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The Measurement of Human Development and Poverty

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JEL Classification numbers: D31, D63, I32, O47

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ABSTRACT

This paper is devoted to the discussion of the measurement of human development and poverty, especially in United Nations Development Program's global Human Development Reports. We first outline the methodological evolution of different indices over the last two decades, focusing on the well-known Human Development Index (HDI) and the poverty indices. We then critically evaluate these measures and discuss possible improvements that can be made.

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Human development is a process of enlarging people's choices.....the process of development should at least create a conducive environment for people, individually and collectively, to develop their full potential and to have a reasonable chance of leading productive and creative lives in accord with their needs and interests.
– Human Development Report (1990)

1. Introduction

The Gross Domestic Product (GDP) has become the yardstick to evaluate the overall economic performance or even the social wellbeing of a country or a region. The underlying assumption is that the wellbeing of an individual depends on the expenditure capacity of that person so that disposable income can be interpreted as a summary measure of her consumption opportunities. As the GDP is the market value of all new goods and services produced and provided in a given region during a year – or equivalently, the total income of all individuals arising in the region in that year, it can be regarded as the macro counterpart of individual incomes or a measure of social wellbeing.

There are many problems associated with the use of the GDP as a measure of social wellbeing and the use of consumption expenditure as a measure of individual wellbeing. The problems associated with the use of GDP are clear: only market transactions are considered, quality is not computed, distributive aspects are ignored, and stocks or durable goods and infrastructures are practically out of the picture. The GDP also leaves out activities of the informal sector that can be significantly large in developing countries and the public sector activities are valued at cost due to the lack of markets and prices (Spence 2009). The use of consumption expenditure as a measure of individual wellbeing is also far from being obvious because it may leave out many factors – such as the quality of health or the value of knowledge – that are crucial for human flourishing, but cannot be measured due to the lack of market prices (for a more detail discussion on the flawed assumptions behind using per capita GDP as a measure of development see Alkire and Deneulin 2009, Giovannini 2013). Yet the GDP and related indicators are used primarily because we have not yet found a better alternative so generally accepted.

The GDP certainly captures a relevant part of the economic performance of a society, but it is far from being a complete measure of economic development and certainly further from being a sufficient measure of human development and social wellbeing. In fact, it is improbable to capture human development or social wellbeing, which is multifaceted by nature, just by any single indicator. This rather requires a *multidimensional approach*, which was recognised soon after the GDP became a standard and has been discussed ever since.[1] Like human development, human deprivation or poverty is also usually understood in terms of deprivation in income or consumption expenditure. However, as Ruggieri, Saith, and Stewart (2003) showed in case of India, non-deprivation in income did not necessarily mean non-deprivations in income and education. In fact, human deprivation or poverty, like human development, is also multifaceted and requires a multidimensional approach. A number of indices based on multiple dimensions have been developed in many areas of research, specially regarding inequality, poverty, subjective wellbeing, education, or health, to name a few. Some of these indices are composite indices and others are more sophisticated multidimensional indices. The relevance of this approach has brought the OECD to issue a manual on the construction of composite indices (Nardo *et* al. 2008).

Note that moving from one to several dimensions, when approaching the development of a society, opens a number of difficult issues that call for agreement and compromise. The key points are: (i) Which are the most relevant dimensions to be considered? (ii) How can we approximate those dimensions by means of specific variables whose data are available? (iii) How should those variables be aggregated into a single index in order to get a systematic evaluation criterion? The difficulty of tackling all those issues explains a good deal the persistence of the GDP as the main index for economic growth and development. In spite of the different proposals put

[1] Let us mention the United Nations 1954 report on the standards of living, the "basic needs approach" fostered by the International Labour Organization in 1974, the *Physical Quality of Life Index* (PQLI), due to Morris (1979) (reformulated by Ram (1982)), or that proposed by the Daj Hammarskjöld Foundation (Max-Neef 1984). For more recent critiques, see Boarini *et al*. (2006), Stiglitz *et al*. (2009), or Fleurbaey (2009).

forward, no general agreement was reached on the adoption of a new standard, at least until the launching of the Human Development Index in 1990.

Since its inception, the *Human Development Index* (HDI) has become the most successful index based on multiple dimensions addressing economic development and social wellbeing. Besides the HDI, the UNDP in subsequent Human Development Reports has introduced several other indices, of which the more well-known ones are the Human Poverty Index (HPI) for measuring poverty, the Gender-Related Development Index (GDI) for capturing inequality in human development across gender, and the Gender Empowerment Index (GEM) for measuring women's empowerment. Each of these measures has evolved over time in terms of the selection of indicators and method. In this chapter, we shall restrict our analysis to the measures of human development and human deprivation or poverty, leaving aside the discussion indices developed for other purposes.

The first Human Development Report (HDR) was launched in 1990 and since then 22 global HDRs have been produced so far. Indices in the HDR proposed by the United Nations have mostly been applications of Amartya Sen's idea of *functionings and capabilities* (Sen, 1985). These indices have been used frequently to measure development and poverty of nations. Many countries have even produced national Human Development Reports, where these indices have been constructed at the sub-national level. The indices in these reports have experienced several changes over time. We divide this timeline into two segments: Pre-2010 and Post-2010, because in the 2010 Human Development Report titled "The Real Wealth of Nations: Pathways to Human Development", all indices have gone through significant amendments.

2. Indices in the Human Development Reports 1990-2009

The 22 global HDRs have introduced various indices of human development, poverty, gender inequality, gender empowerment and a few others. In this chapter and also in this section, we focus on the indices of human development and poverty.

2.1. The index for measuring human development

The Human Development Index was introduced in the first HDR in 1990. The HDI soon became popular and each new edition had a large impact in the mass media because of its intuitive character and the large number of countries that entered the evaluation. This approach to measuring human development identified health, knowledge, and material wellbeing as the key dimensions for social and economic development. The achievement in health was measured by the indicator *life expectancy at birth* (H), which is the number of years that a new-born is expected to live, according to the actual pattern of mortality rates within each country. Knowledge, understood as educational achievements, was approximated by a composite indicator: a mixture of *literacy rate* (E_1) and *gross enrolment rate* (E_2) (with weights of $2/3$ and $1/3$, respectively). Finally, material wellbeing was associated with the *logarithm of the per capita GDP* (Y).

Each of these four indicators was normalized with respect to a maximum and a minimum possible performance. It was essential in order to make the performance across indicators comparable. The maximum possible performances for these four indicators were denoted by H^{max}, E_1^{max}, E_2^{max} and Y^{max}, and the minimum possible performances were denoted by H^{min}, E_1^{min}, E_2^{min} and Y^{min}, respectively. Each of the four indicators was normalized as $i_N = (i - i^{min})/(i^{max} - i^{min})$ for $i = H, E_1$, and E_2 and $Y_N = (\ln Y^{max} - \ln Y)/(\ln Y^{max} - \ln Y^{min})$ for material well-being. The *Human Development Index* was defined as the *arithmetic mean* of the normalized values of those three dimensions and is expressed as:

$$HDI = \frac{1}{3}\left(H_N + \frac{2}{3}E_{1N} + \frac{1}{3}E_{2N} + Y_N\right) = \frac{1}{3}(H_N + E_N + Y_N).$$

Although the life expectancy indicator has been used consistently to assess the health dimension, different indicators have been used to measure the knowledge dimension and different transformations of the same indicator has been used to gauge the material well-being dimension over time. In the first HDR, the knowledge dimension was assessed only by the adult literacy rate. From the second HDR onwards, the knowledge dimension was assessed by both the adult literacy rate and mean years of schooling. In the 1995 HDR, the mean years of schooling indicator was

replaced by the combined enrolment ratio indicator. This pair of indicators has been used until 2009. The well-being indicator, on the other hand, has been assessed throughout by per capita GDP, but with different transformations. In the first HDR, the logarithmic transformation was used, but in consecutive reports an equally distributed equivalent transformation (based on Atkinson 1970) was used until before the 1999 HDR when the transformation was switched back to the logarithmic scale following the suggestions of Anand and Sen (2000).

An index of human development, however, measures the progress of an entire society. The index ensures that any overall progress in human development is supported by an increase in its value and any decline is evaluated by a decrease. An index of human development nevertheless ignores how a progress or decline has been obtained. A progress may occur with perpetual improvement in the life of those already enjoying high levels of human development, while forestalling the life of those actually needing improvement. In other words, progress may take place despite a large section of the population remaining deprived of basic needs, capabilities, and public services. The pursuit for progress in human development remains incomplete until existing deprivations in the population are successfully eradicated.

2.2. Indices for measuring human deprivations

Although the first attempt to assess deprivations using a poverty index was made in the 1996 Human Development Report (HDR), the first four HDRs presented the HDI as a complement of the country's deprivation. A country's deprivation in three dimensions was understood as a shortfall of that country's performance from the best possible performance in that dimension. A deprivation score is assigned to each of the four indicators as $D_i = (i^{max} - i)/(i^{max} - i^{min})$ for $i = H$, E_1 and E_2, and $D_Y = (\ln Y^{max} - \ln Y)/(\ln Y^{max} - \ln Y^{min})$. Then the overall deprivation score was obtained as $D = (D_H + D_E + D_Y)/3$. The HDI was the complement of the overall deprivation score, such that $HDI = (1 - D)$. It is straightforward to verify that this formulation is equivalent to the traditional HDI formulation – the simple average of performances in three dimensions. Thus, in the early Human Development Reports, an effort was made to link the HDI to the concept of deprivation albeit at the country level.

However, the deprivation at the country level may not necessarily be sensitive to the deprivations at the individual level within countries. The HDI, even when presented as complement of country level deprivation may not be sensitive to individual deprivations. Anand and Sen (1997) refer the approach towards measuring human development as *conglomerate approach* and that for measuring poverty as *deprivation approach*. A poverty index, unlike an index of development, is solely focused on those that fail to meet the deprivation cut-off. Every poverty index is supposed to satisfy the *focus axiom*, which requires that the poverty index should not be sensitive to the performance of those that are non-deprived or non-poor.[2]

Like human development, human deprivation is also multidimensional. Reducing deprivation in one dimension – such as, income – may not necessarily translate to the reduction of deprivations in other dimensions. The earliest attempt to introduce a poverty index – referred as Capability Poverty Measure (CPM) – was made in the 1996 Human Development Report. The CPM was a composite index or a simple average of the basic capability shortfalls in three dimensions: living a healthy and well-nourished life, having the capability of safe and healthy reproduction and being literate and knowledgeable. The corresponding indicators were the percentage of children under five years being underweight, the percentage of births unattended by trained health personnel and the percentage of women aged 15 years and above being illiterate. Note that the three chosen indicators did not capture deprivations of the entire population, but only deprivations among women and children.

In the 1997 HDR, two different poverty indices were introduced: one for the developing countries referred to as HPI-1 and the other for the industrialized countries referred to as HPI-2. The HPI-1 consisted of three dimensions (as the HDI): (i) a long and healthy life, (ii) knowledge, and (iii) a decent standard of living. Deprivation in the long and healthy life dimension was measured by the percentage of people not expected to survive to the age of forty (P_1). Deprivation in the knowledge dimension was assessed by the percentage of adults illiterate (P_2). Finally, deprivation

[2] We will discuss afterwards that the terms 'deprived' and 'poor' are not synonymous when multiple dimensions are involved in the construction of a poverty index.

in the standard of living dimension was average of deprivations in three indicators: the percentage of people without access to safe water (P_{31}), the percentage of people without access to health services (P_{32}), and the percentage of moderately and severely underweight children under the age of five years (P_{33}). Thus, the third dimension, a decent standard of living was measured as $P_3 = (P_{31} + P_{32} + P_{33})/3$. However, given the lack of frequent data on the access to health services, since 2001 HDR the third dimension had been measured by the average of the first and the third indicators only such that $P_3 = (P_{31} + P_{33})/2$. The HPI-1 was a composite index of the three dimensions using the well-known formulation of the general mean of order three and can be expressed as HPI-1 $= [(P_1^3 + P_2^3 + P_3^3)/3]^{1/3}$.

The choice of indicators for the HPI-1 was, however, not suitable for the much richer industrialized countries because there would not possibly be any deprivation in any of these indicators. An alternative index, referred as HPI-2, had been developed for the industrialized countries consisting of four dimensions. The first was related to the survival of its citizens at a relatively early age, which was measured by the percentage of people not expected to survive to the age of sixty years (P_1). The second dimension was knowledge assessed by the percentage of people who were functionally illiterate, as defined by the OECD (P_2). The third related to a decent standard of living, measured by the percentage of people living below the income poverty line, which was fifty percent of the median disposable household income (P_3). The final and fourth related to non-participation or exclusion gauged by the rate of long-term (12 months or more) unemployment of the labour force (P_4). The HPI-2 also used generalized mean of order three to formulate the HPI-2 such that HPI-2 $= [(P_1^3 + P_2^3 + P_3^3 + P_4^3)/4]^{1/3}$.

2.3. A Critical Evaluation of the Pre-2010 Indices

Certainly, considering additional indicators besides per capita GDP has been novel and a move towards the right path. Yet, these indices of human development and poverty have also received many criticisms.[3] Let us first discuss the criticisms attributed to the

[3] We follow here Herrero, Martínez & Villar (2010b). See also the contributions in Anand & Sen (1994 a, b), Hicks (1997), Sagar & Najam (1999), Osberg & Sharpe (2002), Philipson & Soares (2001), Pinilla &

HDI. The main ones refer to:

(a) *The nature of the selected dimensions*: There were some relevant aspects of human development that are missing, such as social integration and sustainability.

(b) *The choice of indicators*: Even though the choice of indicators was significantly affected by the availability of data, it was *not* clear that the indicators used for approximating health, education and material wellbeing were the most sensible ones. Moreover, the nature of the three variables involved made the interpretation of the HDI as a summary statistic of a representative agent difficult.

(c) *The absence of time-consistent data*: Due to frequent data revisions of indicators between subsequent years, the inter-temporal comparison using HDI became difficult.

(d) *The lack of concern for distributive issues*: It is only natural to think that the level of human development should compute not only "the size of the cake", but also the way in which it is distributed.

(e) *The additive structure of the index*: Aggregating different components by the arithmetic mean had strong implications on their substitutability (linear indifference curves) and makes the index dependent on the normalization methods applied to different indicators.

(f) *The lack of theoretical justification of the formula*. This makes it difficult to analyse the suitability of this index vis-à-vis other alternatives. Moreover, it induces the use of the HDI as an ordinal measure (a criterion to produce a ranking) and not as a cardinal measure that would help evaluating the *size* of the differences between countries.

Like the HDI, the pre-2010 poverty indices could also be subjected to criticisms. Let us start with the Capability Poverty Measure or CPM, which could be subjected to two major criticisms. The first was related to the selection of indicators. The three chosen indicators did not capture the deprivations of the entire population, but only deprivations among women and children. Indeed, women and children should receive particular attention in any poverty eradication policy, but a poverty

Goerlich (2003), Foster, López-Calva & Székely (2005), Becker, Philipson & Soares (2005), Stiglitz, Sen & Fitoussi (2009), Seth (2009) or Herrero, Soler & Villar (2010).

index for a country should not be restricted to a particular section of the population. The second criticism was attributed to the particular functional form that was used to aggregate and obtain the composite poverty index. Like the HDI, the CPM used the arithmetic mean, which ensured that any increase in the deprivation in one dimension could be compensated by equal sized reduction in another dimension.

There was clearly one methodological improvement over the CPM in that the HPIs used a different order of general mean for aggregation rather than the arithmetic mean. The general mean of order $a \geq 1$ of any n real values $x_1, \ldots, x_n$ is defined as $([x_1^a + \cdots + x_n^a]/n)^{1/a}$. The arithmetic mean is also a general mean with order $a = 1$ and is equal to $(x_1 + \cdots + x_n)/n$. As the value of parameter a increases, more emphasis is given to the larger values. In the HPI formulation, the use of higher order of a puts more emphasis in the larger deprivations. It ensures that an increase in deprivation in one indicator having relatively larger deprivation should be compensated with much larger improvement in another indicator with relatively lower deprivation. Also, a more equal distribution of deprivations across indicators is rewarded by a lower composite value. Note that for well-being measures, the order of generalized mean is assumed to be no larger than one. For, $a = 0$, it is the well-known geometric mean and for $a = -1$, it is the harmonic mean.

Another improvement appears to be in the selection of indicators. Unlike in the CPM, the indicators in the HPIs were not biased towards a particular section of the population; they rather captured deprivations across a wider range of the population. Different indicators were, however, still based on different sets of the population. Consider the HPI-1 for example. The indicator for long and healthy life was based on the population demised. The indicator for the knowledge captured deprivations among the adult population only. Finally, one indicator for standard of living captured deprivations among the entire population; whereas the other captured deprivations among the children only. It was not possible to capture multiple deprivations among the same set of population by using all these indicators to discern them by the extent of their deprivations. In other words, the HPIs were not useful for understanding who, within a country, was more or less poor. This criticism actually could also be partially attributed to the use of composite indices for measuring poverty in general.

A composite index is built by first obtaining a comprehensive deprivation score for each indicator across the population and then aggregating these comprehensive deprivation scores to obtain the index. We can clearly see that, like the HDI, for the CPM and the HPIs, the data for different indicators were collected from different sources and for different population subgroups. For any multidimensional index of poverty, however, information on all indicators ought to be collected from the same dataset so that the information on each indicator is available for each person or each household. Then the construction of a multidimensional poverty index involves two stages: identification of those that are poor and aggregation of the deprivation information of the poor to obtain the overall index. For composite indices of poverty, there is no difference between the terms 'deprived' and 'poor' because people are separately identified as poor in each indicator in order to obtain the comprehensive deprivation score for that indicator. In multidimensional poverty analysis, however, the terms 'deprived' and 'poor' have clear distinction. A person is considered deprived in an indicator if the person fails to meet the threshold in that indicator. By being deprived a person may not necessarily be considered poor though. It is the *identification function* based on the joint deprivations that identifies a person as poor or non-poor. [4]

One clear distinction between the composite indices of poverty and the multidimensional indices of poverty is, thus, the consideration of joint deprivations at the identification stage. The second major difference is that a multidimensional index requires the information on all indicators to be available from the same dataset; whereas a composite index may be constructed by collecting information from different sources. This second difference may make a composite index appear more flexible and the multidimensional index more demanding. However, if it is feasible to capture the joint deprivations then the ability to capture it may outweigh the flexibility of composite indices. Certainly, the construction of CPM and HPIs were innovative at a time when the measurement of poverty was dominated by the income

[4] See however the discussion in Villar (2013) and the chapter on Multidimensional Poverty and Material Deprivation of this handbook.

approach – such as, $1 a day and $2 a day, but they were merely composite indices and failed short of being graduated to a multidimensional index of poverty.

3. Indices in the Human Development Report 2010 and Onwards

The twentieth anniversary of the HDR has been taken as the right occasion to refurbishing these indices, after launching an open discussion among the specialists concerning possible ways of improvement.[5] As a result, some substantial changes have been introduced in the design of the HDI, a complementary index known as the Inequality-Adjusted HDI (IHDI) has been introduced, and the HPI-1 has been replaced by a completely new index of poverty – the Multidimensional Poverty Index (MPI). Let us first discuss the modifications in the HDI and then outline the MPI.

3.1. The Human Development Index

The 2010 Human Development Index is a more solid construct than its predecessor, even though it keeps most of the essential traits of the traditional HDI. In particular, (i) it maintains the three-dimensional nature of the index, (ii) continues to consider that health, education and material wellbeing are the only key dimensions to evaluate human development, (iii) holds the equal-weight assumption for those variables, (iii) keeps the normalization convention already adopted and the evaluation of material wellbeing in terms of logs, and (iv) recurs to a mean in order to aggregate the normalized variables into a single number. There are, however, three major modifications in the 2010 Human Development Index that improve its analytical power. First, the indicators for measuring the achievements in material wellbeing and education have been replaced. Table 3.1 presents the pre-2010 and 2010 HDI indicators for the three dimensions. Second, a time consistent series of each indicator has been developed since 1980 so that a systematic inter-temporal comparison could be made. Third, instead of using the arithmetic mean, the achievements in three

[5] See the research papers 2010 series of United Nations Development Program and, particularly, the contributions by Alkire and Foster (2011), Alkire & Foster (2010), Herrero, Martínez & Villar (2010b), Kovacevic (2010), Alkire and Santos (2010).

dimensions are aggregated using the geometric mean, thus adopting the following formula:

$$HDI_{2010} = \left(\frac{H - H^{min}}{H^{max} - H^{min}} \times \frac{E - E^{min}}{E^{max} - E^{min}} \times \frac{\ln Y - \ln Y^{min}}{\ln Y^{max} - \ln Y^{min}} \right)^{1/3};$$

where H, E, Y are the indicators measuring achievements in health, knowledge, and material wellbeing dimensions, respectively, and the minimum and maximum goalposts are used in order to normalize each variable within the [0, 1] interval. Let us now devote some time conducting a more in-depth analysis about the improvements in the 2010 HDI over the pre-2010 HDI.

Table 3.1: The Dimensions and Indicators of the Old and New HDI

Dimensions	Indicators	
	Pre-2010 HDI	**2010 HDI**
Health (H)	Life expectancy at birth	Life expectancy at birth
Knowledge (E)	Adult Literacy Rate Gross Enrolment Ratio	Mean Years of Schooling Expected Years of Schooling
Material Wellbeing (Y)	GDP Per Capita (PPP USD)	GNI Per Capita (PPP USD)

The first large modification in the 2010 HDI is the amendment of the indicators. Indeed, the choice of the indicators that approximate the achievements in the three selected dimensions is a key element of the construction of the index. The life expectancy at birth has been kept as the indicator for assessing the health dimension, so there is no novelty regarding this dimension. The normalization of this indicator is obtained by taking H^{max} = 83.2 and H^{min} = 20. The 2010 version of the HDI, however, measures material wellbeing in terms of the logarithmic transformation of per capita *Gross National Income* rather than that of the per capita GDP. This entails taking into account the outcomes of the nationals living abroad and the proceeds of the firms operating in other countries. This is a minor improvement in the design of the index. The normalization of this indicator is obtained by taking Y^{max} = \$108,211 and Y^{min} = \$163.

The change in the variable that measures educational achievements is a major one and was really needed. The excessive weight given to the literacy rate in the

traditional HDI made it unsuitable to capture the differences in human capital, mostly in developed countries. Among the several alternatives to measure educational achievements, the 2010 HDI has selected yet another composite variable: the geometric mean of "mean years of education" (adults) and "expected years of schooling" (children), suitably normalized. Getting the normalized variable of education requires first normalizing each partial index and then taking the square root of its product. To normalize mean years of education the max value is set equal to 13,2 years and to normalize the expected years of schooling the max value is set equal to 20,6 years, whereas the minimum golapost is set equal to zero in both cases. The resulting value is normalized again with $E^{max} = 0.951$ and $E^{min} = 0$.

The second major improvement in the 2010 Human Development Report is the reconstruction of time-consistent values for the HDI according to the new method. This allows comparing the evolution of this indicator and yields interesting results on the dynamics of the different countries.

The third major improvement is the use of geometric mean as an aggregator rather than the arithmetic mean. Using the arithmetic mean to aggregate the achievements in the three dimensions into a real-valued indicator has a number of drawbacks, despite the appeal of its intuitive character. The arithmetic mean is an additive aggregation procedure that implies assuming perfect substitutability between their components (linear indifference curves). It amounts to admitting that we can substitute, for instance, expected life years by education at a constant rate, no matter the average level of health. A constant rate of substitution independent on the level of the variable is hard to justify in many contexts and particularly in this one. Moreover, an additive index of this sort generates a ranking that is sensitive to the normalization of the different indictors. Namely, a change in the arbitrary normalization of the raw variables induces changes in the ranking that the index produces (the reason is that changing the normalization amounts to modifying the weights with which those variables enter the index).

The need for a change in the aggregation process was widely recognised in the literature. Many authors agreed on the need to substitute the arithmetic mean by a more general nonlinear type of mean, most particularly the geometric mean (see

Chakravarty 2003; Foster, López-Calva & Székely 2005; Herrero, Martínez and Villar 2010a; Seth 2009, 2013, among others, for a discussion). The geometric mean is a well-known aggregator in economics. It corresponds to the familiar symmetric Cobb-Douglas formula for production and utility functions and exhibits much better properties regarding substitutability among the variables. Also note that the geometric mean penalizes the dispersion of the variables that are aggregated whereas the arithmetic mean is insensitive to the distribution of the variables being averaged.[6]

How does our vision of human development change with the new index? The 2010 Human Development Report says on this respect (p. 217): "The methodological improvements in the HDI, using new indicators and the new functional form, result in substantial changes (...) Adopting the geometric mean produces lower index values, with the largest changes occurring in countries with uneven development across dimensions. The geometric mean has only a moderate impact on HDI ranks." Indeed, the new HDI discriminates more than the old one (the coefficient of variation is 40% higher) and yields a good deal of shifts in the ranking, mostly due to the change in the variable that measures education. See Klugman, Rodriguez & Choi (2011) for a detailed discussion.

3.2. Adjusting inequality in human development

There is a general consensus on the need for taking into account distributive considerations when evaluating economic growth or human development. This can be easily accomplished nowadays because there are statistics on income inequality for many countries and we have a well-established theory that permits linking the evaluation of the size and the distribution of income. It is therefore striking that the human development report waited for twenty years to include distributive considerations into the HDI, in spite of several proposals being put forward (e.g. Anand & Sen 1994b; Hicks 1997; Foster, López-Calva & Székely 2005; Herrero, Martínez & Villar 2010 a, b; Seth 2009, 2013).

[6] Given the small values of the normalized variables the changes in the ranking induced by substituting the arithmetic mean by the geometric mean will be small. The changes in the relative values, though, are more relevant and reflect the dispersion of the partial indices.

The 2010 edition of the Human Development Report includes a new index that approaches the distribution of the different variables: the *Inequality-Adjusted Human Development Index* (IHDI). This index has the same structure that the 2010 HDI, but each constituent variable has previously been adjusted by a discount rate that measures the inequality of its distribution within each country using the Atkinson inequality measure. Thus, each dimension in the HDI is the average of achievements across the distribution of each variable; whereas each dimension in the IHDI is the inequality adjusted average or equally distributed equivalent of achievements across the distribution of each variable. The IHDI is the geometric mean of the inequality-adjusted values of the variables of health, education, and material wellbeing:

$$I(H) = f_H(H)(1 - A_H), I(E) = f_E(E)(1 - A_E), I(Y) = f_Y(Y)(1 - A_Y)$$

where A_C, for $C = H, E, Y$, is the Atkinson's inequality measure of the corresponding variable, and $f_C(C)$ describes the transformation of the original values into normalized values (with logs in the case of the per capita GNI). According to this formulation, inequality reduces the achievements in each variable. The term $f_C(C)A_C$ is a measure of the loss due to inequality.

The report adopts the Atkinson's (1970) inequality index for the value $\varepsilon = 1$, that yields an inequality adjusted measure for each indicator corresponding to the geometric mean of individual achievements (see Foster, López-Calva and Székely (2005) and Alkire and Foster (2010) for details). The IHDI is given by the formula:

$$IHDI = \sqrt[3]{I(H) \times I(E) \times I(Y)}.$$

However, the variables used for computing the inequality measures are not necessarily computed from the same variables used for computing the partial indices for the HDI. Thus, $f_H(H)$, $f_E(E)$, and $f_Y(Y)$ are the partial indices for the HDI such that $f_H(H)$ is the life expectancy at birth, $f_E(E)$ is the geometric mean of expected years of schooling and mean years of schooling, and $f_Y(Y)$ is the corresponding partial index based on the GNI per capita. In contrast, the inequality measure for the knowledge dimension has been computed using years of schooling among adults only as it is not

possible to capture inequality across the expected years of schooling variable. Similarly, the inequality measure for the material well-being dimension has been computed from various variables such as per capita disposable income, per capita consumption expenditure, or income imputed from asset indices.[7] The inequality measure for the health dimension is, however, computed using the same indicator used for constructing the corresponding partial indicator, yet the computation of the inequality measure is not straightforward. The measure is not computed by capturing inequality across the health status of the entire population. Rather inequality is computed across the mortality rates for different age groups (For a detailed discussion, see Kovacevic 2010).

3.3. A new index for measuring human deprivations

In the 2010 Human Development Report, UNDP introduced a new index of multidimensional poverty referred as the 'Multidimensional Poverty Index (MPI)' for developing countries proposed by Alkire and Santos (2010). This shows the UNDP's willingness to mark a clear departure from the use of composite indices to multidimensional indices that are able to capture joint distributions across the population. Like the HDI and the HPI-1, the MPI also has three dimensions – education, health and standard of living, but consisting of ten indicators. The indicators and their deprivation cut-offs are reported in Table 3.2. The health dimension and the education dimension consist of two indicators each and the standard of living dimension consists of six indicators. Thus, two indicators in the MPI, child mortality and access to safe drinking water, are the same as that in the HPI-1.

Table 3.2: Dimensions, Indicators, Deprivation Cut-offs and Weights of the MPI

Dimension	Indicator	A Person in a Household is Deprived if ...
Health	Nutrition	Any woman or child in the household with nutritional information is undernourished
	Mortality	Any child has died in the household
Education	Schooling	No household member has completed five years of schooling
	Attendance	Any school-aged child in the household is not attending school up to class 8

[7] Income inequality is calculated with respect to the original distribution without logarithmic transformations.

Standard of Living	Electricity	The household has no electricity
	Sanitation	The household´s sanitation facility is not improved or it is shared with other households
	Water	The household does not have access to safe drinking water or safe water is more than 30 minutes walk round trip
	Flooring material	The household has a dirt, sand or dung floor
	Cooking fuel	The household cooks with dung, wood or charcoal
	Assets	The household does not own more than one of: radio, telephone, TV, bike, motorbike or refrigerator, and does not own a car or truck

Source: Alkire, Roche, Santos, and Seth (2011)

The method of the MPI is an adaptation to that of the Adjusted Headcount Ratio proposed by Alkire and Foster (2007, 2011). Unlike the HPI-1, the MPI is computed directly from the survey dataset rather than the indicators being computed from different sources. Let us provide a brief outline of the method with an exemplary country with n individuals and d indicators. In case of the MPI, $d = 10$. Let us refer the performance of a person in an indicator by *achievement*. The achievements of all n persons in d dimensions by the $n \times d$-dimensional matrix X. The achievement of any person i in indicator j is denoted by x_{ij}. The weight attached to indicator j is denoted by $w_j > 0$ such that $\sum_j w_j = 1$. Each indicator has its own deprivation cut-off. A person failing to meet the cut-off is identified as deprived in that dimension. The deprivation cut-off of indicator j is denoted by z_j. Subject to the deprivation cut-off, person j is assigned a *deprivation status score* in indicator j, which is denoted by g_{ij} such that $g_{ij} = 1$ if person i is deprived in indicator j and $g_{ij} = 0$, otherwise. In the next step, a *deprivation score* is obtained for each person i such that $c_i = \sum_j w_j g_{ij}$. The deprivation score of each person is the weighted average of deprivation status scores. Note that at two extremes, $c_i = 0$ if person i is not deprived in any indicator and $c_i = 1$ if person i is deprived in all indicators, and so $c_i \in [0,1]$.

Not all those who are deprived in any indicator are identified as poor though. The identification step involves a poverty cut-off k. A person is identified as poor whenever $c_i \geq k$ and non-poor whenever $c_i < k$. If the value of k is positive, but lower than the minimum weight assigned to any indicator such that $0 < k < \min\{w_1, \dots, w_d\}$, then the identification approach is referred as the *union approach*. By union approach, a person is identified as poor, even when the person is deprived in a single indicator.

On the other extreme, an *intersection approach* identifies a person as poor only if the person is deprived in all indicators or when $k = 1$. Both these approaches may be too stringent and in that case an alternative middle ground may be found by using an *intermediate approach*, such that $\min\{w_1, \dots, w_d\} < k < 1$. Once, individuals are identified as poor and non-poor, then a censored distribution of deprivation scores are obtained, such that $c_i(k) = c_i$ if $c_i \geq k$ and $c_i(k) = 0$ for all $c_i < k$. The adjusted headcount ratio, denoted by M_0, is computed from the censored distribution scores as $M_0 = [\sum_i c_i(k)]/n$.

The MPI uses a particular set of indicators and deprivation cut-offs, a particular set of weights and a certain value of poverty cut-off. The three dimensions, ten indicators and the corresponding deprivation cut-offs are already outlined in Table 3.2. Like the HDI and the HPI-1, the MPI weights each dimension equally and furthermore weight within each dimension is equally distributed across indicators. For example, the mortality indicator in health dimension is assigned a weight equal to $1/6$; whereas the assets indicator in the standard of living dimension is assigned a weight equal to $1/18$. The poverty cut-off for the MPI is equal to one third of weighted indicators or $k = 1/3$. Thus, a person within a household is identified as poor if the household's deprivation score is equal to larger than $1/3$. Note that the identification takes place at the household level, but not at the individual level because it is difficult to obtain data at the individual level. Because the identification takes place at the individual level, it is not possible to capture the difference in achievements that may exist within a household. Despite this shortcoming, the construction of the MPI is a big leap forward in the measurement of poverty.

The MPI also has certain useful properties. First, it can be expressed as a product of two terms. One is the multidimensional headcount ratio (H), which is the proportion of the population living in households that are deprived in one-third of weighted indicators or with deprivation scores equal or larger than one-third. If we denote the number of poor by q, then $H = q/n$. The other is the average deprivation scores among the poor (A). By definition, H lies between zero and one: it is equal to one when everybody is identified as poor and is equal to zero when there is no poor at all. The range of A is, however, not straightforward. Whenever there is at least one

poor, A lies between k and one; but when there is no poor in the society, then A cannot be defined. The second useful feature is that the MPI can be expressed as weighted average of censored headcount ratios of the ten indicators. The censored headcount ratio of an indicator is the proportion of the population who is identified as multidimensionally poor and is simultaneously deprived in that indicator. The third useful property is that it is decomposable across any population subgroup, which means that the overall MPI can be expressed as a weighted average of subgroup MPIs where the weight attached to each subgroup is equal to its relative population share.

4. A Critical Evaluation of the 2010 Indices

Although the indices introduced in the 2010 HDR overcame many limitations of the indices introduced in the previous HDRs, there is still room for improvement. In this section, we devote some time to critically assess these 2010 indices.

4.1. The Human Development Index

The new HDI has been regarded as a major improvement regarding the change in the way of measuring educational achievements, the construction of time consistent data series, the new aggregation formula, and the introduction of distributive considerations. Yet it has opened an important discussion about some methodological issues, which refer to the nature of the index and its internal structure. From a purely theoretical viewpoint, there are some flaws in the design of the new Human Development Index that should be addressed (see Herrero, Martínez & Villar 2012). From an empirical perspective, the 2010 HDI has received a number of criticisms related to the apparent performance of African countries and the questionable trade-offs between variables, according to the new method (see Ravallion 2010).

Most of the criticisms are related to the change of the aggregation procedure. Some argue that the change in the aggregation formula does not alter significantly the ranking of the countries (most of the changes are actually due to the new education variable) whereas the geometric mean is a less intuitive concept than the arithmetic mean. Moreover there are empirical outcomes regarding the resulting rates of

substitution between dimensions that have shed some doubts about the advantage of the new formulation (see the discussions in the blog "Let's Talk Human Development", Ravallion 2010; Zambrano 2011b; and Klugman, Rodríguez & Chow 2011). Finally, there are also criticisms on some modelling choices, particularly regarding the use of logs for the income variable and the normalization strategy (see Herrero, Martínez & Villar 2010b, 2012). Let us critically evaluate the new HDI in more detail.

4.1.1. Choice of Weights

The 2010 HDI preserves the number and the nature of the selected dimensions and the equal-weight principle that was attributed to the traditional HDI. There is no novelty in those respects and the criticisms that applied to the pre-2010 HDI also apply here. The choice of equal weights for the different dimensions was made essentially on the basis that there were no rationale to give more weight to any of those essential aspects of human development (see HDR 1995, p. 48). The 2010 edition of the HDR keeps this weighting system. Yet, as Anand and Sen (1997) have pointed out, one may well consider that "the weights in the HDI should be traced either to individual preferences, some collective social choice process, or to a strong normative argument." In an empirical paper regarding 1975-2005, using principal components techniques, Nguefack-Tsague, Klasen, and Zucchini (2012) provide a statistical justification for the HDI weighting scheme.[8]

Any precise weighting scheme, however, is difficult to agree upon universally and therefore, instead of just debating on the selection of a particular weighting scheme, it is important to understand how robust the comparisons are with respect to the choice of the initial weighting scheme to possible alternatives. Different tools for sensitivity and robustness analyses have been developed recently in order to test the robustness of rankings generated by the composite indices. For example, Foster, McGillivray and Seth (2009, 2013) propose a tool for testing the robustness of pair-wise comparisons with respect to the initial weighting scheme. Applying the tool to the HDI ranking for various years, they find that nearly seventy percent of all the HDI

[8] For a discussion on different techniques for setting weights for multidimensional indices, see Decancq and Lugo (2013).

pair-wise comparisons to be fully robust. Fully robust meant that seventy percent of the pair-wise comparisons did not alter no matter which alternative weighting schemes were selected so that the weights were strictly positive and summed up to one.[9]

4.1.2. Choice of Variables

Do the three dimensions of HDI sufficiently cover all facets of development? Certainly, the answer is no. In particular the question of *sustainability* is essential and should be incorporated to the index, the sooner the better.[10] Also some aspects regarding social exclusion may help measuring better the differential impact of economic fluctuations. However, caution needs to be taken while increasing the number of dimensions because (i) the larger number of dimensions makes the aggregation procedure more difficult and (ii) the larger number of variables makes the decision on the choice of precise weighting scheme more complex.

Which precise dimensions should be added is a matter of great debate, which is out of the scope of this chapter. However, we provide a critical evaluation of the variables that have been used to measure the three dimensions of the new HDI.

4.1.2.1. The health variable

Life expectancy at birth is an estimate of the average number of years for a new-born in a given society at a given point in time. It is obtained from the mortality tables of the existing population as follows. First, one determines the probability of death at age y, p_y, and then computes the corresponding survival probability at that age, given by $\bar{p}_y = 1 - p_y$. The number of survivors at age y in a given year, S_y, is simply $S_y = S_{y-1}\bar{p}_y$, under the convention of starting from a fictitious population S_0 = 100,000. *Life*

[9] For further discussions on robustness and sensitivity analyses of the composite indices, see Nardo *et al*. (2008), Cherchye *et al*. (2008), Permanyer (2011).

[10] The 2011 edition of the Human Development Report pays particular attention to this issue. The UN team responsible of the Report is actively working on this topic, trying to find ways of incorporating the sustainability dimension to the HDI. See also Eurostat (2005), Costantini & Monni (2005), Neumayer (2011), or Llavador, Roemer & Silvestre (2011).

expectancy at age y (assuming that agents live during half of the year in which they die) is calculated as:

$$e_y = \frac{1}{2} + \frac{1}{S_y}\sum_{i=y+1}^{\infty} S_i = \frac{1}{2} + \sum_{i=y+1}^{\infty}\left(\prod_{j=y+1}^{i} \bar{p}_j\right)$$

Life expectancy *at birth* is simply e_0, that is, the average number of years that a person born in the year of reference will live.

It is clear from the formulation at the right in the above equation that life expectancy at any reference age y is independent of the demographic structure of a country, which allows comparing consistently health in countries with different population pyramids.[11] Life expectancy at birth is a variable that provides a sensible approximation to the measurement of a long and healthy life. Although the data are available for most countries, this variable is a rather elementary in construct. The data show that developed countries exhibit very high values of life expectancy at birth, with a small variance, while they exhibit more relevant differences in the demographic structure. Therefore life expectancy at birth tends to overestimate the development capacities of those countries, with a relatively older population, and to underestimate the development capacities of those countries with a younger population (typically developing countries). In future revisions of the health variable, the adjustment regarding the *quality of life*, besides the *quantity* of life (e.g. in terms of QALYs or self-perceived health states) and regarding population structure (e.g. the relative size of the working age population) should be under consideration. Finally, there is a more essential consideration that refers to whether this is the type of indicator that fits best to evaluate human development.

[11] The independence of life expectancy on the demographic structure is a way of avoiding the "composition effect" that appears when using the average mortality rates. Indeed, it might be the case that country A has a lower average mortality rate than country B while A exhibits higher mortality rates in all age intervals. The reason is that specific mortality rates vary a lot across cohorts and the relative size of the different cohorts may induce this counter-intuitive outcome. That is why life expectancy is preferred.

4.1.2.2. The education variable

The change of the variable that measures educational achievements was probably the most needed one. The HDI 2010 has substituted the old combination of literacy rate and gross enrolment rates by another composite variable that consists of the geometric mean of "mean years of education" (among adults) and "expected years of schooling" (among children), suitably normalized. These two new partial indicators are certainly more informative and capture the essential differences in the level of human capital among countries.

Yet the way in which the composite education variable has been constructed presents two disadvantages worth considering. The use of geometric mean in order to create the composite variable of education makes their impact on the human development index less transparent. Moreover, the geometric mean of the two partial indicators of education amounts to penalising unjustifiably the improvement of the educational expectations of the young, as the geometric mean fosters the equalization of the component variables. Consequently, improvements in children's schooling are only partially reflected in the index of education, which makes incentives to invest in education less apparent. From a different perspective it is worth taking into account that the empirical evidence suggests that, after some minimal threshold, it is the *quality* of education and not the years of schooling indicator that better explains differences in development. The PISA studies provide a rich database to be considered for the future incorporation of the quality of education (e.g. by computing quality-adjusted years of schooling).

4.1.2.3. The income variable

As in the traditional HDI, the new version has kept the strategy of measuring material wellbeing in terms of logs of an income variable (per capita GDP before 2010 and per capita GNI afterwards). The use of logs implies that the effect of one additional unit of a given variable decreases with the level at which this happens. This is the conventional way of describing how the consumption of a given good relates to personal welfare and is an expression of the "decreasing marginal utility" principle. The Human Development Report provides this type of explanation to justify the use of

logs when measuring material wellbeing: and additional euro has a different impact depending on the level at which it happens. The obvious question is: Why this principle is applied to the income variable and not to the other ones in the HDI? Why is that an additional year of life or education has the same value no matter the level at which it occurs?

A reasonable explanation of this asymmetry goes along the lines of the axiomatics provided in Zambrano (2011a) (see also Klugman, Rodríguez & Chow (2011) for a wider discussion). Interpreting raw variables as estimates of *capabilities* permits one distinguishing between direct and indirect indicators of capabilities and then getting the differential treatment of the variables. Even though this is a consistent approach that might justify the use of logs for the income variable, it involves some drawbacks. First, it does not fit very well with some of the novelties of the HDI 2010 (especially with respect to inequality adjusted measures, discussed in the next subsection). Second, it imposes restrictions on the normalization formula, as one cannot take a minimum values below one for the logged variable, no matter the units in which we measure income. Third, it has a relevant impact on the substitutability of the primary variables whose meaning is not very clear (or, alternatively, prevents making sensible calculations of marginal rates of substitution).

4.1.2.4. Rights

We shall be extremely brief on this point as this is a well-known problem: the human development index does not take into account human rights. People in charge of the Human Development Reports are well aware of that. As an example, the heading of Figure 4.1 in the 2010 runs as follows: "A high Human Development Index does not mean democracy, equality or sustainability". Equality has already been taken care of and dealing with sustainability is on the agenda. What about democracy? (e.g. the compliance with some basic rights, as those identified in the Universal Declaration of Human Rights, that goes back to 1948).

The objective of involving as many countries as possible has lead to neglect this basic question and to look elsewhere when dealing with basic rights of citizens. This is an arguable strategy, because it seems to send the message that those aspects are not

so important.

4.1.3. Modelling flaws

The preceding discussion regarding the choice of variables is partly a matter of judgement on which are the best options to approach the different dimensions. We now discuss two aspects that can be regarded as conceptual flaws in the way of modelling the HDI.

4.1.3.1. The normalization formula

As the variables that approach the three human development dimensions are measured in different units, some normalization process is required. Following the procedure already used in the traditional HDI, the normalization formula chosen by the 2010 HDI preserves the maximum and minimum goalposts. The interpretation of maximum and minimum goalposts is somehow different. Maximum goalposts are mostly regarded as a technical devise used to keep the range of variables into a compact interval. Minimum goalposts, on the contrary, are given an ethical content and interpreted as minimum admissible values (a sort of subsistence levels).

We have already seen that a given raw variable, X, is transformed into a normalized variable, x, according to the formula:

$$x = \frac{X - X^{min}}{X^{max} - X^{min}}$$

where x^{max} and x^{min} are the corresponding goalposts. That is, we transform the original values into *relative gains* so that all transformed variables move into the [0, 1] interval and the normalized variables are all unit-free. Note that the above formula can be regarded as a linear transformation of the original variable, $x = aX'$, where $a = \frac{1}{X^{max} - X^{min}}$ defines the *units* in which the variable is measured and $X' = X - X^{min}$ is the *net value* of the variable.

This way of normalizing the variables, however, has three negative implications.

1. It makes the whole construction of the HDI dependent on the arbitrary choices of the normalization parameters. In particular, changing the minimum goalpost can

revert (and indeed does it!) the ranking and modify the relative valuations.[12] This is unfortunate because the dependence of the ranking on the arbitrary choice of normalization values was one of the main criticisms attributed to the arithmetic mean. Note that the multiplicative formula of the 2010 HDI implies that changing the maximum goalposts only affects the units of measurement and therefore it alters neither the ranking nor the relative values of any two countries.[13]

2. Deducting any positive value from the original variables (i.e. using minimum goalposts) worsens the picture we get of those countries with a lower performance while has practically no impact on those countries with higher values. As a consequence, the gap between top and bottom countries increases artificially. A simple illustration obtains by thinking of the health variable: a minimum goalpost of 20 years implies computing 1/2 of the Afghanistan's life expectancy and 3/4 of the Japan's corresponding value.
3. The use of minimum goalpost in the normalization may have a very large effect on the marginal rates of substitution, due to the behaviour of the slope of a Cobb-Douglas function when a given component approaches zero. Therefore, subtracting whatever amount to an already very close to zero magnitude will increase substantially (and again artificially) the associated marginal rates of substitution. This is the main reason behind the polemic substitution rates found in Ravallion (2010); see Herrero, Martínez & Villar (2012) for a discussion and a calculation of marginal rates of substitution without using minimum goalposts.

4.2. The Inequality-Adjusted Human Development Index

The 2010 edition of the HDI took (at last!) distributive issues into account. It not only introduced inequality measures regarding income but also with respect to the two other dimensions. Distributive considerations are introduced by calculating the

[12] It can be checked that calculating the HDI 2010 by normalizing the raw variables as shares to the same max values used in the report (i.e., letting minimum goalposts equal to zero), some 30 % of the countries change their ranking by 5 or more positions.

[13] A change in the minimum goalpost modifies both the units in which the variables is measured and the net value. The first impact only affects the scale and does alter the ranking in a multiplicative formula (as it happens with changes in the maximum goalposts). The second impact is indistinguishable from a change in the level of the raw variable and that is why the ranking is altered.

egalitarian equivalent worth of a given value. That is, if $f_C(C)$ is the mean value of a reference variable C and A_C is an inequality measure, then the egalitarian equivalent value is given by $f_C(C)[1 - A_C]$. This is a well-founded conceptual construction, provided two requirements are fulfilled: (a) Both the inequality measure and the mean value should refer to the very same variable. (b) Perfect equality is the best possible world. Unfortunately, the IHDI does not seem to satisfy those requirements.

Take the income variable first. The egalitarian-equivalent income fits neither with the use of logs nor with the normalization choice. If we measure inequality over the income distribution vector, as it is done in the Report, we cannot use consistently the log of income as the reference variable. Moreover, the normalization used (with or without logs) is also inconsistent, as the chosen inequality measure is sensitive to the choice of minimum goalposts in the normalization.[14] If we want to keep the interpretation of the capability approach proposed in Zambrano (2011 a), one should measure the inequality over the vector of log income values. Be as it may, the inconsistency with the normalization choice remains, unless one measures the inequality over the distribution of the normalized individual logged variables. But the meaning of that exercise is far from clear. Measuring income in logs for the HDI and measuring inequality without logs or normalization, as it is done in the report, violates requirement (a) stated above.

In order to understand why the second requirement is not fulfilled, let us consider the health dimension. Why perfect equality is the most desirable state?. Recall that inequality in health dimension is not based on the inequality in health conditions of the population in a given time period, but it is based on the inequality in mortality rates across different age groups in a given time period. If we consider two countries with same life expectancies at birth, one with equal mortality rates across all age groups and the second with larger mortality rates among the elderly and much lower mortality rates among the children, the latter country would be penalized only because it had made significant improvement in providing health services to the

[14] We consider here the family of *relative* inequality measures, which is the one taken as reference in the Report.

younger generation over, say, the past ten or fifteen years. Even acknowledging that it is quite tough to find a proper indicator to reflect health conditions of the citizens of a country, the present way of computing health inequality is hard to justify and requires further research for improvement.

Another area of concern for the IHDI is the ignorance of the joint distribution of well-being in various dimensions. In terms of measuring poverty, the UNDP has moved in the right direction by introducing a poverty measure that captures the joint distribution of deprivations rather than computing a composite index of poverty. The same, however, has not been true for the human development index or the IHDI. The chosen indicators have not been obtained from a single survey and thus not from the same set of individuals or households within a country. In this sense, the IHDI (and certainly the HDI) still remains a composite of dashboard indices and is being prevented from graduating to a multidimensional index capturing joint deprivations. Is it possible to capture the joint distribution of achievements? The answer is yes, but this requires the data on all indicators to be available from a single survey and across all individuals or households as in case of the MPI. An extension of the class of indices developed by Foster, López-Calva & Székely (2005) has been proposed by Seth (2009, 2013), which captures the joint distribution of achievements and has been used to compute the UNDP's Gender Inequality Index in 2010. This index is in the same class of indices to which the IHDI belongs and may be used when the data are available.

4.3. The Multidimensional Poverty Index

UNDP's effort of upgrading the measurement of poverty from using a composite index (HPI) to a multidimensional index (MPI) capturing joint distribution is indeed novel. However, there are still room for improvement in certain aspects. One is the consideration of inequality across the poor and the second is the different types of robustness of the ranking or pair-wise comparisons with respect to different parameters, such as alternative choices of deprivation cut-offs, poverty cut-offs, and weighting schemes.

Consideration of inequality while measuring poverty has been customary following Sen (1976). By construction, however, the MPI is an average of weighted

deprivations that the poor experience and is not sensitive to inequality across the poor. There are various alternative poverty measures that use binary indicators as the MPI does, but are sensitive to inequality across the poor (see Bossert, Chakravarty and D'Ambrosio 2009; Jayaraj and Subramanian 2009; Rippin, 2011). However, there is a trade-off: these inequality-sensitive poverty indices do not allow the overall indices to comprehend the contribution of each indicator or dimension to the overall poverty, which is crucial for policy analysis. Which of these two properties is more important and whether it is possible to find a way out without sacrificing any of these two properties is a subject for further research.

A second improvement should come from developing a tool that may be used to test the robustness of ranking and country comparisons with respect to the choice of parameters in MPI's construction. Although Alkire and Santos (2010) test the robustness of country rankings with respect to a few alternative weighting schemes, a range of poverty cut-offs and a few different alternative set of deprivation cut-offs, a more sound and concrete approach is required.

5. Concluding Remarks

In this chapter, we present a critical evaluation of the indices for measuring human development and poverty in various Human Development Reports. We show how these indices have evolved over time to capture various aspects of well-being and deprivations. The introduction of simplified indices in the early reports was required to catch the attention of the mass media and policy makers to put the concept of human development in the agenda. However, a simplified index is not sufficient for capturing the complexity of human lives and their development and deprivations. These make the construction of these indices more complex. More complex indices, however, make their interpretation difficult. Hence, further research is required to amend the indices in the direction such that the intuitive interpretations of the indices are maintained and at the same time the complex realities of human development and deprivations are properly captured.

Another important issue with these indices is the requirement of data. We have reiterated that the consideration of joint distribution is imperative in order to graduate an index of well-being or poverty from its composite index status to a truly multidimensional index status. The UNDP has moved in this regard by introducing a multidimensional measure of poverty. However, a move to the same direction has not been possible for the measurement of human development primarily due to the lack of appropriate data. Our proposals for theoretical improvements cannot be materialized without solving the data constraints.

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