the indicator for the health dimension, adult literacy, as the indicator for the education dimension and the (log of) GDP per capita, as the indicator for living standard, but mainly as a surrogate for other dimensions for which there were no data available. The HDI has continued to be reported annually. Over the years, the

HDI experienced several modifications in terms of the indicators, goalposts used for normalization and aggregation formula, but its essence has remained the same. The Report never intended to present it as an exhaustive measure of human development, but merely as a practical and feasible way (given data constraints) of having a broader view, beyond GDP per capita. In that, the Report and the HDI were successful.

In 1997, the HDR incorporated a 'mirror' of the HDI: the Human Poverty Index (HPI), developed by Anand and Sen (1997), which was a composite index of 'failures' in achievements in the three dimensions of the HDI. The HPI was reported annually until 2009. The HPI can be considered a pioneering international poverty measure from a multidimensional perspective. In 2010 it was replaced by the Multidimensional Poverty Index (MPI, Alkire and Santos, 2010) explained in Section 5.4.2.

2.2.5. The 2000 World Development Report

The 2000 World Development Report (WDR) focused on poverty. Enriched by the *Voices of the Poor* study (Narayan et al., 2000a,b), the report explicitly referred to the 'many dimensions' of poverty (p. 15). It adopted a broader conceptualization of poverty, emphasized the importance of simultaneous deprivations and acknowledged the capability approach.

This report accepts the now traditional view of poverty (...) as encompassing not only material deprivation (measured by an appropriate concept of income or consumption) but also low achievements in education and health. Low levels of education and health are of concern in their own right, but they merit special attention when they accompany material deprivation. This report also broadens the notion of poverty to include vulnerability and exposure to risk—and voicelessness and powerlessness. All these forms of deprivation severely restrict what Amartya Sen calls the "capabilities that a person has, that is, the substantive freedoms he or she enjoys to lead the kind of life he or she values". (World Bank 2000, p. 15)

2.2.6. The Millennium Development Goals

About the same time of the launch of the WDR, heads of State and Government of 189 nations gathered at United Nations Headquarters in New York, where they sanctioned the Millennium Declaration in which they committed to eradicate poverty alongside promoting other fundamental aspects of development.

We will spare no effort to free our fellow men, women and children from the abject and dehumanizing conditions of extreme poverty, to which more than a billion of them are currently subjected. We are committed to making the right to development a reality for everyone and to freeing the entire human race from want. (UN Development Declaration, p.4)

The Millennium Declaration was then operationalized in 8 development goals (MDGs) which are monitored with 48 quantitative indicators (UN, 2003). The goals are:

1. Eradicate extreme poverty and hunger,

2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development

Clearly, the eight goals cover a wide range of dimensions, including material deprivation, health, education, sustainability and empowerment. Such international commitment significantly contributed to draw the attention of governments, policy makers, the media and the public to various dimensions which development includes.

2.2.7. The Stiglitz-Sen-Fitoussi Commission

The multidimensional perspective received a further push from the developed world in 2008 when, amidst the global financial crisis, the president of France, N. Sarkozy, unsatisfied with the available statistical information, formed a Commission on the Measurement of Economic Performance and Social Progress (CMEPSP), with J. Stiglitz as the president, A. Sen as the Advisor and J. P. Fitoussi as the coordinator. The report by the Commission reflects the strong interest in advancing multidimensional measurement in countries' official measurement systems.

In the first place, there is an explicit recognition of the relevance of measurement:

...the crisis is teaching us a very important lesson: those attempting to guide the economy and our societies are like pilots trying to steering a course without a reliable compass. The decisions they (and we as individual citizens) make depend on what we measure, how good our measurements are and how well our measures are understood. We are almost blind when the metrics on which action is based are ill-designed or when they are not well understood. For many purposes, we need better metrics. Fortunately, research in recent years has enabled us to improve our metrics, and it is time to incorporate in our measurement systems some of these advances. (Stiglitz, Sen, Fitoussi 2009, p. 9, emphasis added.)

Second, the commission proposed a shift of emphasis from economic production to people's well-being:

Another key message, and unifying theme of the report, is that the time is ripe for our measurement system to shift emphasis from measuring economic production to measuring people's well-being. And measures of well-being should be put in a context of sustainability. (...) Changing emphasis does not mean dismissing GDP and production measures. (...) But emphasising well-being is important because there appears to be an increasing gap between the information contained in aggregate GDP data and what counts for common people's well-being. (Stiglitz, Sen, Fitoussi 2009, p. 12)

Third, to do so a multidimensional perspective is required:

To define what well-being means a multidimensional definition has to be used. At least in principle, these dimensions should be considered simultaneously: i. Material living standards (income, consumption and wealth); ii. Health; iii. Education; iv. Personal activities including work v. Political voice and governance; vi. Social connections and relationships; vii. Environment (present and future conditions); viii. Insecurity, of an economic as well as a physical nature. All these dimensions shape people's well-being, and yet many of them are missed by conventional income measures. (Stiglitz, Sen, Fitoussi 2009, p. 14)

Fourth, the relevant space for measurement is the capability set,

What really matters are the capabilities of people, that is, the extent of their opportunity set and of their freedom to choose among this set, the life they value. (Stiglitz, Sen, Fitoussi 2009, p. 15)

Fifth, joint deprivations matter:

"It is critical to address questions about how developments in one domain of quality of life affect other domains, and how developments in all the various fields are related to income. This is important because the consequences for quality of life of having multiple disadvantages far exceed the sum of their individual effects. Developing measures of these cumulative effects requires information on the "joint distribution" of the most salient features of quality of life across everyone in a country through dedicated surveys." (Stiglitz, Sen, Fitoussi 2009, p. 15)

The report does not recommend one particular overarching measure of well-being but it encourages statistical offices to provide the information needed to aggregate across quality-of-life dimensions, allowing the construction of different indices (Recommendation 9, p. 16)

This evolution in the ideas towards the inherent multidimensionality of development and poverty led many countries in recent years to adopt either a host of indicators to monitor development, as in the case of the OECD, or to design an official multidimensional poverty measure, as it is the case of Mexico and Colombia; others are under construction. Multidimensional poverty measures for Europe are also being proposed (Whelan, Nolan, Maître, 2012; Alkire, Apablaza and Jung, 2012).

3. Operationalizing a Multidimensional Perspective in Measurement

The various arguments in favor of multidimensionality fostered the development of multidimensional measures. As we have seen, pioneer measures going beyond the income dimension in the 1980s and 1990s included the UBN indices and the HPI in terms of poverty, and the PQLI and HDI in terms of achievement or well-being. The literature on multidimensional poverty measurement has significantly evolved since then and we can now distinguish different approaches to multidimensional poverty measurement.

3.1. A Multiple Indicators Approach

Some claim that poverty is indeed multidimensional but that this does not imply the need to adopt a multidimensional poverty measure. Ravallion (2011) has made such a statement:

> *"Poverty is multidimensional. However, that does not imply that one needs a MIP [Multidimensional Poverty Index]. It is one thing to recognize that something is missing from a given measure, and needs to be considered, and quite another to create a single composite index. The more common approach is to collect multiple indicators of the various dimensions of poverty, invariably including an index of command over market goods, but also including indicators for health and education attainments and access to services. A well-known example is the United Nations' Millennium Development Goals, which span multiple dimensions, but without forming a single composite index."* (Ravallion 2011, p. 236.)

This approach prefers looking at a 'dashboard' of separate indicators: income poverty, education poverty, health poverty, and so on, rather than constructing a single multidimensional poverty measure.

This approach has some drawbacks. A first drawback is that looking at several indicators at the same time with no summary indicator can be confusing and in practice, it is difficult to operationalize. Income poverty can go down, education poverty can increase, health poverty may remain stable: how can we evaluate these changes altogether? There is some practicality and policy-power in having one-summary number (Alkire, Foster and Santos, 2011).

Having said that, (i) one must then be able to 'unpack' that one multidimensional poverty estimate to analyze poverty patterns, (ii) one must be aware that no multidimensional poverty index will be able to address all valuable dimensions; in fact that has never been the claim of any of the authors that have proposed multidimensional measures, (iii) some indicators are best kept separately because the population to which they apply is relatively small and they are inherently difficult to merge with other indicators that apply to wide populations(e.g. crime rates, indicators of maternal health).

A second drawback is that using a dashboard of indicators (Ravallion, 2011) does not reveal the prevalence and intensity of joint deprivations, precisely a key reason for having a multidimensional perspective. Are the people counted as income poor the same as those who are counted as education poor?

To evaluate poverty from a multidimensional perspective we want to know how many people or households are experiencing simultaneous deprivations and to what extent. (Alkire and Foster 2011b, Alkire, Foster and Santos, 2011). The importance of joint deprivations has been conceptually discussed in Section 2.

Thirdly, and more importantly, a key step in poverty measurement consists of identifying the poor (Sen, 1976). Thus, measuring multidimensional poverty requires

defining a criterion of who is to be considered multidimensionally poor and this cannot be done by looking at separate indicators (Alkire, Foster and Santos, 2011).

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