The HDI 2010:
New Controversies,
Old Critiques

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Abstract

Since its introduction in the first Human Development Report in 1990, the Human Development Index (HDI) has attracted great interest in policy and academic circles, as well as in the media and national audiences around the world. Its popularity can be attributed to the simplicity of its characterization of development - an average of achievements in health, education and income – and to its underlying message that development is much more than economic growth. Yet the HDI's very simplicity prompted critiques from the start, with some contending that it was too simplistic, while others who accepted its self-imposed limitations still questioned its choice of indicators and its computational methodology. In 2010, for the twentieth anniversary edition, the Human Development Report undertook a comprehensive review of these critiques and introduced several major changes to the HDI. This article is a detailed review of key critiques of the HDI, today and in the past, and explains the recent changes introduced to the HDI formula and indicators.

1. Introduction

The Human Development Index (HDI) is a well-known yardstick of wellbeing. Since its introduction twenty years ago, the index has attracted enormous interest in discussions of development, both in policy and academic circles as well as in the broader community interested in development issues. The simplicity of the index's characterization of development (as an average of achievements in health, education and income), linked to the basic message that development is about much more than growth, has contributed to its popularity.

The index emerged in the first *Human Development Report* (HDR), published in 1990.[1] This was part of an intellectual effort led by the late Pakistani economist Mahbub ul Haq, together with a group of scholars that included Amartya Sen. It was born out of a dissatisfaction with per capita income serving as the standard measure of development. In the words of ul Haq, "[a]ny measure that values a gun several hundred times more than a bottle of milk is bound to raise serious questions about its relevance for human progress."[2]

In many respects, the HDI has been remarkably successful. According to the *New York Times,* "only one measure has succeeded in challenging the hegemony of growth-centric thinking…. the Human Development Index."[3] Its annual publication attracts significant attention from the media and national policymakers from a diversity of countries. Comparative data from internet searches shows that the HDR does far better than its main competitor (the World Bank's World Development Report) in terms of Google searches (Figure 1). The HDR also seems to do better in terms of academic citations, at least since 2005.[4]

[1] The HDR is an independent report commissioned and published by the United Nations Development Programme. All editions are available at: http://hdr.undp.org.
[2] Ul Haq (1995, p. 46).
[3] Gertner (2010).
[4] The numbers of articles published in 2010 citing the HDR were 4470, in contrast to 3020 citing the WDR, according to Google Scholar. See Figure 5 in Wagstaff (2011) for the cumulative "Google Scholar hits."

Figure 1. Popularity of the Human Development Index, Human Development Report and World Development Report, January 2010- January 2011
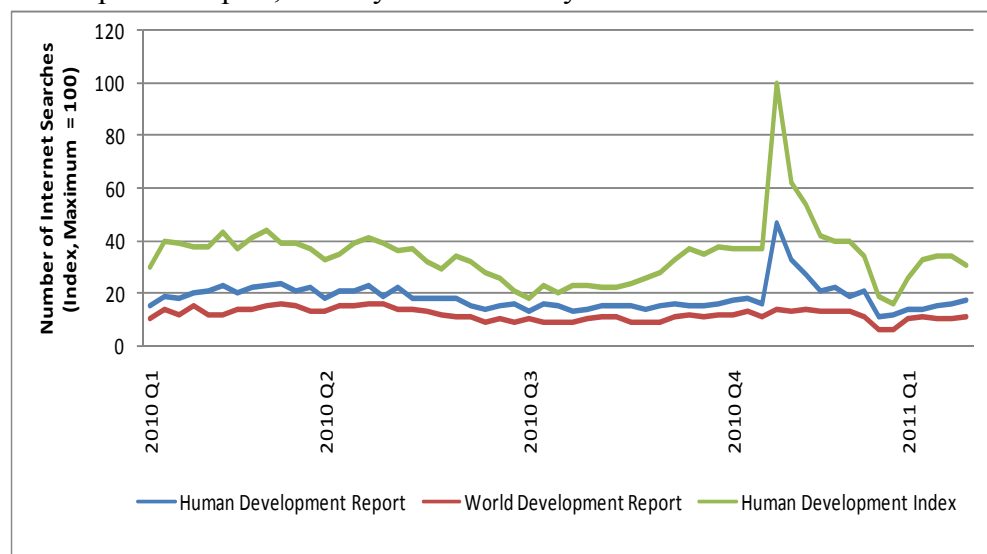
Note: The left axis is the number of searches expressed as a percentage of the highest number attained by any of the three series.
Source: Generated by the HDRO from Google Insights, accessed 3 March 2011.

The HDI has spawned an extensive academic literature which has considered its properties, provided critiques and suggested potential improvements.[5] With the occasion of the twentieth anniversary of the report, the authors of the Report undertook a comprehensive revision of these critiques and introduced several major changes in the 2010 edition. Though this is by no means the first time that the HDI has been modified, it is the first time that major changes have been simultaneously introduced to the indicators used to measure progress and the functional form used to convert them to a single measure of progress.

The purpose of this paper is to explain the rationale behind the new HDI. We start with a discussion of the concept, definition and key insights obtained from the HDI, in section 2. Section 3 outlines the basic criticisms that were leveled at the past HDI methodologies. Section 4 introduces the changes to the functional form and indicators, and explains how these address some of the valid criticisms. Section 5 reviews current debates around the formula, and finally, Section 6 concludes.

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[5] Some key contributions have been published in the *Journal of Human Development and Capabilities* or presented at the annual meetings of the *Human Development and Capabilities Association*. See, for example, Anand and Sen (2000), Chatterjee (2005), Foster, López-Calva and Székely (2005), Gaertner and Xu (2006), and Klasen, Nguefack, and Zucchini (forthcoming). For a recent survey, see Kovacevic (2010), which was part of a comprehensive review undertaken by the HDRO to inform possible revisions.

2. What is the HDI?

The HDI is a composite index aggregating three basic dimensions into a summary measure, which is published annually, using country level information, in the HDR. The motivation behind the structure of the HDI was powerfully expressed in the 1990 HDR in the following terms:

"Human development is a process of enlarging people's choices. In principle, these choices can be infinite and change over time. But at all levels of development, the three essential ones are for people to lead a long and healthy life, to acquire knowledge and to have access to resources needed for a decent standard of living. If these essential choices are not available, many other opportunities remain inaccessible." (UNDP. 1990. p. 10.)

The HDI's simplicity, coupled with the transparency assured by the utilization of data published by international organizations, has been one of the main drivers behind the success of the HDI in the past twenty years.

2.1 The (Old) HDI

Until 2010, the HDI had been defined as a simple arithmetic average of normalized indices in the dimensions of health, education and income:

$$HDI = (1/3)*(H_h + H_e + H_{ls}) \qquad (1)$$

where H_i denotes the sub-index for dimension I, with i={h,e,ls} respectively denoting the health, education and living standards dimensions. Each of these indices were in turn estimated as (or derived from) normalized indicators of achievements in each of these dimensions. Life expectancy (le) and GDP per capita (gdp) were the proxies for health and living standards respectively, whereas the education dimension used two indicators: literacy (lit) and the gross enrolment ratio (ger). The indices were normalized using given upper and lower bounds. Thus:

$$H_h = (le-le_{min})/(le_{max}-le_{min}), \qquad (2)$$

$$H_e = (1/3)*((ger-ger_{min})/(ger_{max}-ger_{min}))+(2/3)*((lit-lit_{min})/(lit_{max}-lit_{min})), \qquad (3)$$

$$H_{ls} = (ln(gdp)-ln(gdp_{min}))/(ln(gdp_{max})-ln(gdp_{min})). \qquad (4)$$

The reason for normalizing each dimension was to allow each of the sub-indices H_i to vary between zero and one, thus allowing the arithmetic sum of the indices given in (1) to give equal relevance to each dimension. The criteria for choosing the upper and lower bounds changed over

time: the 1990 report used observed minima and maxima but in 1994 this was changed to fixed thresholds. In the 2009 report, these limits were:

$$\{le_{min}, le_{max}, \} = \{25 \text{ years, } 85 \text{ years}\} \tag{5}$$

$$\{ger_{min}, ger_{max}\} = \{0 \text{ percent, } 100 \text{ percent}\}$$

$$\{lit_{min}, lit_{max}\} = \{0 \text{ percent, } 100 \text{ percent}\}$$

$$\{gdp_{min}, gdpmax\} = \{100 \text{ US\$, } 40000 \text{ US\$}^6\}$$

When a variable exceeded the upper bound of its dimensions, the value was truncated at the upper bound so that none of the dimension sub-indices H_i exceeded one. In practice, this only arose in the case of income per capita exceeding 40,000 US\$.[7] But while the structure in (1) was the same as that introduced in 1990, the choice of indicators and definition of sub-indices had varied over time. Table 1 outlines the key methodological changes made to the index during this twenty year period.

Table 1. Changes to the Human Development Index, 1990-2010

HDR	Bounds	Indicators			Treatment of Income	Aggregation Formula
		Health	Education	Income		
1990	Observed	Life expectancy at birth (UN Population Division)	Adult literacy rate (25+) (UNESCO)	Real GDP per capita PPP \$ (log) (World Bank)	Logarithmic transformation with a cap	Arithmetic mean
1991 ~ 1993			(2/3)Adult literacy rate (UNESCO) (1/3)Mean years of schooling (UNESCO)	Real GDP per capita PPP \$ (adjusted) (World Bank)	Atkinson formula with threshold value derived from poverty line	
1994			(2/3)Adult literacy rate index (UNESCO) (1/3)Mean years of schooling index (UNESCO)		Atkinson formula with threshold value derived from global average	
1995 ~ 1998	Fixed		(2/3)Adult literacy rate index (UNESCO) (1/3)Combined gross enrolment ratio index with a cap starting to bind in 1996 (UNESCO)			
1999 2000 ~ 2009			(2/3)Adult literacy rate (15+) index (UNESCO) (1/3)Combined gross enrolment ratio index with a cap starting to bind in 1996 (UNESCO)	Real GDP per capita PPP \$ (log) (World Bank)	Logarithmic transformation with a cap starting to bind in 2001	
2010	Upper: Observed Lower: Fixed		(1/2)Mean years of schooling index (Barro-Lee) (1/2)Expected years of schooling index (UNESCO)	Real GNI per capita PPP \$ (ln) (World Bank)	Natural logarithmic transformation without a cap	Geometric mean

Note: GDP per capita was "adjusted" using Atkinson formula in the period from 1991 to 1998.

Table 1 shows that changes prior to 2010 affected one of three aspects of the index. First, there was a move from observed to fixed thresholds in 1994. This was motivated by the idea that there were objective upper and lower bounds to the values, beyond which each of the indicators did

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[6] Unless otherwise stated, all dollar figures are adjusted for purchasing power parity.
[7] Literacy rates were also capped at 99 percent. This meant that the maximum attainable value of the literacy sub-index was 0.99 instead of 1. In the 2009 HDR, the caps on income and literacy were binding for 12 and 44 countries respectively.

not contribute to human development. The lower bound was conceived as some sort of subsistence minimum and the upper bound as a "satiation" point, beyond which additional increments did not contribute to the expansion of capabilities. Second, there were several changes in the measurement of the education dimension: mean years of schooling was introduced in 1991 but dropped four years later because of lack of updates; it was then replaced by the combined gross enrolment ratio of primary and secondary schooling.[8]

The third major change related to the income dimension. From the outset, the authors of the HDR argued that income should receive differential treatment in the index, because unlike the other indicators, income was not a capability but an input into the formation of capabilities.[9] One key idea was that, beyond a certain level of income, additional increments would not yield a significant increase in capabilities. In the 1990 report a cutoff level of income per capita was set to equal the official poverty line in nine industrial countries, an amount equal to $8,193 in 2008 dollars. Starting in 1991, this was replaced by the Atkinson formula in which the return on income would vary at a discontinuous rate as income exceeded multiples of the poverty rate, and in 1994 the poverty rate was substituted by the global average GDP per capita.[10] In 1999, this function was replaced with the logarithm of income, with an upper bound of $40,000. In 2010, the cap on income was removed (as discussed further below). The formula shifted to natural logarithms in order to enable greater familiarity with economics literature more generally, although this did not make any significant difference to the results.

Figure 2 shows the resulting mapping of per capita income into H_{Is} of these different functions. Each function used imposed some level of diminishing returns to income, but varied in method and extent. The 1990 function and the 1999-2009 function specified an upper limit beyond which income was assumed not to count any further for the expansion of capabilities, whereas between 1991 and 1998 the function lacked an upper limit yet did impose significant discontinuities in income's contribution to the HDI. All of these changes can be traced to the attempt to deal with the different status of income in the index as an input into the generation of capabilities, a point to which we return below.

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[8] See *Technical notes* of UNDP (1991, 1995) for further discussion.
[9] Anand and Sen (2000).
[10] The Atkinson formula used in the period from 1991 to 1998 is:

$W(y) = y*$ for $0 < y \leq y*$
$\quad = y* + 2[(y-y*)^{1/2}]$ for $y* < y \leq 2y*$
$\quad = y* + 2(y*^{1/2}) + 3[(y-2y*)^{1/3}]$ for $2y* < y \leq 3y*$
$\quad = y* + 2(y*^{1/2}) + 3(y*^{1/3}) + \ldots + n[(y-(n-1)y*)^{1/n}]$ for $(n-1)y* < y \leq ny*$.

Between 1991 and 1993, the y* was set at the poverty line value of $4,829, while it was replaced by the global averages of $5,120 in 1994 and 1995, $5,711 in 1996, $5,835 in 1997 and $5,990 in 1998.

Figure 2. Conversion of income into the index of living standards, various methods
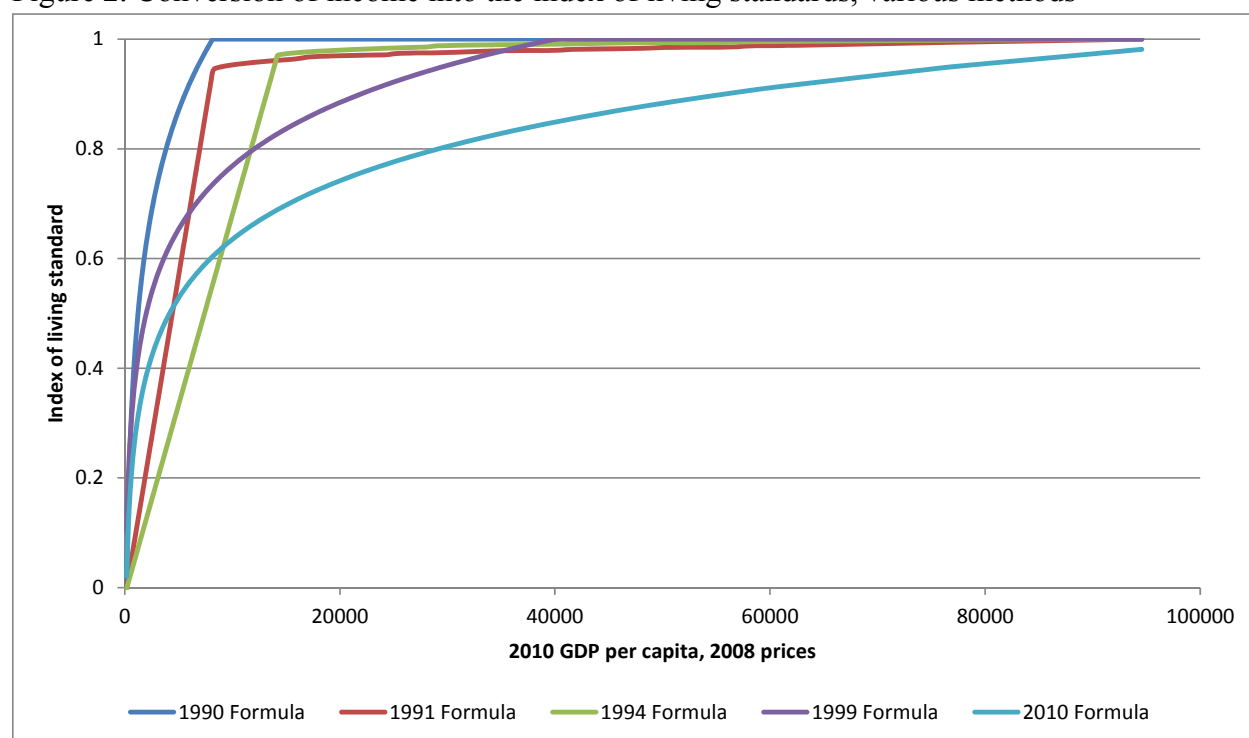
Source: HDRO calculations from HDRO database.

2.2 The HDI as a measure of capabilities

The human development approach is closely related to the idea of human capabilities proposed by Sen (1985, 1999, 2009) and developed further by, among others, Nussbaum (2000, 2006) and Robeyns (2005). In fact, the intellectual origins of both approaches are tightly intertwined. In 1989, as he was joining the team of collaborators that wrote the first HDR, Amartya Sen published the paper "Development as Capability Expansion," in which he argued that "the foundational importance of human capabilities provides a firm basis for evaluating living standards and the quality of life." The close collaboration between Sen, ul Haq and other members of the HDR team led to the idea of capturing these concepts in an aggregate index.[11] The idea of the HDI as an index of capabilities was clearly stated at the outset and in other writings by the report's authors. The 1990 HDR, for example, describes the HDI as "an index that captures the three essential components of human life…longevity and knowledge refer to the formation of human capabilities, and income is a proxy measure for the choices people have in putting their capabilities to use."[12] Anand and Sen (2000) write that "longevity and education are clearly valuable as aspects of the good life, and also valued as constituents of the capability to do other things…the income component of the HDI has been used as an *indirect* indicator of

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[11] The aforementioned New York Times article, in recounting the origins, traces back to discussions between Sen and ul Haq in the 1950s when both were students at Cambridge University.
[12] UNDP (1990, p. 12). See also UNDP (1993), Anand and Sen (1992) and Desai (1991).

some capabilities not well reflected, directly or indirectly, in the measures of longevity and education" (2000, p. 86, emphasis in original).

The term *capabilities* refers to the opportunities that a person has to exercise his or her "freedom to attain different kinds of alternative lives between which a person can choose."[13] The HDI centers on three: living a long and healthy life, having access to knowledge, and a decent standard of living expand these freedoms.

But of course the HDI is a very imperfect measure of capabilities.[14] As we detail below, it only captures some of the relevant dimensions and its choice of indicators is severely restricted by data availability. At the same time however, the concept of capabilities is so broad, rich and abstract, that any aggregate measure (particularly one covering a large number of countries) will necessarily entail a significant degree of generalization and approximation.

Unlike a social welfare function, a capabilities index does not carry the implication that one should seek to maximize it. Rather, a capabilities index is a summary description of the freedom that people have to pursue alternative valuable life plans. Expanding these freedoms should be one objective – and a very important one – of society. However, there is no contention that it should be the *only* objective, and there is the recognition that other objectives will enter into social decisions alongside the pursuit of human development.

For example, a relatively opulent society could decide to pursue actions that further expand the income of many of its citizens. For those of its citizens that are sufficiently well-off, the greater income may contribute to greater pleasure or enjoyment, but does not radically alter the lives they can lead. A society may find it worthwhile to pursue these actions, and the capability approach would not necessarily see this as objectionable. But these further improvements in income would not figure significantly into an index of capabilities, because the capabilities index is trying to capture the ways in which the choices open to people are qualitatively different.[15]

2.3 Contributions of the HDI to the development literature

The HDI was part of an effort to shift attention away from an overly large focus on economic growth as the objective of development policies. In this sense, one of the main purposes of the HDI is to play an advocacy role, seeking to reestablish balance in priorities to counteract a focus distorted by a growth-centric approach. This motivation is evident throughout the 1990 report, starting with its statements in the opening paragraph that the report "is about more than GNP growth, more than income and wealth and more than producing commodities and accumulating

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[13] See Sen (2008 p. 23), Zambrano (2011b) presents a more detailed description of the HDI as a capabilities index.
[14] See Sen (2003) for a discussion of the HDI's limitations.
[15] This is partly the motive for using a logarithmic transformation of income in the index, as we discuss in greater detail below.

capital." (1990, p. 1). The explicit comparison of HDI and GDP rankings (p. 128-129) likewise drove home the point that the essence of the human development approach was to go beyond income to a broader vision of human development.

Some critics, however, contend that the growth-centric approach that the HDR was designed to counter is merely a straw man. In an early review, T.N. Srinivasan wrote that "income was never even the primary, let alone the sole, measure of development, not only in the minds of economists but, more importantly, among policymakers."[16] It is true that much of development economics in the postwar era was about the structural transformation of economies and how this related to changes and improvements in multiple dimensions of well-being, including health and education, and that development practice up through the 1970s put significant emphasis on the promotion of national and global health initiatives.[17]

This criticism of the HDI, however, misses the point that the human development approach was motivated more as an explicit challenge to the reigning paradigm of the late 1980s in development policy circles, commonly known as the Washington consensus.[18] The "new" development economics was nowhere better symbolized than in the World Bank's *World Development Report's* practice of ranking countries by per capita income in the presentation of its tables. But it also found concrete expression in a literature which, using cross-national data sets to measure the effects of different determinants on economic growth, that would mushroom in the next decade; a literature that would in turn be closely associated with the policy recommendations of the Bretton Woods Institutions.[19] The HDR and HDI were essentially conceived as alternatives and responses to these approaches.

The HDR's effect on development debates is reflected in, among other things, the World Bank's approach to key topics. In 1997, the World Bank created the Human Development Network, whose main mission is to inform the public of the institution's promotion of sustainable and inclusive investment in people. The 2000/01 World Development Report on Attacking Poverty was a turning point in the institution's analysis, placing significant emphasis on non-income dimensions of well-being. This framework went beyond health and education, incorporating such topics as empowerment and security as important dimensions of wellbeing. A few years earlier, in 1998, the Bank had abandoned its practice of ranking countries by per capita income and shifted to an alphabetical presentation of its tables.

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[16] Srinivasan (1994).

[17] Examples include the UN Expanded Programme on Immunizations in the 1970s and 1980s, the UNESCO regional conferences on free and compulsory education held in the 1950s, and Indonesia's massive expansion of education under its INPRES program in the 1970s.

[18] It is interesting that John Williamson's (1990) original characterization of the Washington consensus was as a rejection of the broader concerns of traditional development economics.

[19] This literature is broadly recognized as having begun with the 1989 publication or Robert Barro's article "Economic growth in a cross-section of countries". See Barro (1991); Barro and Sala-i-Martin(2003) provide a comprehensive survey of this approach.

One way in which the HDI helps highlight other components of development is by pinpointing the differences in rankings that emerge from a comparison between the HDI and per capita incomes. Ul Haq (1995) pointed out that, of the 173 countries included in the HDI rankings, for only four countries, there was no difference between the HDI rankings and the per capita income rankings and less than a five-rank difference for 29 countries, while for more than a third of the sample the HDI and per capita income ranks differed by more than 20 places. These patterns still hold today (Table 2).

Table 2. Distribution of differences between per capita income ranks and HDI ranks

| Differences in Ranks	Distribution
30+	5%
20-29	11%
10-19	31%
5-9	30%
less than 5	23%

Note: Data from 169 countries listed in 2010 HDR.
Source: HDRO calculations from HDRO database.

Despite these differences in ranks, it is true that there is a strong correlation between the levels of the HDI and per capita income. This is not surprising as it reflects the fact that more developed countries tend in general to be richer, healthier and more educated than poor countries. Here the difference between changes in the HDI and per capita income are important. As explored in the 2010 HDR, even over relatively long periods of time, there is little correlation between improvements in per capita income and improvements in the non-income dimensions of human development. A positive correlation will still exist between the HDI and economic growth, which reflects the fact that income growth is by definition part of what changes the HDI. But once we purge this component from the HDI by centering on the non-income components (Figure 3, right panel), the relationship disappears, becoming statistically insignificant.[20] This underlines the importance of paying attention to the non-pecuniary dimensions of human development.

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[20] The nonincome HDI comprises the health and education indices, equally weighted. The correlation between changes in the nonincome HDI and economic growth is negative (-0.30) and statistically significant at the 1 percent level. However, this measure may be biased by the fact that less developed countries tend to have faster rates of improvements in the HDI. Thus in Figure 2 we use the deviation from fit measure to account for different HDI starting points. The corresponding correlation is 0.13 and is not statistically significant. This robust finding does not depend on the specific indicators used to calculate nonincome human development.

Figure 3. Weak relation between economic growth and changes in health and education, 1970-2010
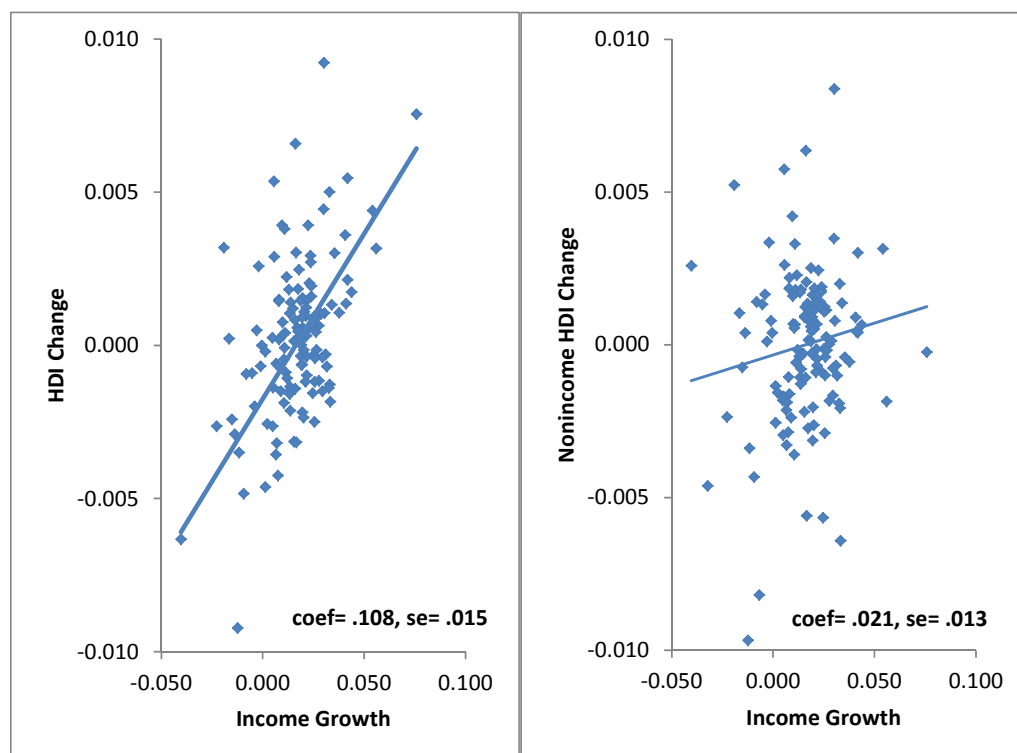
Note: Based on the analysis of deviation from fit method adopted in the 2010 HDR. Income is per capita GDP.
Source: HDRO calculations from HDRO database.

This underlines the point that the choice between a growth-centered approach and a broader definition of human development makes a difference to our objectives and our assessment of progress, with important implications for policy design. The human development approach has also made significant contributions to our measurement of poverty and inequality, showing that multidimensionality also matters to the assessments that are commonly made in those dimensions.[21]

3. The old critiques

Despite the ongoing media popularity and insights offered by the HDRs, the HDI has not been unanimously embraced among academics. At one extreme, some have described it as an overly simplistic representation which has little, if any, conceptual or theoretical basis.[22] But there also have been more constructive critiques. In this section we review concerns about the choice of

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[21] UNDP (2010, Ch. 5)
[22] For instance, McGillivray (1991) calls the HDI "yet another redundant composite inter-country development indicator," while Srinivasan (1994) claims "the HDI is conceptually weak and empirically unsound …. Meaningful inferences about the process of development and performance as well as policy implications could hardly be drawn from variations in HDI."

variables, functional forms, and the issue of redundancy and robustness, before we introduce the new HDI 2010 and its response to these critiques.

3.1 Choice of variables

Critiques of the choice of variables used in the HDI take two broad forms. First, the aspects of well-being included in the HDI (which we refer to in what follows as the *core HDI dimensions*) obviously excludes other dimensions, such as equity, political freedoms, human rights, sustainability and happiness – just to name a few. Second, some specific indicators used to measure the core dimensions have been questioned.

Among critics of the narrowness of the HDI are Sagar and Najam (1998), who noted that the HDI "ignores the environmental dimensions of development, especially the relationships between the performance of countries on the environmental and human development dimensions."[23] This concern can be extended to other dimensions of capabilities, as the HDI is obviously not capturing all of people's freedoms and opportunities, but only a restricted subset. For example, Martha Nussbaum (2000) has defined a list of ten basic capabilities, such as being able to move about freely, to engage in various forms of social interaction, to participate effectively in political choices or to be protected against discrimination. Most of these capabilities are not measured in the HDI.

The criticisms leveled at the indicators used to measure the core dimensions are partly conceptual. A longstanding issue has been that the HDI is a mixture of stock and flow variables, as well as of inputs and outputs. For example, the gross enrolment ratio is a flow variable which is also an input into the educational process, whereas literacy measures a stock.[24] However, the distinction between stocks and flows is not always clear.[25] For example, life expectancy has been described both as a flow and as a stock variable. In fact, neither description is completely accurate: life expectancy is the *expectation* of a stock *conditional* on current flows (in particular, current age-specific mortality rates), which responds directly to changes in these rates (like a flow variable) even though the intrinsic concept represented (the average years of life of a population) is a stock.[26]

It has also been noted that the reported indicators do not truly capture variations across countries in the relevant dimensions. Life expectancy is a measure of longevity but tells us nothing about the health of people during the time that they are alive and only captures part of the dimension of

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[23] Among others, there is Dasgupta and Weale (1992) which attempts to include political and civil liberties into their index.
[24] Gross enrolment ratio was adopted in 1995 while adult literacy ratio was used since the outset.
[25] We use the conventional definition of stock or state variables as quantities that are measured at a given moment of time, and flow or control variables as quantities measured per unit of time.
[26] The use of life expectancy as a measure of current health is common.

"a long and healthy life."[27] Similarly, literacy and enrolment ratios tell us nothing about the quality of that education, and the criticisms of GDP for its failure to capture non-market activity, disregard for distribution or international transfers are well known.[28]

3.2 Functional form

The functional form of the HDI – described above – has attracted much attention, among other things because its simplicity leads one naturally to ask whether a more detailed consideration of welfare-theoretic issues would lead to a more complex form. Key concerns relate to the substitutability assumptions, the normalization of indicators, the asymmetric treatment of income, and the choice of weights.

The issue of substitutability has been raised by several authors, including Desai (1991), Palazzi and Lauri (1998), and Nathan et al. (2008). They saw the additive form of the HDI as problematic, because this implies perfect substitution across dimensions. There are constant marginal returns to improvements in each dimension, and therefore the marginal rate of substitution between dimensional achievements is also a constant. This would seem to run counter to the intuition that, the worse the deprivation in a particular dimension, the more urgent the efforts to improve achievements in that dimension should be regarded. For example, imagine that a country is suddenly affected by an epidemic that directly impacts on mortality and life expectancy, yet does not immediately reduce education or income (Botswana, one could argue, is just such an example). The linear aggregation formula tells us that we should not give any more priority to investments in health, relative to those that improve education nor living standards, than we did before the HIVAIDS crisis. It also leads to somewhat paradoxical results: if a society were to seek policies to maximize its HDI, it may lead to corner solutions, where it would completely emphasize one dimension and disregard the others.[29]

Ravallion (1997), in contrast, argued that there is *too much* substitutability in the HDI. Note that while the HDI assumed perfect substitutability across dimensions, this is not the same thing as perfect substitutability across indicators. To understand the difference, note that in equation (4) above the variable *gdp* is the indicator used to measure income, but this is distinct from the index H_{ls} used to measure the living standards dimension. Because equation (4) assumes that the dimension index used to measure living standards is concave in the indicator of income,[30] the index will display imperfect substitutability between per capita income (an indicator) and the

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[27] UNDP (1990, p. 10).
[28] GDP per capita has always been used as a measure of income.
[29] As we discussed in section 2 above, HDI maximization has never been prescribed by the HDR, because of the key distinction between a capabilities index and a welfare measure. That said, it is still worthwhile to investigate the implications of maximizing the HDI (i.e., if promoting human development was the only objective and we believed that the HDI is a good enough approximation to that).
[30] The logging of income attempts to capture the idea that the transformation from income to capabilities is concave. See Anand and Sen (2000) for an elaboration of this point.

health and education indicators even if it displays perfect substitutability between dimensions. One consequence of this fact is that the marginal rate of substitution of longevity for income (i.e., the number of dollars that one would trade-off for an extra year of life if one were maximizing the HDI) goes up with income. Ravallion argues that the rate at which the trade-off increases with income, (which will vary inversely with the degree of substitutability), is too high.[31]

The arithmetic formula also means that results are sensitive to the choice of normalization. The problem emerges from the fact that the ordering produced by an additive functional form is not invariant to the scale used for measurement of the dimensions. The choice of normalization, which is in principle designed to keep the index on the 0-1 range, can thus have significant implications for the index values, and rankings. Different normalizations will imply different marginal effects of each variable's improvements on the HDI, with the choice of normalization implying a choice of implicit weights.[32]

Since 1994, the HDI had used fixed upper and lower bounds.[33] This led to the practice of "capping" i.e., truncating at the upper bound. By 2009, 12 countries (including Norway, Ireland and Kuwait) had their income capped at $40,000 for the purposes of HDI calculation. This strong discontinuity in the index was justified in terms of the diminishing marginal effect of income on capabilities, although the latter was already incorporated in the logarithmic transformation. The idea that increases in average income beyond $40,000 make no contribution to capabilities seems rather extreme, particularly as part of these increases in average income could reflect improvements in the availability and remuneration of jobs for more disadvantaged groups. A similar problem would have arisen when countries start surpassing the 85 year cap on life expectancy.[34]

Finally, but not least, the choice of equal weights has been criticized. This point has been recognized by Anand and Sen (1997), who wrote that "any choice of weights should be open to questioning and debating in public discussions." Ideally, the weights in the HDI should be traced either to individual preferences, some collective social choice process, or to a strong normative argument. One could, for example, derive these indicators from some type of empirical exercise, such as principal components analysis. Klasen, Nguefack and Zucchini

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[31] Ravallion at times appears to disagree with the idea that the MRS should increase with income, and at other times he appears to be objecting only to the speed with which it declines. For example, he writes "It can be granted that a rich person will be able to afford to spend more to live longer than a poor person, and will typically do so. But that does not justify building such inequalities into our assessment of progress in 'human development."(2010 a or b, p. 18) However, his proposed alternative, which we discuss in greater detail in section 5, also has an $MRS_{le,y}$ which is increasing in income, although it increases more slowly than that of the HDI.

[32] This point is discussed in Kovacevic (2010).

[33] With fixed bounds, the effect of moving between the extremes of the distribution of any given variable will have greater effect the farther the extremes are from the bounds.

[34] UNDESA-PD (2009). According to the United Nations' Department of Economic and Social Affairs' medium variant population projections, Japan will have reached this threshold by 2025-2030 period and 15 others will have joined by 2045-2050 period.

(forthcoming) carry out this exercise on 1975-2005 data, and show that the first principal component, which accounts for between 78 and 90 percent of the total variability in the data, has nearly equal weights, thus providing a statistical justification for the HDI weighting scheme.[35] In more practical terms however, in the context of a global report like the HDR, as ul Haq argued, equal weights were decided and justified "on the simple premise that all these choices were very important and that there was no *a priori* rationale for giving a higher weight to one choice than to another." (1995, p. 48)

3.3 Redundancy and robustness

A related concern is whether the rankings derived from the HDI are sufficiently robust to different weighting schemes and changes in the underlying data. To some extent, of course, robustness is the flip side of redundancy: if there is perfect correlation between index subcomponents, then any set of weights will deliver the same ranking, so the index will be both robust and completely redundant.[36] Similarly, a low correlation among indicators implies that the choice of weights is very important in determining country rankings, and thus that the index is unlikely to be robust to this choice.

Recent empirical investigations have confirmed that the HDI is actually quite robust to the choice of weights – which is good news, although this in turn could be taken to buttress concerns about potential redundancy.[37] However, as we showed in Table 2 above, there are still very significant differences in country rankings between HDI and per capita income, and there are very different patterns in changes of time. So while the correlation between the levels of the HDI and its potential components is high, the index itself does provide important insights.

One could contend that such insights could just as easily be derived from separately analyzing disaggregated information on each of the component dimensions, and that summarizing all of this information in an aggregate number obscures important details, something unnecessary in a world in which the cost of conveying disaggregate information is low.[38] But this ignores the communicational effectiveness of both the aggregate indicator and the derived rankings in helping to focus attention on the differences between income and other relevant dimensions of

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[35] See also Noorbakhsh(1998). Critics contend that the results of these exercises are irrelevant as the empirical correlation of observed variables has no bearing on their normative relevance. Brandolini (2007), for example, states that "we should be cautious in entrusting a mathematical algorithm with a fundamentally normative task." To illustrate the critique, imagine the case in which achievements in education were orthogonal to achievements in the other two dimensions, perhaps as a result of political economy constraints. In that case, the first principal component would give a zero weight to the education dimension, but one should not conclude from that result that education is not a relevant component of human development. See also Decancq, Decoster, and Schoekart (2007) for a related argument.

[36] The Spearman rank correlations between the HDI and per capita income, life expectancy and gross enrolment ratios for 182 countries in the 2009 HDR are respectively 0.95, 0.93 and 0.87.

[37] See Cahill (2005), which establishes robustness using various combinations of weights for the subcomponents. See also García and Kovacevic (2011)

[38] Ravallion (2010a) has recently made this argument.

development (as shown in Figure 3 above). Thus, while the HDI is a single number, its contribution to policy debates has been, precisely, to illustrate the multidimensional nature of development.

Furthermore, such a criticism also ignores the fact that many basic questions about development have been framed in a unidimensional way. Some examples are what the causes of long-run development are, whether poor and rich countries have been converging over time, and what the most successful development experiences of recent times are. Addressing these questions has been the objective of an extensive literature in economic development, much of which uses per capita income growth as the preferred indicator of development. However, some of the answers to these key questions differ significantly depending on the chosen indicator of development. For example, over the past four decades there has been convergence in human development though not in income, and of the ten countries with fastest improvements in the HDI, only three are also top ten growth countries for the same period.[39] The choice of headline indicators thus has a significant effect on the answers to some basic questions about the development process.

4. The 2010 HDI

The 2010 *Human Development Report* introduced several changes in the HDI. The new formula, which replaces (1), is:

$$HDI = (H_{Health} * H_{Education} * H_{Living \; standard})^{1/3} \tag{6}$$

The indices H_i are still normalized indicators of achievements. Life expectancy (le) remains the indicator for the health dimension, while Gross National Income (gni) replaces GDP as the measure for living standards[40], and while mean years of schooling (mys) and expected years of schooling (eys) now make up the education dimension. The rationale for the introduction of new indicators is explained in section 4.1 below:

$$H_h = (le-le_{min})/(le_{max}-le_{min}), \tag{7}$$

$$H_e = [((mys-mys_{min})/(mys_{max}-mys_{min})) *((eys-eys_{min})/(eys_{max}-eys_{min}))]^{1/2 \; 41} \tag{8}$$

and

$$H_{ls} = (ln(gni)-ln(gni_{min}))/(ln(gni_{max})-ln(gni_{min})). \tag{9}$$

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[39] For a more extensive discussion of these results, see chapters 2 and 3 of UNDP (2010).
[40] GNI is measured in constant, PPP adjusted dollars of the year in which the most recent internationally comparable purchasing-power adjusted price data exist, which was 2008 for the 2010 report.
[41] This index is then normalized using zero and the observed maximum value of the composite education index,

The upper values are now set to observed maxima over the time series between 1980 and the most recent year available, while the lower bounds are set equal to subsistence minima (as detailed in section 4.2 below):

$$\{le_{min}, le_{max}\} = \{20, 83.2\} \tag{10}$$

$$\{mys_{min}, mys_{max}\} = \{0, 13.2\}$$

$$\{eys_{min}, eys_{max}\} = \{0, 20.6\}$$

$$\{gni_{min}, gni_{max}\} = \{163, 108211\}[42]$$

In sum, this form retains the same three-dimensional structure with equal weights, with several key changes. It replaces the indicators for income and education, it changes the method of aggregation from an arithmetic average to a geometric average, and it redefines the upper and lower bounds used to normalize the index, eliminating the practice of capping variables that surpass the upper bounds. We now discuss in greater detail how these changes address the concerns discussed in section 3.

4.1 Choice of dimensions and indicators

Dimensions and weights
The 2010 HDR decided not to introduce any new dimensions into the HDI, on several grounds. While it does not argue that the core dimensions necessarily have primacy over additional dimensions, it does offer a distinction, borrowing on Sen (2002), between two types of freedoms that are valued by the human development approach: the freedoms which give us greater opportunities to achieve those things we value (opportunity freedoms), and those that ensure that the process through which things happen is fair (process freedoms). Using this distinction, the HDI can be characterized as an index of opportunities freedoms. The 2010 HDR makes a strong case for the consideration of several process freedoms in the discussion of human development, and explores in its chapter 4 the evolution of the "broader dimensions" of human development: empowerment, sustainability and equity.

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[42] The sources for these variables are respectively UN Population Division (Life expectancy at birth), Barro and Lee (2010) (Mean years of schooling), UNESCO Institute for Statistics (Expected years of schooling), and World Bank and IMF (Gross national income). The income per capita of $108,211 corresponds to the United Arab Emirates in 1980. It is important to note that this value is quite high because constant price GDP data evaluate the level of income that an economy would have at the base year's prices if it had the level of production of the year at which production is valued at the prices of the base year. In the case of oil exporters, this often leads to the paradox of a level of real income that is quite different from what they were able to attain at the prices prevailing at the time production was measured. This is because constant price series fix both nominal and relative prices to those of the specified price year, and thus do not capture variations in purchasing power that come from changes in relative prices. For a discussion of these types of counterintuitive results in the case of oil abundant economies, see Rodríguez (2006).

However, the 2010 HDR's case for keeping the measurement of opportunities and process freedoms separate is largely pragmatic. Measurement difficulties coupled with political controversies makes the incorporation of these dimensions into the HDI in itself very difficult. For example, the use of indicators of agency, political freedoms, civil liberties and accountability in the tables of the 2010 Report prompted formal complaints before the United Nations by Cuba and the League of Arab States. These problems are not new: the publication of similar analyses had led to a General Assembly discussion in 2002, and the attempt to construct an index of Political Freedom in 1992 generated a huge political backlash during which the continuity of the Report was perceived to be in jeopardy.

At the same time, it was possible to address one key critique: the neglect of inequality. Three new measures of the distribution of human development are introduced: the Inequality-Adjusted HDI, the Gender Inequality Index, and the Multidimensional Poverty Index. These new indices are discussed in greater detail in section 6 below.

The measurement of other dimensions presents considerably greater practical challenges. An ongoing debate about measuring sustainability has pitted advocates of weak sustainability (who believe in high rates of substitutability among different types of capital) against those who defend the idea of strong sustainability (who believe that it is very difficult to substitute for the degradation of natural capital). Even for a given definition of sustainability, some of the technical problems in the valuation of different types of capital are daunting.[43] For empowerment, the problems are even more prominent. There is no consensus on the definition and measurement of empowerment. The 2010 HDR takes a broad view of the concept, defined so as to include political and civil liberties, as well as direct exercise of agency.[44]

Indicators
Conceptually, there are three distinct reasons that could motivate a change in indicators. A new indicator may be introduced because *measurement improvements* make feasible its construction for a sufficiently large number of countries, as the benefits of its use outweigh the costs of measurement, where in a more restrictive sample they would not. A change of indicators could also be the result of a *conceptual reconsideration* of the compatibility between different measures and the purpose of the index. Alternatively, a new indicator could be introduced because the indicators used previously had lost *current relevance* as a result of structural changes.

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[43] Neumayer (2010). For a more detailed discussion on the issue and concept of sustainability, see Neumayer (1999).
[44] The meaning of agency and empowerment are much debated in the literature. Sen (1985) defines agency, as "*what a person is free to do and achieve in pursuit of whatever goals or values he or she regards as important*" (p. 203). Some scholars define empowerment as the expansion of agency (Ibrahim and Alkire 2007, Sen and Batliwala 2000) while others emphasize the role of entitlements and opportunity structures (Narayan 2005, Kabeer 1999). For one of the first attempts at systematic measurement of empowerment, see World Bank (2000).

Three of the four variables that go into the HDI were revised. GDP per capita was replaced by GNI per capita (both valued in PPP US$), whereas literacy and gross enrolments were replaced by mean years of schooling and expected years of schooling. This section explains in greater detail the rationale behind these changes.

Revisions took into account measurement improvements and the wide array of conceptually solid measures that exist. Unfortunately, closer considerations of these alternative measures generally revealed that these measures are available for far fewer countries than typically covered by the HDI, and are often not updated frequently enough for an index that is published yearly.

The best example is perhaps that of life expectancy. Life expectancy is of course a measure of longevity, but this is only one of the ingredients of "a long and healthy life." The World Health Organization has reported Health-Adjusted Life Expectancy (HALE) for 192 countries, as the number of years that a person might expect to live in good health. The estimates are based on country life tables, analyses of 135 causes of disability for 17 regions of the world and 69 health surveys in 60 countries. Despite the significant problems of inter-country comparability of disability concepts and other data limitations, HALE is a promising avenue. However, the WHO does not at present have plans to regularly update its estimates of HALE so this is not presently a viable candidate for inclusion in the HDI. Existing estimates of malnutrition could also have been a useful counterpart to life expectancy, but the data are of a variable quality across countries.[45]

Similar problems arose in the case of education, where the cross-national assessments of science, mathematics and reading levels that could be used to construct quality adjustments are only available for a limited number of countries.[46]

The approach in the 2010 HDR was to adopt mean years of schooling as calculated in Barro and Lee (1993, 1996, 2001, 2010) as the indicator to measure the education of adults. This indicator is more frequent, has broader coverage, and better discriminatory power than literacy. The methodology used to estimate this figure is well-established and broadly accepted and the Barro-Lee estimates of educational attainment have become the standard measure of human capital

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[45] Perhaps the most striking problem of this data provided by the FAO is its inability to differentiate among the countries with relatively high development – for the period of 2003 to 2005, 70 out of the total 154 countries were coded "<5%" for the proportion of the malnourished. Herrero, Martínez and Villar (2010) propose an alternative HDI which uses indicators especially suited for analysis of human development in highly developed countries, and apply their proposal to OECD countries.

[46] From the 2007 data from Trends in International Mathematics and Science Study (TIMSS) provided by the International Association for the Evaluation of Educational Achievement (IEA), the 2007 average scores in mathematics and science of fourth graders and eighth graders are available only for 36 countries and 48 countries, respectively, including Hong Kong SAR and Chinese Taipei.

used in cross-country empirical work.[47] The calculations are based on primary data from the UNESCO Institute of Statistics' Database of Censuses and can thus be replicated and updated.[48]

The replacement of the literacy measure by mean years of schooling is, however, also an example of a revision whose main purpose is to ensure current relevance. Literacy – which had up to now carried a 2/3 weight in the education index – has become deeply unsatisfactory over time as a measure of progress in education. The world average literacy rate rose from 60 to 83 percent between 1970 and 2010. Almost half of countries have a literacy rate higher than 95 percent[49] and, indeed, developed countries no longer collect data on basic literacy. Further, many developing countries are poised to attain universal literacy in future years, as younger cohorts emerge from the schooling systems. While literacy was likely a good measure to evaluate progress during the past two decades, it is unlikely to be as informative of the future.

The new HDI also changed its measure of the education of children, replacing the gross enrolment ratio with a measure of expected years of schooling.[50] This captures the average number of years that children today could be expected to attain in adulthood if enrolment rates stay at their current levels. Formally, expected years of schooling in year t

$$eys^t = \sum_{i=0}^n \frac{E_i^t}{P_i^t} \tag{11}$$

Where E_i^t is the enrolment of children of age i, and P_i^t is the population of age i in that year. n is the theoretical maximum age of schooling. Thus, if all the school-age population is enrolled in school, $eys^t=n$, but with less than one hundred percent enrolment, eys^t will generally be lower than n[51] and will recast the enrolment information into the same units in which we are measuring the education of adults (years of schooling), so that the education index is now framed as a measure of years of schooling, with the education of current and future generations receiving equal weights. This is an example of a conceptual reconsideration, where it was deemed desirable to have an education index expressed in terms of a relevant outcome variable, in this case years of schooling.

There is by now a well-known and extensive literature on the drawbacks of GDP per capita as a measure of well-being and economic progress, most recently aptly summarized by the report of

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[47] See Durlauf, Johnson and Temple (2005) and Bosworth and Collins (2003).
[48] HDRO is currently working with UNESCO with the objective of setting up a mechanism whereby UNESCO can take up the reporting of mean years of schooling data based on the Barro-Lee methodology or some variant thereof. The mean years of schooling indicators is estimated by Barro and Lee using primary census and survey data for five-year intervals.
[49] The population-weighted figures are derived from the 135 countries used in the trend analysis of the 2010 HDR, covering 92% of the world population. Among these countries, 64 countries registered the literacy rates of 95% or higher in 2010.
[50] Also known as school life expectancy.
[51] UNESCO Institute for Statistics (2011).

the Commission on the Measurement of Economic and Social Progress led Joseph Stiglitz, Amartya Sen and Jean-Paul Fitoussi (2009). Some of these criticisms relate to its inadequacy as a broader measure of welfare or capabilities (and thus need not apply to its use in the HDI, where it is but one of several components), but others do relate to its ability to measure an economy's capacity to provide goods and services to its people. Most notable among its shortcomings are that it does not measure non-market activity, such as subsistence agricultural production or household work, that it does not register productivity growth in the provision of public goods, that it makes no adjustment for the depletion of natural resources, and that average income is often not representative of the typical person's income.

In order to put some of these criticisms in perspective and to understand their relevance to the HDI, it is important to consider why income is included in the HDI in the first place. As discussed in the early HDRs as well as by Anand and Sen (1995), income differs from health and education in that it is not a direct measure of a capability but rather an input into these capabilities. The relevant capabilities include adequate nourishment, shelter, and access to participation in the basic life of society. Attaining these capabilities requires people to have command over a basic set of resources necessary to ensure a decent standard of living.

In other words, the measure of income in the HDI is a proxy for the typical person's command over resources that they can use to acquire goods and services, and save for the future. Note that this is very different from the idea of GDP as a measure of how much an economy can *produce*. The contrast is perhaps most evident in the case of transfers between countries. Gross *Domestic* Product does not include transfers received from other countries while it does include transfers sent to other countries (i.e., it does not subtract them from GDP), as it is meant to capture the goods and services produced within the territory of an economy. For a measure of an economy's productive capacity, GDP captures what the economy's factors of production can be employed to produce. But to the extent that one wants to capture command over resources, one would like to include transfers from abroad and exclude transfers to other countries. The new HDI does this by replacing per capita GDP with per capita Gross National Income (GNI), which is equal to GDP less primary income payable to non-resident units plus primary income receivable from non-resident units.[52] This is another example of a conceptual reconsideration leading to a change in the indicators used in the HDI.

The new indicators recast the HDI closer to the concept of outcomes, thus addressing one of the criticisms leveled at the old formula. But the combination of stock and flow variables persists. As noted in section 3, this issue is not easy to resolve: life expectancy is the expected value of a stock conditional on the assumption of constant future flows (i.e., constant age-specific mortality rates). A similar characterization is true for expected years of schooling. A measure of average (or perhaps median) wealth would probably be the most appropriate measure of people's

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[52] World Bank (2010).

command over resources, yet attempts to measure wealth stocks at a cross-national level are not yet well established;[53] thus the best proxy for command over resources is a flow variable (GNI per capita). Therefore, the HDI now combines a stock variable (mean years of schooling), a flow variable (GNI), and two expectations of stock variables conditional on current flows (life expectancy and expected years of schooling).

Data limitations force some degree of pragmatism. The combination of stock and flow variables appears to be unavoidable in a composite measure that attempts to combine information on the core dimensions of human development. To the extent that the flow variables are understood as proxies for the stocks one would want to measure in the index, this appears to be an acceptable compromise. But for analytical purposes it is important to bear in mind that the stock components of the HDI will react only slowly to changes in policies or other determinants, while the flow components (including the expectation of future stocks conditional on current flows) can change rapidly.

4.2 Functional form

Perhaps the most radical innovation introduced in 2010 was the shift to a geometric mean in order to aggregate dimensional indices. This marks a significant conceptual change in the way in which one conceives the relationship between different dimensions of capabilities.

The shift to the geometric mean addresses the issue of perfect substitutability discussed in section 3.2 above. This was a problematic assumption of the old formula, because it implied that the level of priority to be given to a dimension was invariant to the level of attainments. In the words of Desai (1990): *"Going back to the notion of capabilities as being corealisable, one should try to restrict the substitutability as between the basic variables (…) [making the] deprivations multiplicative, each feeding off the other. Such a weighting would heighten the plight of the very poor and make the gradient of human development steep."*

Figure 4 contrasts the new HDI functional form with the old one in terms of a set of iso-capabilities curves mapping the levels of individual capabilities (health, education, living standards) consistent with a given HDI level. For simplicity, we represent these curves in the two-dimensional space of health and education, given the level of living standards, although a similar representation applies in any two of the index's three dimensions. The old HDI functional form (I_o) is represented by a linear iso-capabilities curve in which the improvements in health that need to be obtained to offset a decrease in education and maintain the same capabilities index do not vary with the level of each variable. This is the case of perfect substitutability, wherein the rate at which you substitute one capability for another one is constant. At the other extreme, we could have a fixed coefficients function (I_f), also known as the

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[53] The closest are the World Bank's (2006) wealth stock estimates. However, the assumptions on relative valuation of different types of capital implicit in this exercise are controversial.

Leontief functional form, in which the only way to increase well-being is by improving both dimensions simultaneously – this is the case of full complementarity.[54] The iso-capabilities curve corresponding to the new HDI functional form (I_n) occupies a middle ground between these two extremes, characterized by some level of both complementarity and substitutability.

Figure 4. Iso-capabilities curves corresponding to different substitutability assumptions
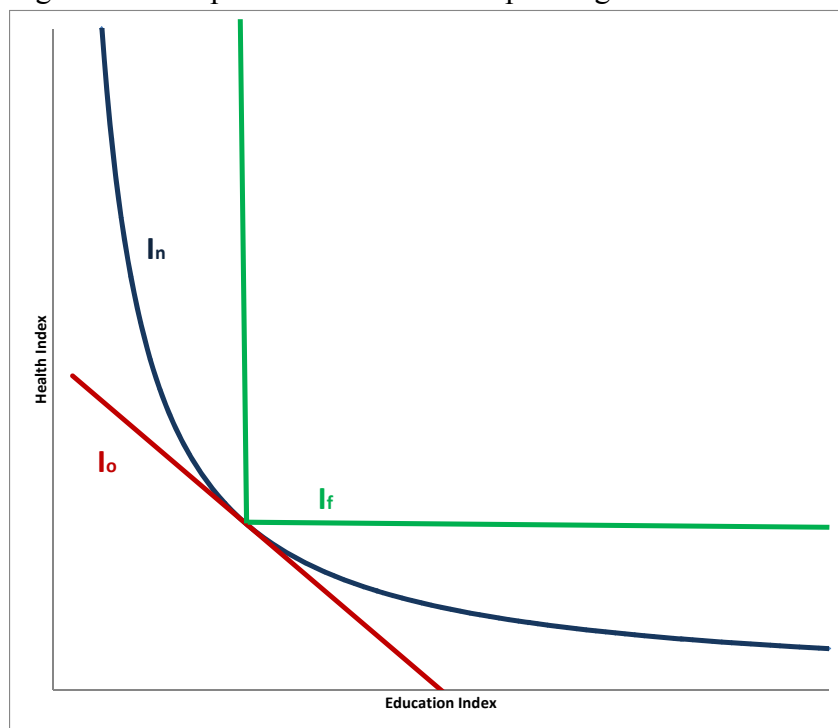
Some degree of both substitutability and complementarity seem to make sense. On the one hand, there are many ways in which people can compensate for lower capability in one dimension through improvements in others. For example, people whose ability to communicate is impaired by a physical or mental disability will have a greater chance of communicating with others if they are more educated (e.g., learning the Braille language) or if they have greater economic resources (e.g., by using electronic means of assisted communication). At the same time, it is obvious that one needs at least a basic level of any of these capabilities in order to take advantage of the rest. For example, access to education has little relevance to someone who is starving.

The new HDI attains a compromise by adopting a functional form that is between the extremes of perfect substitutability and perfect complementarity. The implied elasticity of substitution of 1 in the geometric mean lies between the extremes of 0 for the Leontief function and infinity for the linear formula of the old HDI. Of course there are many values between zero and infinity that

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[54] The fixed coefficients functional form was introduced by Wassily Leontief as a way of conceptualizing the relationships between productive sectors in his seminal contributions on input-output modeling. See Leontief (1936).

would have delivered some combination of substitutability and complementarity. However, there is a distinct advantage to the geometric mean – unlike the arithmetic mean or other forms of aggregation with a non-unitary elasticity of substitution, the rankings produced by the geometric mean are invariant to the scale in which each variable is measured. In the case of the arithmetic mean or functions with a constant non-unitary elasticity of substitution, multiplying any of the HDI components by a scalar factor would lead to a change in the relative weight of that variable. The only functional form that allows us to avoid this undesirable result is the geometric mean.[55]

Scale invariance is a problem for the construction of an aggregate index because we typically consider the scale in which a variable is measured as theoretically and normatively irrelevant. For example, one should not care whether the average life expectancy of a population is measured in years, months, days, or decades. The lack of scale invariance was addressed in the old HDI formula by normalizing all the dimensions between zero and one. Normalization addresses scale invariance but introduces another problem, which is the sensitivity of the index to the chosen minima and maxima. This is problematic because we do not want the index to be affected by what appear to be arbitrarily chosen bounds.

To fix ideas, consider the relative comparison between Japan and France. Japan has a higher life expectancy than France, with a higher education index and also a slightly higher living standards index. With the additive functional form, Japan ranks 6 positions above France. But if we change the maximum for life expectancy by 10 years, we see that Japan drops by 2 positions relative to France. The reason is that as the maximum threshold for the health dimension is raised, the contribution of improvements in health to the HDI drops consequently, and Japan benefits less from its high advantage in life expectancy.

Note that this problem does not affect the new HDI. While a normalization is still carried out, the maxima used in the normalization are irrelevant for HDI rankings.[56] In the same example posed above, the relative ranking between Japan and France is unaffected by the choice of maxima, with Japan always occupying three positions above France in the ranking. This is particularly relevant as the maxima are likely to evolve with global progress.

The choice of minimum, in contrast, will continue to have significant implications for rankings even in the geometric mean. The geometric mean values an increment of x percent in any of the dimensional indices equally. Whether that increase of x percent t corresponds to a higher or

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[55] Note from (5) that if we multiplied $H_{Living\ standard}$ (or any of the H_i) by a scalar factor α, the HDI becomes $\alpha^{1/3} *$ $(H_{Health} * H_{Education} * H_{Living\ standard})^{1/3}$, a constant times the previous HDI. However, if the HDI took a CES form then HDI becomes $F*(A*(H_{Health}{}^{\wedge}r)+B*(H_{Education}{}^{\wedge}r)+ \alpha^{1/3} *C*(H_{Living\ standard}{}^{\wedge}r))^{\wedge}(1/r)$, affecting the relative weights given to the three dimensions.

[56] This is not the case for the old functional form, where changing the upper bound for life expectancy by ten years leads 80 out of 169 countries listed in 2010 HDR to change their ranks.

lower number of absolute units is irrelevant. What is relevant is the size of the change in relation to that initial value. This means that whether the initial value is considered to be the level of the variable or its level in excess of a particular minimum will be of major significance. That is, an increase of life expectancy from 30 to 40 is an increase of 33 1/3 percent, but if we consider that the minimum attainable level of life expectancy is 20, then it is actually an increase of 100 percent in life expectancy with respect to its minimum. Raising the minimum level of life expectancy does affect the relative comparison between Japan and France, in contrast to the maximum. For instance, raising the minimum for the life expectancy by 10 years changes the ranks of 105 of out 169 countries listed in 2010 HDR.

Therefore, while the new formula means that maximum values and scale are no longer issues, the geometric mean is affected by the choice of minima, similar to the old HDI and thus requiring careful consideration of the choice of these minima. It seems that these lower bounds can best be perceived as subsistence values – values below which we would not expect a society to survive. This is consistent with the argument sketched above for complementarity in the HDI – when people are close to survival in terms of any capability, they are less able to take advantage of improvements in the other capabilities. In the extreme, if any of the indicators is at the minimum, then the value of the whole index collapses to zero, so that the values of other capabilities become irrelevant. This is a general characteristic of indices characterized by some level of complementarity.

What are reasonable subsistence values for the components of the HDI? For formal education, the answer seems clear enough: we know that societies did survive even in the absence of formal systems of education, so the minimum can be set to zero. In the case of longevity, there is good evidence that the long-run minimum attained by any society is around twenty years.[57] It appears that it is very difficult for societies to reproduce at levels below twenty years, as humans have to reach not only the minimum age to procreate but also live for enough years so as to care for their offspring until they become able to survive on their own: thus the lower bound for life expectancy was set at 20.

The case of income is more complicated. Maddison (2010) uses $400 in 1990 international dollars as a subsistence estimate of per capita GDP for large swathes of the world back to 1 A.D., and $450 for those regions in which the majority of people were living at subsistence levels but there were enough resources to sustain a small elite. Either of these numbers implies that large numbers of people today are living *below* subsistence levels of income: average income in six countries, home to 104 million people, is below the lowest of these thresholds.[58] Yet while life is

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[57] See Riley (2005) and Maddison (2010).
[58] When the GDP per capita of $400 in 1990 international dollars is converted to 2008 international dollars, the threshold becomes $604. The six countries are: Burundi, DR Congo, Guinea-Bissau, Liberia, Somalia and Zimbabwe. Bairoch (1993) calculated a bare subsistence minimum to be $80 at 1960 prices, which would equal $446 in 2008 international dollars. Becker, Philipson and Soares (2005) calibrate the level of income at which an

surely very difficult in these places, subsistence does appear possible even at such low levels of income.[59] In order to reach a more reasonable estimate of the subsistence income level, the 2010 HDR looked at levels in more contemporary times, and assumed that it was equal to the lowest level of per capita income observed in the historical time series, which corresponds to $163 in 2008 PPP dollars, the level observed in Zimbabwe in 2008.

Another important change was to eliminate the binding income cap. Income is still transformed into capabilities at a declining rate, using the logarithmic form, but there seems to be no strong argument for why this marginal effect should truncate at a particular threshold. The invariance to scale transformations and thus to maximum values implies that future revisions to the formula based on increases in the maximum attained levels will have no effect on the HDI rankings.

Maintaining the logarithm in the income index in equation (9) above, alongside the adoption of the geometric mean formula (which already implies diminishing marginal returns in each of the sub-indices) might seem redundant. However, as argued in section 3, it is important to distinguish between the existence of diminishing returns (and thus imperfect substitutability) in *capabilities*, and the existence of diminishing returns in the function through which income is transformed into capabilities. Since each of the three indices H_i are conceptualized as indices of capabilities, the geometric mean ensures that there are diminishing returns in each. In addition, the use of the natural logarithm captures the fact that there are also diminishing returns in the transformation of income into capabilities.

What are the effects of the choice of indicators and weights on the final HDI rankings? Table 3 below considers the case of four countries: France, Japan, Kenya and Bangladesh. The first two are countries in the Very High Human Development Category, or the top quartile of the distribution, whereas the latter two belong to the Low Human Development, or bottom quartile category. The table shows the effect on rankings that result from the methodological innovations introduced in the 2010 report, taking as a starting point the rankings that would have been obtained had we used the 2009 functional form. First, we show the effect of changing the indicators in each dimension. The change to GNI benefits France and Japan while the change in education indicators relatively benefits Kenya and Bangladesh. The changes to the upper and lower bounds, on the other hand, benefit Kenya while penalizing France and Japan when the upper bound is changed. This is because uncapping the GNI allowed Liechtenstein, a country

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individual would be indifferent between being dead and alive at $353 in 1990 prices, which would equal $518 in 2008 prices.

[59] This observation also applies to the World Bank $1.25/day poverty line, which is often used as a measure of subsistence, and which would correspond with a threshold of $456: according to it, a substantial fraction of the world's population live below subsistence levels. While this may make sense if the interpretation is a normative concept of subsistence (i.e., the minimum below which people *should not* live), this is obviously not the case if a positive concept of subsistence is what is sought (i.e., the minimum below which people *cannot* live). The problem with adopting the normative interpretation for the purposes of the HDI is that doing so would make it impossible to calculate the HDI for countries below that level, which would defeat the purpose of using the HDI to compare deprivations around the world.

with very high GNI ($81,011), to jump up. Lastly, aggregation via the geometric mean tends to favor Kenya and hurt Bangladesh. This is because Kenya has a more balanced composition of development, which tends to be favored when the index takes into account complementarities.

Table 3. Effect of change in methodologies on rankings – France, Japan, Kenya and Bangladesh

Country	HDI	Health	Education	Living standards	Rank using 2009 methodology	Ranks according to subsequent changes in				
						Indicators		Bounds		Aggregation method
						Living standards	Education	Upper	Lower	
France	0.871	0.975	0.825	0.823	10	8	13	15	14	14
Japan	0.885	1.000	0.840	0.825	8	6	8	8	9	10
Kenya	0.471	0.563	0.522	0.354	118	118	117	118	116	114
Bangladesh	0.469	0.742	0.397	0.350	119	119	113	112	113	115

Note: Total number of countries with data availability for 2010 used is 149. The numbers are slightly different from those reported in UNDP (2010) due to rounding errors.
Source: HDRO calculations from HDRO database.

4.3 Redundancy and Robustness

As pointed out in section 3.3, one concern with the HDI relates to its potential redundancy, given the high correlation of the index with its underlying components. The 2010 HDR addresses this criticism head on, by showing that this criticism is fundamentally unfounded. It explores how the HDI illuminates investigations of advances in human development over time. The 2010 Report argues that the picture of development obtained from looking at the past forty years through a human development lens is vastly different from that obtained through a sole focus on economic growth.

As Figure 3 shows, there is no statistically significant correlation between growth and improvements in human development in a sample of 135 countries for the period 1970-2010 studied by the report. To take just one example, China is by far the economy with the greatest rate of economic growth in that period – its annual per capita growth rate of 7.6 percent significantly exceeds not only the world average (1.8 percent) but also that of the second highest growing economy (Botswana, 5.6 percent). But China ranks 64th out of the same 135 countries in terms of average improvements in the non-income HDI,[60] and is one of only 10 countries in the world that have a lower gross enrolment ratio today than they did in 1970. More generally, only three of the top 10 fast growing economies for the period of study are also top improvers in the HDI – the majority of countries that get into the list of top HDI performers do so because of their performance in terms of health and education, not of income growth.

Therefore, if one looks at changes over time instead of levels, the redundancy argument disappears. Note that this evidence relates not to short-term changes (where one would understand that country-specific shocks, noise and lags in effects would lead to a low

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[60] The non-income HDI is the geometric mean of the health and education indices.

correlation) but rather to long-term changes: the lack of correlation noted is over a forty-year period.

Both levels and changes are of course important to understanding development. For some purposes, such as identifying who is most disadvantaged and steering international efforts to expand development efforts to the places where these people live, information about the levels of human development is indispensable. But if we want to understand what works and what does not, and what countries can do and have done to improve the opportunities open to their people, we care much more about changes than levels. In fact, most contemporary development economic literature is concerned with the study of economic growth, i.e., changes in per capita income. It is clear that the choice of metric to measure improvements over time makes a huge difference to the results of this literature.[61]

4.4 A note on country classification

Even if the HDI rankings are robust to country weights, other information derived from the HDI may not be so robust. Wolff et al. (2010) have argued that the HDI categories that were used to classify countries into low, middle and high levels of human development are not robust to changes in the underlying data or index functional form. This was because the numerical HDI thresholds used to define these categories (0.5 and 0.8) were kept fixed even after changes in methods and data. Had they been updated, Wolff et al. (2010) estimate that 34 percent of countries (and 45 percent of developing countries) would have been in a different HDI category in 2006 than they were in that year's report.

This valid criticism was addressed in the 2010 HDR by changing the method used to create country categories. Rather than using fixed thresholds, countries are now grouped by quartiles of the HDI distribution. The problem of change in development groups due to data updates or formula revisions is no longer an issue, because countries are grouped according to their ranks, not their values. This is consistent with Wolff et al.'s argument that the threshold values need to be adjusted in some way to ensure robustness of groupings.

Since Wolff et al. suggest an alternative method for revising thresholds, based on calculating the values that the index would take after the formula/data revisions for countries in the vicinity of the old threshold, the question arises: how many countries are in a different category than would be if we used their suggested method for revising thresholds?

In order to do this, we compare the country quartiles from the 2010 formula to those emerging from the 1990 formula according to the Wolff et al. criteria for threshold revision. In other

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[61] For instance, Rodrik (2010) refers to some of the North African countries' relatively remarkable growths captured in the 2010 HDR and states that these findings "substantially enrich our understanding of the development landscape over the last four decades."

words, we check how many countries lie between the 1990 formula's quartile threshold value recalculated using the 2010 formula, and the 2010 formula's actual quartile threshold value. Table 4 shows dramatic drops in the proportion of countries with a changed classification as we switch to the new categorization method adopted in 2010. Depending upon whether we use the latest or earliest data and formula to set the thresholds, we calculate that the number of countries in which our classification disagrees with the Wolff et al. method is at most 3.4 percent of the sample.

Table 4. Number of countries with changed classifications under the new method of classification

Data year	Number of observations	Old methodology (0.5 and 0.8)	New methodology (quartiles)
1990	149	48 (32.2%)	5 (3.4%)
2010	153	52 (34.0%)	2 (1.3%)

Note: The most up-to-date data for the trends analysis in 2010 HDR was used.
Source: Human Development Report Office calculations.

5. New Critiques?

At the time of writing (February of 2011), fewer than four months had passed since the publication of reforms to the HDI. Thus, it is still quite early to assess how it will be received among academic economists and policymakers. The following paragraphs survey some initial reactions.

Herrero, Martinez and Villar (2010) discuss a number of problems with the old HDI and show how these shortcomings could be addressed, by switching to the geometric mean, incorporating the issue of inequality into the dimension of living standards, and changing indicators for the health and education dimensions. In fact, the new HDI is similar to the formula previously suggested by Herrero, Martinez and Villar (2005).

Zambrano (2011a) provides an axiomatic characterization of the new HDI. He shows that a number of desirable axioms are satisfied, namely monotonicity (that the index should increase in all capabilities), subsistence (that there is no trade-off between any of the dimensions when people are at the lowest level of attainment), independence (that improvements in two dimensions that increase the index cannot cause deterioration in the index at other levels of the third dimension) and basal growth (the extra income needed to generate an increase in capabilities is proportional to the initial level of income). Zambrano (2011b) concludes that "… .The new methodology chosen by the HDRO in 2010 is a vast improvement over both the old formulation and the numerous alternatives that at one point or another have made it to the drawing board."

Yet there have also been criticisms. Most notably, Ravallion (2010b) has argued that the trade-offs implicit in the new HDI should be a cause of concern. Ravallion calculates the marginal rates of substitution between longevity and income in the new HDI (henceforth $MRS_{h,y}$) and shows that these vary from $0.53 per year of life in Zimbabwe to about $9,000 in the richest countries, claiming that "the highest valuation of longevity is 17,000 times higher than the lowest."[62] Ravallion draws the policy implication that "if one accepted the tradeoffs embodied in the new HDI, one would be drawn to conclude that the most promising way to promote human development in the world would be by investing in higher life expectancy in rich countries – surely an unacceptable implication of the HDI's tradeoffs." He also recommends an alternate functional form, which he attributes to Chakravarty (2003) and claims could have avoided this feature of steep increase of the "value" of longevity with per capita income.

There are several major problems with Ravallion's lines of argument, which need to be addressed because they have attracted some attention. [63]

First, Ravallion is incorrect in his assertion that the new formula has exacerbated this problem.[64] His evidence for this assertion is a comparison of the $MRS_{h,y}$ in the new and old index. However, he ignores the fact that incomes were capped at $40,000 in the old index. Formerly, $MRS_{h,y}$ was a constant fraction of income for income lower than $40,000, and infinity for incomes higher than or equal to $40,000. This discontinuity is key, as it implies that the old version of the index was much more concave in income than the new version. It also implies that the ratio between the "value" of longevity in the richest to the poorest country in the old HDI was infinity, contrasting the new formula, where it is a positive, if large, real number.

But there are more basic reasons why Ravallion's concerns are misplaced. Recall that in section 3 we discussed why an index of capabilities is conceptually different from a social welfare function. The key difference is that a social welfare function is designed to be maximized, and thus the trade-offs along that social welfare function can be interpreted as values. But a capabilities index is meant to give a measure of the extent to which people in different countries have access to substantively different lives. Obviously, we care about the expansion of these capabilities and believe that expansion is welcome. But this is very different from claiming that the maximization of capabilities should be the only objective of social action.

There are at least three reasons why one should not recommend that societies try to maximize the HDI. One is that, for the reasons discussed in section 3.1, not all the components of human development or of well-being are included in the HDI. Maximizing the HDI would imply

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[62] Ravallion (2010b, p. 10).
[63] Bill Easterly and Laura Freschi (2010) have argued that the new HDI formula makes Africa look worse than it should. Since Easterly and Freschi's arguments are derivative from Ravallion's, we will not discuss them in detail here. The interested reader can consult Rodríguez (2010a, 2010b).
[64] For example, Ravallion writes "the new HDI has also greatly reduced its implicit weight on longevity in poor countries, relative to rich ones." (2010, p. 1)

attributing a zero weight to the excluded dimensions, completely going against the spirit of the human development approach, which has forcefully argued for the relevance of the broader dimensions in human development. Second, the expansion of capabilities is only one of the reasons why people may care about the components of the HDI. People may enjoy the luxuries that come from higher levels of income even if these don't contribute to them leading substantively different lives. For this reason, policymakers can and often do put a weight on the generation of economic growth in rich countries that goes beyond anything that would be justifiable if they only cared about the expansion of the capabilities derived from that income.[65] From the standpoint of the human development approach, there is nothing inherently wrong with this – recognizing the value of capabilities is not the same thing as saying that they should be the one and only overriding concern. Third, as the discussion in the preceding sections makes clear, the HDI is a crude measure of development which is severely limited by data constraints, and thus one can at best expect it to give a rough characterization of a country's relative stance. Policymakers in any particular country are likely to have at their disposal much superior information to inform their decision-making process.

In this sense, the capabilities approach contrasts with traditional theories of social justice, such as utilitarianism, which postulate an overarching objective as the end result of human action. The capabilities approach is a *partial* theory of well-being that does not purport to establish a complete description of all the components of a good life. Instead, a capabilities index aims to tell us the extent to which people have the freedom to live substantively different lives. Expanding these freedoms is a worthy objective of social action, but not the only one. The idea that partial and incremental theories provide us with a more cogent basis to consider issues of ethics and justice than overarching theories have, has been elaborated on, among others, by Scanlon (1999) and Sen (2009).

Once we understand that the relevant social maxim and is different from the HDI, then we realize that it is inappropriate to label the trade-offs implicit in the HDI as "values," and the comparison exercises and results of Mincer regressions are not very meaningful. This is not to say that these trade-offs are unimportant. They are extremely relevant as they tell us about the marginal contributions of improvements in different dimensions to furthering capabilities. But it does establish that their comparison to market prices is meaningless, because we would expect no reason for these to be related to market valuations in any consistent way.

The marginal rate of substitution is better interpreted as reflecting the differing relative contributions of income vis-à-vis health in furthering capabilities. Since the relative contribution of income to furthering capabilities is infinitesimally small in rich countries, it looks huge by

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[65] It may of course also be the case that these policies are geared towards improving other capabilities, such as security and the social bases of self-respect. Our point is not that growth may not enhance these other capabilities, but that it is also pursued by policymakers who are seeking improvements in well-being above and beyond what would be implicit in the expansion of capabilities.

comparison in poor countries. Thus, the 17000:1 ratio merely says that the HDI puts very low weight on increases in income in rich countries, compared to the very high value on health improvements. Because of this, improvements in longevity matter much more than increases in income to the expansion of capabilities in rich countries and the implied valuation of longevity in a rich country is huge. In other words, the 17,000:1 ratio only tells us that in rich countries, income is nearly worthless in terms of increasing capabilities. This, in fact, is a simple implication of the idea that beyond a certain level income contributes very little to the expansion of capabilities, as argued in section 2 above.

In other words, dealing with the MRS point more directly – if the HDI does measure some kind of country-level welfare, the fact that Zimbabwe exhibits a marginal rate of substitution between health and income (i.e., a marginal value of health in terms of dollars) of only 53 cents, while Qatar has one that is $8,800, simply reflects the relative abundance of health compared to income in Zimbabwe, and the relative abundance of income compared to health in Qatar.

Saying that longevity is worth 17,000 times as much in Qatar as in Zimbabwe will likely lead some readers to infer that additional (e.g., aid) dollars should go to Qatar instead of Zimbabwe. But this is nonsense. What it means is that dollars that Qatar has should be spent on health improvements, but that dollars that Zimbabwe has should probably be directed toward enhancing people's livelihoods.

Does the ratio have any broader relevance – for example is it a guide to where should an extra dollar of a(n aid) budget go? It's hard to tell from the simple MRS computation. Suppose a donor wants to maximize the sum of HDIs across countries (or something like that), what we need to know is the marginal impact of a dollar (spent on health or elsewhere) on a country's HDI. Nothing in the comparison of MRSs speaks to that question. Indeed, while the dollar value of health might be 17,000 times higher in Qatar than in Zimbabwe, the value of incomes (measured in terms of extra years of life) is 17,000 times higher in Zimbabwe than in Qatar. In both cases, 17,000 sounds like a large number, but it doesn't provide information for the allocation of aid. In other words, even if MRSs could be used as a guide to allocate aid within countries (subject to the above discussed caveats on maximization), this would have no implications for the allocation of aid across countries.

Does it make sense, as Ravallion advocates, to drop the logarithmic transformation of income, so that the gradient of the valuation of longevity in income would be less steep? Let us recall that the HDI in (5) is a convex function in capabilities, and that the dimension index H_i, which measures the capability of "a decent standard of living," is concave in income (as it uses the logarithmic transformation). The first of these features comes from the idea that there should be imperfect substitutability in capabilities, whereas the second one comes from the idea that the capability of a decent standard of living is a concave function of income.

The asymmetric treatment of income has strong roots in capability theory. The authors of the early HDRs argued that if HDI is an index of capabilities, then income should be treated differently. This is because income is not a capability but rather an input that people use to develop and use these capabilities. It is a means, not an end in itself.[66] When income is low, its growth helps people to gain access to essential goods and services which constitute relevant capabilities. Yet as income rises its contribution to further expanding capabilities declines. Therefore, one must draw a distinction between the input into the formation of capabilities (income) and the resulting capability (a decent standard of living). The fact that income turns into capabilities at a declining rate implies that the function mapping income into capabilities should be concave. Dropping the log transformation, however, would have been equivalent to disregarding this key distinction between capabilities and inputs into the formation of capabilities.

The idea that income is not a capability and thus requires an asymmetric treatment from that given to health and education appears to have been well understood by Satya Chakravarty (2003), who developed a generalized family of concave indices that generalized the HDI, and all of which used the concave piecewise function of income designed in the early Human Development Reports to capture the idea that income turns into capabilities at a declining rate (a function which was later replaced by the logarithmic transformation). Ironically, Ravallion claims to apply the Chakravarty formula without using any concave transformation of income. As shown by Zambrano (2011b), the real Chakravarty index (i.e., the index using the concave transformation of income as originally posited by Chakravarty) actually delivers rankings which are much closer to those given by the new HDI than to those of the Ravallion index.

A final separate source of concern is the fact that in absolute levels these valuations are quite low for poor countries. The case of Zimbabwe, where the marginal rate of substitution of longevity for income is $0.53, appears striking, and we agree that this value is so very low. However, the reason why we get such a low value is driven by the fact that Zimbabwe's current level of per capita income ($176) is quite close to the subsistence level of $163 discussed in section 4. This proximity implies that the increment in HDI derived from economic growth at this level of income is very high; in fact, the increment will approach infinity as per capita GNI approaches the lower bound. Remember that, given the properties of the index, as any dimension reaches its level of subsistence, improvements in that dimensions will have a huge impact in terms of improving human development.

One may question whether Zimbabwe is really hovering so close to subsistence income as implied by the HDI formula. However, as argued above, the use of $163 is actually quite

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[66] See UNDP (1990, p. 10). It argues "(i)ncome is a means, not an end. It may be used for essential medicines or narcotic drugs. Well-being of a society depends on the uses to which income is put, not on the level of income itself." See also Stiglitz, Sen and Fitoussi (2009), the report prepared for the Commission on the Measurement of Economic Performance and Social Progress.

conservative in comparison to the estimates of subsistence income typically used by economic historians. It may well be the case that the combination of well-known problems in national income accounting (particularly the lack of valuation of subsistence activities) combined with poor quality statistics generates what is likely to be a significantly distorted estimate of Zimbabwean income. But this is fundamentally an issue with the data, not with the principles underlying the index.

6. Broadening the measurement of human development

As discussed in section 3.1 above, one of the key contentions of the 2010 HDR is that the measurement of human development should be expanded to go beyond the core dimensions. The 2010 Human Development Report introduced major measurement innovations beyond the HDI, designed in particular to address the key dimensions of inequality and deprivation. The HDR has always recognised that inequality in human development deserves serious consideration, and that averages can be misleading. The 1990 report recognized its importance, but refrained from measurement on grounds of data availability (p. 11-12). Over the past two decades, the information available on inequality, not only on incomes but multiple dimensions drawing on micro level data, has grown enormously and provides much larger possibilities on several fronts.

The Inequality adjusted HDI introduced in the 2010 HDR is one reflection of this progress. The data requirements for international comparisons of inequality have been met through developments in method employing sources available from the United Nations and the World Bank, as well as other key sources which kindly allow data access and international comparisons.[67] A measure of the level of human development of people in a society that accounts for inequality in health, education and income, the IHDI is constructed to be directly comparable to the HDI and across countries, reflecting inequality in each dimension of the HDI for 138 countries. Under perfect equality the HDI and the IHDI are equal. When there is inequality in the distribution of health, education and/or income, the HDI of an average person in a society is less than the aggregate HDI.[68]

Broadly speaking, there are three steps to computing the IHDI.[69] The first is to measure inequality in underlying distributions. The IHDI draws on the Atkinson (1970) family of inequality measures and sets the aversion parameter ε equal to 1. In this case, the inequality

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[67] Inequality in the underlying distributions of mean years of schooling and income come from: Luxembourg Income Study; EU Statistics on Income and Living Conditions; United Nations Children's Fund Multiple Indicator Cluster Surveys; Measure DHS; the UN University's World Income Inequality Database; and, the World Bank's International Income Distribution Database. Inequality in the distribution of life expectancy comes from the United Nations Population Division.

[68] Alkire and Foster (2010).

[69] For more details on measuring inequality in the distribution of the HDI indicators, see Alkire and Foster (2010) and Kovacevic (2010).

measure is $A = 1 - g/\mu$, where g is the geometric mean and μ is the arithmetic mean of the distribution.

This can be written:

$$A_x = 1 - \frac{\sqrt[n]{X_1 ... X_n}}{\bar{X}}$$

(12)

where $\{X_1, \ldots, X_n\}$ denotes the underlying distribution in the dimensions of interest. A_x is obtained for each variable (life expectancy, years of schooling and disposable income or consumption per capita) using household survey data and the life tables. Note that the geometric mean in equation 12 does not allow zero values, which requires specific adjustments in each dimension.[70]

The second step is to adjust the mean achievement in a dimension, $X-$, adjusted for inequality as follows:

$$\bar{X}^* = \bar{X}(1 - A_x) = \sqrt[n]{X_1 ... X_n} \ .$$

(13)

Thus $X-^*$, the geometric mean of the distribution, reduces the mean according to the inequality in distribution, emphasizing the lower end of the distribution.

The inequality-adjusted dimension indices, I_{IX}, are obtained from the HDI dimension indices, I_{I_x}, by multiplying them by $(1 - A_x)$, where A_x is the corresponding Atkinson measure:

$$I_{I_x} = (1 - A_x) \cdot I_X.$$

(14)

It should be noted that the inequality-adjusted income index, I^*I_{Income}, is based on the unlogged gross national income (GNI) index, $I^*Income$. This enables the IHDI to account for the full effect of income inequality which, in turn requires specific steps to re-estimate the HDI without logged income, in order to enable the relevant comparisons to be made.

We can then compute the percentage loss to the HDI* due to inequalities in each dimension is calculated as:

$$Loss = 1 - \frac{IHDI^*}{HDI^*} = 1 - \sqrt[3]{(1 - A_{Life}) \cdot (1 - A_{Education}) \cdot (1 - A_{Income})}.$$

(15)

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[70] For mean years of schooling one year is added to all valid observations to compute the inequality. Income per capita outliers—extremely high incomes as well as negative and zero incomes—were dealt with by truncating the top 0.5 percentile of the distribution to reduce the influence of extremely high incomes and by replacing the negative and zero incomes with the minimum value of the bottom 0.5 percentile of the distribution of positive incomes.

And the IHDI is then calculated as:

$$IHDI = \left(\frac{IHDI^*}{HDI^*}\right) \cdot HDI$$

(16)

which is equivalent to

$$IHDI = \sqrt[3]{(1-A_{Life}) \cdot (1-A_{Education}) \cdot (1-A_{Income})} \cdot HDI.$$

(17)

It is interesting to compare the extent of inequality across dimensions, which are not only large on the income front, for there are also significant differences across regions, and HDI categories. The loss in potential human development due to inequality is the difference between the HDI and the IHDI, and is often expressed as a percentage. The aggregate loss in human development due to inequality is 22 percent, ranging from a low of 6 percent (Czech Republic) to a high of 45 (Mozambique), with the largest losses in the low HDI countries (Figure 4).

Figure 4. Inequality adjusted HDI by region
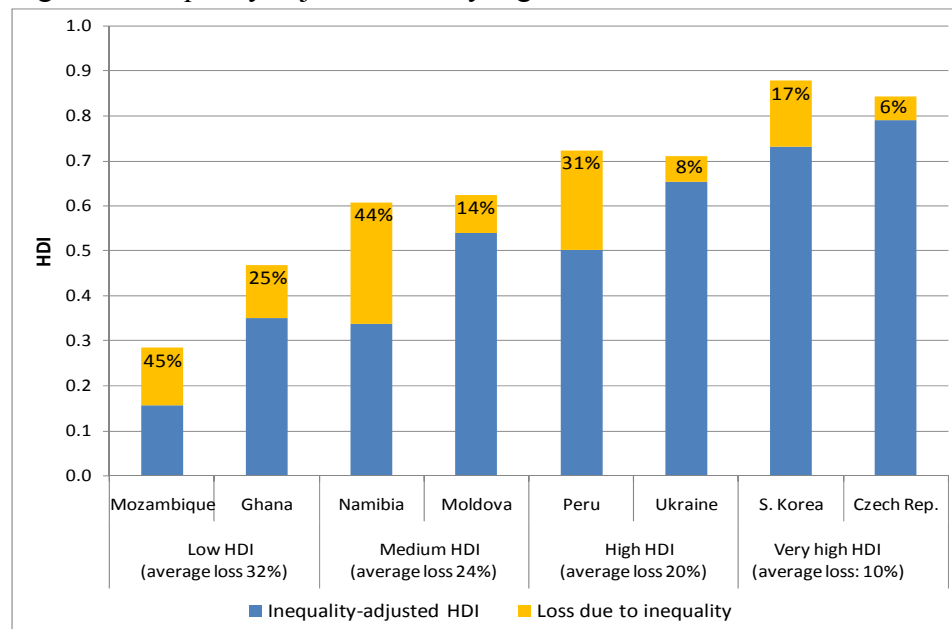
Source: HDRO calculations from HDRO database.

One striking manifestation of inequality relates to gender. The HDR 1995 introduced the first global measures of gender inequality, in the Gender-related Development Index (GDI) and the Gender Empowerment Measure (GEM). However these both had a range of shortcomings including lack of data and misinterpretation.[71]

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[71] Critics noted three key drawbacks of the GDI and GEM: that they combine absolute and relative achievements, thus a country with low income scores poorly even with perfect gender parity; that extensive imputations were needed to fill missing data; and that nearly all indicators in the GEM arguably reflect a strong urban elite bias and

The HDR 2010's Gender Inequality Index is a new measure of the inequalities faced by women and girls built on the same framework as the HDI and the IHDI – to better expose differences in the distribution of achievements between women and men.[72] The GII includes educational attainment, economic and political participation and female-specific health issues [73] Unfortunately, data limitations still significantly constrain the choice of indicators, although the indicators selected did allow application to 138 countries around the world.

The GII is computed using the association-sensitive inequality measure suggested by Seth (2009). The index is based on the general mean of general means of different orders – the first aggregation is by the geometric mean across dimensions; these means, calculated separately for women and men, are then aggregated using a harmonic mean across genders.[74]

One important feature of the GII method is its association-sensitivity – that is, unlike the IHDI for example, we can take account of overlapping disparities. Aggregating across dimensions for each gender group by the geometric mean makes the GII association sensitive (see Seth 2009).

The estimates involve aggregating across dimensions *within* each gender group, using geometric means. Then we aggregate *across* gender groups, using a harmonic mean. The female and male indices are aggregated by the harmonic mean in order to create the equally distributed gender index. Using the harmonic mean of geometric means within groups captures the inequality between women and men and adjusts for association between dimensions. We then calculate the geometric mean of the arithmetic means for each indicator. Finally, we can then calculate the GII by comparing the equally distributed gender index to the reference standard.

We can write the formula as follows:

$$GII = 1 - 4 \frac{\left[\left(\sqrt[3]{\left(\dfrac{1}{MMR}\dfrac{1}{AFR}\right)^{1/2}\left(PR_f SE_f\right)^{1/2} LFPR_f}\right)^{-1} + \left(\sqrt[3]{\left(PR_m SE_m\right)^{1/2} LFPR_m}\right)^{-1}\right]^{-1}}{\sqrt[3]{\left(\sqrt{\dfrac{1}{MMR}\dfrac{1}{AFR}}+1\right)\left(\sqrt{PR_f SE_f}+\sqrt{PR_m SE_m}\right)\left(LFPR_f + LFPR_m\right)}}$$

(18)

where MMR and AFR refer to maternal mortality and adolescent fertility rates, PR for parliamentary representation and SE school enrolment, and LFPR for labour force participation rates, and f and m for female and male respectively.

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use some indicators more relevant to developed countries. Hawken and Munck (2009) and Klasen and Schüler (2010) provide useful reviews.
[72] See Gaye et al. (2010)
[73] The Gender Inequality Index relies on data from major publicly available databases, including the maternal mortality ratio from UNICEF's *The State of the World's Children;* adolescent fertility rates from the UN Department of Economic and Social Affair's *World Population Prospects;* educational attainment statistics from Barro-Lee data sets; parliamentary representation from the International Parliamentary Union and labour market participation from the International Labour Organization's LABORSTA database.
[74] See Gaye et al. (2010) for details and the steps involved in estimating the GII.

Again the analysis shows large losses due to gender disparities, ranging as high as 70 percent for the Arab states and South Asia (Figure 5).

Figure 5. Gender Inequality Index and Human Development Index
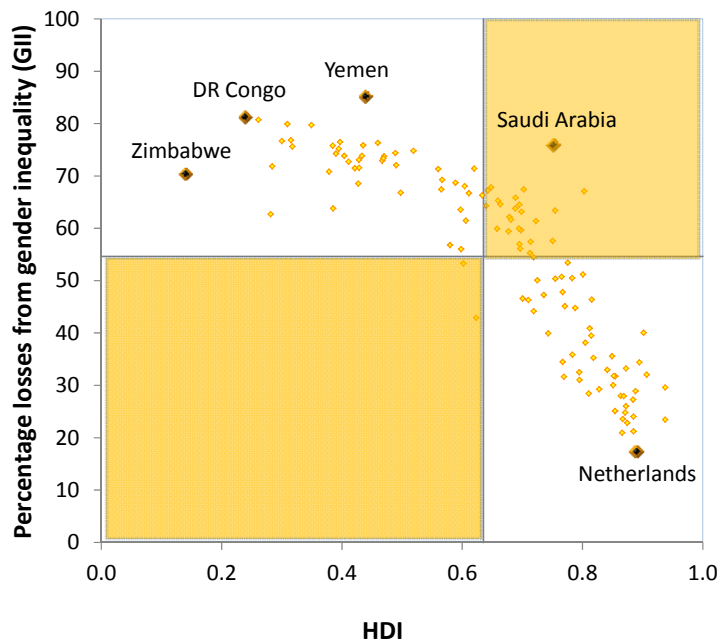
Source: HDRO calculations from HDRO database.

Third, the 2010 HDR introduces a Multidimensional Poverty Index, which captures acute overlapping deprivations in 104 developing countries.[75] The measure uses micro data to identify deprivations in health, education and living standards and shows the number of people who are poor (suffering a given number of deprivations) and the number of deprivations with which poor households typically contend. It presents an interesting profile of the poor which is complementary to monetary based estimates, and can be deconstructed by region, ethnicity and other groupings. In countries such as Uzbekistan and Tanzania, the fraction of the population who are MPI poor lie below those who are income poor according to a $1.25 PPP poverty line, but in other countries, such as Morocco, Indonesia and Pakistan the percentage of MPI poor significantly exceed those who are income poor (Figure 6).

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[75] Alkire and Santos (2010).

Figure 6. Multidimensional Poverty Index and $1.25 PPP poverty line
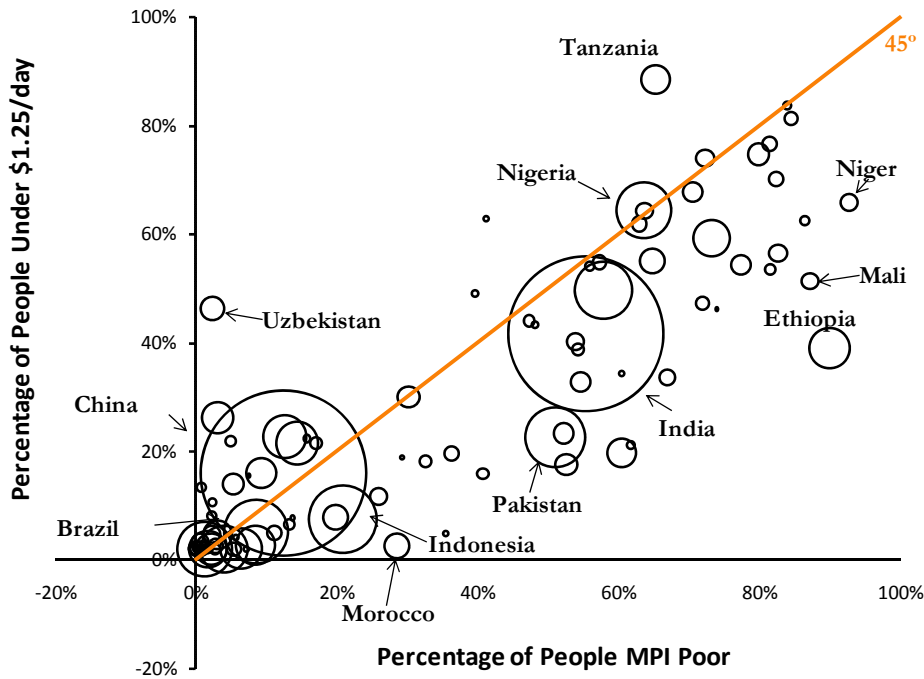
Source: HDRO calculations based on Alkire and Santos (2010).
Note: Size of the bubbles reflects the absolute number of people (population) in each country.

7. Conclusions

This paper has outlined the contributions of the HDI to thinking about development, surveyed the criticisms of the old HDI and explained how the new HDI has addressed these criticisms. We have shown how the arguments presented in the 2010 HDR offer ground to rethink some of the old criticisms, particularly those that referred to the presumed redundancy of the HDI with respect to other measures of development, and offer new avenues for enhancing public debate on the component dimensions. We have also argued that some of the criticisms of the new functional form stem from a basic misunderstanding of the conceptual basis for the HDI.

There is still substantial room for progress in the measurement of human development. The 2010 HDR made a significant move away from the idea that the ideal measure of human development must cover only the three core dimensions, and presented three new measures that take into account different aspects of the distribution of human development. In addition, it also published in its website a feature that allows users to "build your own development index." This feature allows users to build an alternative HDI using any of nine potential dimensions: in addition to the 3 core dimensions, users can choose indicators in the areas of inequality, poverty, gender, sustainability, human security and empowerment. They can also choose from a number of indicators for each dimension, varying the weights both within and between dimensions, as well as upload their own data.

The introduction of this feature constitutes a significant departure from the traditional vision of the HDI in which the weights are objectively set by the authors of the Report. The HDI is rather conceived as one of a multitude of potential measures, where the weights and measures used should be subject to open public debate. HDRO takes the role of participant and enabler of this debate, but not of ultimate arbiter. Yet, the measurement of sustainability and empowerment remains significantly underdeveloped, and require closer consideration and analysis from a capabilities perspective.

Further careful analysis is also required to inform us of how to deal with the consequences of data problems for the HDI results. This was illustrated in section 5 with reference to the case of Zimbabwe, whose absolute HDI value, as well as the trade-offs implicit in the index, are almost certainly distorted by problems in adequately measuring its GDP. Accurately dealing with these issues may require the production of alternate estimates of GDP that can make some imputation for non-market production, or of a suitable compensatory adjustment in the lower bounds of the index.

Most importantly, the 2010 HDR has stressed the fact that the HDI is not and was never intended to be an overarching definitive measure of development. By design, the HDI is a partial measure that uses imperfect indicators and that attempts to provide a broad vision of the advance of countries in furthering capabilities. As emphasized by HDRO through its introduction of online tools that allow users to construct different indices and vary the dimensions, indicators and weights, the HDI should be understood as the starting point of a conversation about what we mean by development, rather than as its endpoint.

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