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Troubling Tradeoffs in the Human Development Index

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Abstract

The 20th Human Development Report has introduced a new version of its famous Human Development Index (HDI). The HDI aggregates country-level attainments in life expectancy, schooling and income per capita. Each year's rankings by the HDI are keenly watched in both rich and poor countries. The main change in the 2010 HDI is that it relaxes its past assumption of perfect substitutability between its three components. However, most users will probably not realize that the new HDI has also greatly reduced its implicit weight on longevity in poor countries, relative to rich ones. A poor country experiencing falling life expectancy due to (say) a collapse in its health-care system could still see its HDI improve with even a small rate of economic growth. By contrast, the new HDI's valuations of the gains from extra schooling seem unreasonably high—many times greater than the economic returns to schooling. These troubling tradeoffs could have been largely avoided using a different aggregation function for the HDI, while still allowing imperfect substitution. While some difficult value judgments are faced in constructing and assessing the HDI, making its assumed tradeoffs more explicit would be a welcome step.

This paper—a product of the office of the Director, Development Research Group—is part of a larger effort in the department to assess whether prevailing development indices are providing a reliable guide to assessing country performance and guiding policy making. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at mravallion@worldbank.org.

Troubling Tradeoffs in the Human Development Index

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1. Introduction

The *Human Development Index* (HDI) aims to provide a broader characterization of "development" than is possible by focusing on national income alone. For this purpose, the HDI aggregates country-level attainments in life expectancy and education, as well as income. The index has been published since 1990 in the UNDP's *Human Development Reports* (HDRs).

Each year's scores and rankings by the HDI are keenly watched in both rich and poor countries. The countries that do well on the index are congratulated by each new HDR.[2] Politicians and the media often take note. The HDI aims not only to monitor human development, but to encourage countries to take actions that promote it. The latest (2010) HDR claims that the HDI and its various descendants "…yield many novel results—and insights—that can guide development policy debates and designs" (UNDP, 2010, p.8). UNDP (undated) documents numerous examples of the policy influence of the HDRs, including the HDI.

As in any composite index, users should know what weights are attached to the HDI's dimensions, to properly judge if it has got the balance right.[3] The weight in any given dimension can be defined as the index's first partial derivative ("slope") with respect to that dimension. Since the units of the index are arbitrary (the HDI is normalized to lie in the 0, 1 interval) what really matters is the relative weights of its component dimensions. In other words, we need to know the assumed <u>tradeoffs</u>, as given by the HDI's marginal rate of substitution (MRS), i.e., how much of one desired component of the HDI must be given up for an extra unit of another component, keeping the overall index constant. If a policy or economic change entails that one of the positively-valued dimensions increases at the expense of another dimension, then it is the MRS that tells us whether human development is deemed to have risen or fallen.

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[2] In answer to the question: "Which countries have been most successful in furthering the human development of their people?" (UNDP, 2010, p.41) the HDR looks at HDI indices over 1970-2010 for 135 countries and identifies the "top 10 movers," defined by the rate of increase in their HDI relative to its 1970 value; the countries are Oman, China, Nepal, Indonesia, Saudi Arabia, Lao PDR, Tunisia, South Korea, Algeria and Morocco. At the other extreme, the report identifies three countries for which the 2008 HDI is lower than its 1970 value: Democratic Republic of the Congo, Zambia and Zimbabwe.

[3] On the importance of knowing the weights built into a composite index of development see Ravallion (2010a), which also discusses a number of other issues not touched on here, including the robustness of country rankings and whether aggregation of the core dimensions is useful for policy.

While the HDI has clearly aimed to influence policy makers, and appears to have had some success, the interest in identifying its tradeoffs does not rest on a view that the HDI is the maximand of some policy calculus. The interest stems instead from the need to understand the properties of the index. We can all agree that GDP is an incomplete metric of development.[4] The real issue is how we form a better composite index, should we feel the need for one.[5] What tradeoffs does the index attach to the various components? Only if we accept those tradeoffs can we be confident that the composite index is adequately measuring what it claims to measure.

In common with other "mashup indices" (Ravallion, 2010a), the HDI's tradeoffs are not constrained by theory, though economic theory can offer some insights into how one might form a composite index of human development.[6] The authors of the HDR set themselves free to pick the HDI's variables and weights. From 1990 to 2009 the HDI gave equal (linear) weights to three functions of its core dimensions for health, education and income.[7]

While the choice of variables and their weights can certainly be questioned, the HDI has at least appeared to be transparent and simple. That appearance is not quite so evident on closer inspection. Indeed, the HDI has never made explicit its tradeoffs across the core dimensions; users are only told the weights on its three derived functions of those core dimensions, even though the deeper tradeoffs between the core dimensions are clearly more salient. Since income is one of those core dimensions, the tradeoffs can also be monetized, which makes them easier to understand, and to assess whether they are appropriate by comparison with other research findings, including on the economic returns to better health and education.[8]

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[4] The claims regularly made by the HDR's that "development" is typically defined solely in terms of GDP have surely been exaggerated, as Srinivasan (1994) argued in an early critique of the HDI.

[5] Saying that there is more than one relevant indicator of development does not in itself imply that we need to force them into one dimension; see Ravallion (2010a) on this point.

[6] In the context of aggregating mean income and life expectancy, Dowrick et al. (2003) show how revealed preference theory can guide the methodological choices. Also see the more structural economic models in Becker et al. (2005) and Jones and Klenow (2010), and the latent-variable statistical model used by Høyland et al. (2010) to set the weights for a version of the HDI.

[7] The income variable has been somewhat controversial, with some observers arguing against its inclusion in the HDI; on the case for including income, see Anand and Sen (2000).

[8] Advocates of making human development the overarching development goal often reject monetary valuations. However the fact of using money *per se* as the metric of value cannot be objectionable; rather the issue is how we assess "value." For further discussion and references to the literature on money metrics of social welfare see Ravallion (2010a).

This paper examines the tradeoffs embodied in the latest version of the HDI, as presented in UNDP (2010).[9] After summarizing how the index has changed, the paper turns to its valuations of longevity and schooling. The paper questions whether the HDI's implicit valuations are sending the right signals to governments trying to monitor and promote human development. Next the paper shows that the troubling tradeoffs found in the 2010 HDI could have been avoided to a large extent using an alternative aggregation function from the literature—indeed, a more general form of the old HDI, as proposed by Chakravarty (2003). A final section concludes.

2. The Human Development Index

The three core dimensions of the HDI are life expectancy (*LE*), schooling (*S*) and income (*Y*). The changes introduced in the 20th *Human Development Report* (UNDP, 2010) concern the precise measures used for these core dimensions, and how they are aggregated to form the composite index. Life expectancy is the only core dimension that is unchanged in the 2010 HDI. Gross national income (GNI) has replaced GDP, both still at purchasing power parity (PPP) and logged. The two variables used to measure the third component, education, have changed. Literacy and the gross enrolment rate (as used in the old HDI) have been replaced by mean years of schooling (*MS*) and the expected years of schooling (*ES*), given by the years of schooling that a child can expect to receive given current enrolment rates.

As in the past, the three core dimensions of the HDI are first put on a common (0, 1) scale. The rescaled indicators are:

$$I_x = \frac{x - x^{min}}{x^{max} - x^{min}} \quad (x = LE, S) \tag{1.1}$$

$$I_Y = \frac{lnY - lnY^{min}}{lnY^{max} - lnY^{min}} \tag{1.2}$$

where the "max" and "min" denote the assumed bounds (in obvious notation). (Note also that *S* is itself a composite index of *MS* and *ES*, which I return to.)

[9] In addition to its new HDI, UNDP (2010) introduced a new "multidimensional poverty measure," which raises a number of distinct issues, as discussed in Ravallion (2010a).

The bounds used in rescaling all three variables to common units have also been modified. It used to be assumed that life expectancy is bounded below by 25 years, and above by 85 years; in the 2010 HDI these bounds changed to 20 years and 83.2 years (Japan's life expectancy). In the 2010 HDI, GNI per capita is bounded below by $163 (the lowest value, for Zimbabwe in 2008) and above by $108,211 (for the United Arab Emirates in 1980). The new education variables are both taken to have lower bounds of zero with *MS* bounded above by 13.2 years (the US in 2000) and *ES* bounded above by 20.6 years (Australia, 2002).

Figure 1 gives the density functions of the three scaled indicators across the 169 countries for which UNDP (2010) provides estimates of the HDI. The distributions are quite different, with notably higher values for life expectancy than schooling and (especially) income. There are also signs of bi-modality for schooling and life expectancy. There are 14 countries with life expectancy under 50 years and 13 with mean years of schooling less than three years. (Five countries are common to both categories.)

An important change (in the present context) is in how the three scaled indicators are aggregated. The old HDI used their arithmetic mean:

$$HDI_{old} = (I_{LE} + I_S + I_Y)/3 \qquad (2)$$

The 2010 HDI uses instead their geometric mean:

$$HDI_{new} = I_{LE}^{1/3} I_S^{1/3} I_Y^{1/3} \qquad (3)$$

Similarly, the way the two education variables are aggregated has changed, so that the new HDI has $I_S = (MS/MS^{max})^{0.5}(ES/ES^{max})^{0.5}$. Using either (2) or (3) the HDI is automatically bounded below by zero and above by unity.

Note that equation (3) embodies two distinct sources of nonlinearity in the income effect (unlike the one source in (2), namely through the log transformation). In HDI_{new} there is both the log transformation of income built into I_Y and the power transformation in (3). On twice differentiating HDI_{new} with respect to Y one finds that the 2010 HDI is still strictly concave in income. However, the combined effect of these two sources of nonlinearity is to impart a large positive income effect on the HDI's valuations of longevity and schooling, as we will see later.

Why did the 2010 HDR switch from equation (2) to (3)? The report offers the following explanation:[10]

> "Poor performance in any dimension is now directly reflected in the HDI, and there is no longer perfect substitutability across dimensions. This method captures how well rounded a country's performance is across the three dimensions. As a basis for comparisons of achievement, this method is also more respectful of the intrinsic differences in the dimensions than a simple average is. It recognizes that health, education and income are all important, but also that it is hard to compare these different dimensions of well-being and that we should not let changes in any of them go unnoticed." (UNDP, 2010, p.15)

These reasons are not as compelling as they may seem at first glance. It is true that the old HDI assumed that the scaled indices (I_{LE}, I_S and I_Y) were perfect substitutes (constant MRS), but this was not true of the core dimensions. Since income enters on a log scale (and is only then rescaled to the 0, 1 interval), income and life expectancy (or income and schooling) were not in fact perfect substitutes even in the old HDI. And relaxing perfect substitutability between I_{LE}, I_S and I_Y does not imply that one should switch to the form in (3); one can do so by using instead the generalized (old) HDI proposed by Chakravarty (2003). (I will return to Chakravarty's index in section V.) The other arguments made by the 2010 HDR for switching to the geometric mean are also less than fully compelling. It is not evident in what sense using the geometric mean makes poor performance more "directly" reflected in the HDI, or more "well rounded," or "more respectful of the intrinsic differences in the dimensions," or that using this aggregation formula means that we do "not let changes in any dimension) go unnoticed." Indeed, one can argue, to the contrary, that the HDI's new aggregation formula hides partial success amongst countries doing poorly in just one dimension. As dimension x approaches x^{min} we see that HDI_{new} approaches zero no matter what value is taken by the other dimensions.

Consider, for example, Zimbabwe, which has the lowest HDI_{new} of 0.14 (UNDP, 2010)—and it is the lowest by far, at about 60% of the next lowest. Yet this is due to one component that currently scores very low, namely income; Zimbabwe's I_Y=0.01—the lowest of any country, and by a wide margin (60% of the next lowest value)—while I_S=0.52 and I_{LE}=0.43, both well above the bottom. Indeed, there are 56 countries with a lower schooling index than Zimbabwe's, yet this relative success is hidden by the HDI's new aggregation formula, given its

[10] A number of commentators in the literature have advocated a multiplicative form for the HDI, such as (3), including Desai (1991), soon after the HDI first appeared, and Sagar and Najam (1998) (although the 2010 HDR does not refer to these antecedents in the literature).

multiplicative form. Using the arithmetic mean instead (with other data unchanged), Zimbabwe still has a low HDI, but it ranks higher than six countries. (And Zimbabwe does even better using the alternative HDI discussed in Section V.)

The rest of this paper examines the country-specific tradeoffs implied by the 2010 HDI, and how they have changed. On *a priori* grounds it is unclear what effect relaxing perfect substitutability between the scaled indicators (I_{LE}, I_S and I_Y) would have on the tradeoffs in the core dimensions. Whether the MRS increases or decreases will depend on the data. This is illustrated in Figure 2, which plots the contours (holding the HDI constant) between log income per capita and life expectancy for both the arithmetic mean (the straight line contour) and the geometric mean (the convex one). As usual, the MRS is the absolute value of the slope of the contour. For convenience, countries A and B are taken to have the same HDI either way.[11] For country A, the switch implies a higher MRS, while for B the MRS is lower. The fact that we are more interested in the MRS with the core dimension of income ("unlogged") adds further theoretical ambiguity to the effect of this change in the HDI.

While the focus here is on the HDI's implicit tradeoffs, knowing those tradeoffs is clearly not sufficient for deciding whether policies that promote health care or education will promote human development. Even leaving aside the issue of whether the HDI is an adequate representation of that goal, we would also need to know the costs, assuming that it is national income net of those costs that is valued for human development.[12] And those costs will vary across countries. The costs of lengthening life or raising school attainments are also likely to be higher in richer countries, given that health and education services are labor intensive, and (hence) will tend to be more expensive in rich countries where wages are higher.

I will note some comparisons with the costs of increasing longevity, drawing on the literature. However, this paper's focus on the valuations built into the HDI is primarily intended

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[11] In other words, the scaled values of log income and life expectance are swapped between A and B. More generally, depending on the data and assumed bounds, the switch to the geometric mean may alter the HDI ranking of A and B.

[12] For example, let *VLE* denote the monetary valuation (MRS) for longevity and let *MCLE* denote its marginal cost i.e., the income forgone for other purposes when life expectancy is increased by one year. Then higher life expectancy will increase the HDI if (and only if) *VLE*>*MCLE*.

to inform public understanding of the HDI, rather than to inform discussions of what policies might increase human development.

In examining the implications of the changes to the HDI for its implicit valuations, I focus first on the HDI's valuation of longevity, after which I turn to its valuation of schooling.

3. The HDI's troubling valuations of longevity

While the weights attached to the HDI's scaled indices (I_{LE}, I_S and I_Y) are explicit, those on the core dimensions (*LE*, *S* and *Y*) are not, and arguably it is these weights that we care about in understanding the properties of the HDI.[13] The HDRs have never discussed explicitly the valuations on its core dimensions, and they can be questioned. Ravallion (1997) pointed out the seemingly low monetary value implicitly attached to longevity in poor countries by past HDIs (using an earlier functional form). As we will see, it turns out that the changes introduced in the 2010 HDR have lowered the HDI's valuation of longevity in poor countries even further.

The HDI's marginal weights can be readily derived by differentiating equation (2) or (3) with respect to each variable. The effect on these weights of switching to the new formula for the HDI is theoretically ambiguous, and will vary across countries according to:

$$\frac{\partial HDI_{new}}{\partial x} / \frac{\partial HDI_{old}}{\partial x} = \frac{HDI_{new}}{I_x} \quad (x = LE, S, Y) \tag{4}$$

For longevity we find that $HDI_{new} < I_{LE}$ for 164 of the 169 countries. So the new HDI has lowered the weight on longevity for all but five countries (using the new bounds). For the old HDI the marginal value on longevity was a constant, $(3(LE^{max} - LE^{min}))^{-1} = 0.0054$. (Going from the lower bound of life expectancy of 20 years, as assumed by the 2010 HDI, to the upper bound of 83.2 years, adds 0.34 to the HDI.) This changed when the HDR switched to the geometric mean; the marginal weight on longevity then became:

$$\frac{\partial HDI_{new}}{\partial LE} = \frac{HDI_{new}}{3(LE - LE^{min})} \tag{5}$$

[13] The HDI is not alone in this respect. Ravallion (2010a) discusses a range of composite indices of development which tell their users little or nothing about the weights attached to their core dimensions. Their weights are made explicit, but not in what is (arguably) the most relevant space.

Figure 3 plots the new and the old weights on longevity against national income per capita (on a log scale to avoid bunching up at low incomes). It can be seen that a strong positive income gradient has been introduced, with markedly lower weights for poorer countries (in terms of GNI per capita). This pattern is not confined to income; the weight on longevity is also positively correlated with the (new) HDI (r=0.697; which is significant at 0.001level using a robust standard error) and life expectancy (r=0.347—also significant at 0.001 level).[14]

By contrast to longevity, the new formula for the HDI increased the weight on income for the bulk of the countries. In particular, one finds that $HDI_{new} > I_Y$ for 148 countries.

The HDI implicitly puts a monetary valuation on an extra year of life, where that valuation is defined by the tradeoff between longevity and income, i.e., the extra income needed to compensate for a year less of life expectancy, keeping the HDI constant. This is given by the ratio of the HDI's marginal weight on longevity to its weight on income. Denote this tradeoff by VLE. We have (in obvious notation):

$$VLE_{old} = \frac{Y(lnY^{max} - lnY^{min})}{LE^{max} - LE^{min}} \quad (6.1)$$

$$VLE_{new} = \frac{Y(lnY - lnY^{min})}{LE - LE^{min}} \quad (6.2)$$

It can be seen that VLE_{old} is directly proportional to Y, given the bounds.

The direction of the effect on *VLE* of switching from the old to the new formula for the HDI is theoretically ambiguous, and depends on both the data and the bounds used for rescaling the variables. Since the weight on longevity has fallen for the bulk of countries, while it has risen for income, we can also expect lower monetary valuations of longevity. More precisely, it is plain from equations (6.1) and (6.2) that $VLE_{old} > VLE_{new}$ if (and only if) $I_{LE} > I_Y$. Out of the 169 countries, I find that the monetary valuations of longevity have been revised down for 158 countries (161 if one uses the new bounds). The Annex gives my calculations of the HDI's valuations of longevity for all 169 countries, as well as the 2010 HDI and GNI per capita in

[14] Given the function form, the new HDI is strictly concave in its core dimensions, but this only tells us that the weight on *x* declines with *x*, holding the other two components constant. In these data-based comparisons, the other variables are not constant, and so their interaction effects come into play.

2008. Figure 4 plots the valuations against national income. (I return to explain the "marginal cost" series in Figure 4.)

The HDI's value of longevity in the poorest country, Zimbabwe, is a remarkably low \$0.51 per year, representing less than 0.3% of that country's (very low) mean income in 2008. Thus the 2010 HDI implies that if Zimbabwe takes a policy action that increases national income by a mere \$0.52 or more per person per year at the cost of reducing average life expectancy by one year, then the country will have promoted its "human development."

Granted Zimbabwe has an unusually low GNI. The next lowest valuation of longevity is for Liberia, for which the HDI attaches a value of \$5.51 per year to an extra year of life expectancy; this is 10 times Zimbabwe's valuation, though it is still only 1.7% of Liberia's annual income. The value tends to rise with income and reaches about \$9,000 per year in the richest countries (Figure 4). The highest valuation of longevity is 17,000 times higher than the lowest. Even dropping Zimbabwe's (exceptionally low) valuation, the differential is 1,600.

The least-squares elasticity (the ordinary regression coefficient of $lnVLE_{new}$ on lnY) is 1.208 (with a robust standard error of 0.033; n=169). This is significantly greater than unity, implying that the HDI's valuation of longevity as a proportion of mean income tends to rise with mean income. The elasticity is also higher than most past estimates of the income elasticity of market-based estimates of the value of statistical life.[15]

The fact that the valuation of longevity as a proportion of mean income tends to rise with mean income is confirmed by Figure 5. (The highest value as a proportion of GNI turns out to be almost 16%, in Equatorial Guinea, though this is clearly an outlier.) By contrast, the old HDI had an income elasticity of unity, and (when evaluated with the HDI's new bounds) VLE_{old} is almost exactly 10% of each country's annual income.

The changes to the HDI have devalued longevity, especially in poor countries. Given the construction of the index, VLE_{new}/VLE_{old} is directly proportional to VLE_{new}/Y (equations 6.1 and 6.2); the constant turns out to be 10.014. So by dividing the vertical axis of Figure 5 by 10 (noting that the axis is in percent), we can also read it as a graph for VLE_{new}/VLE_{old}. (Selected

[15] A review of the evidence by Viscussi and Aldy (2003) concludes that the income elasticity is in the range 0.5-0.6.

points for VLE_{new}/VLE_{old} are indicated on the vertical axis in parentheses.) There was a roughly 25% downward revision on average (mean $VLE_{new}/VLE_{old} = 0.748$). If one focuses on the poorest half of countries (GNI per capita below the median) then the average downward revision was close to 40% (mean $VLE_{new}/VLE_{old} = 0.620$; n=84); for the poorest quarter, the valuation of longevity has been almost halved ((mean $VLE_{new}/VLE_{old} = 0.545$; n=42)).

Figure 6 provides a "blow up" of Figure 4 for the poorest half of countries (in terms of GNI per capita), as well as the values implied by the old HDI aggregation using the arithmetic mean. (I also give the old valuation of life using the arithmetic mean and old bounds.) It can be seen that changing the bounds alone in the old HDI would not have produced this large downward revision to the index's monetary valuation of longevity. Rather it was the combined effect of switching to the geometric mean, the form of the scales used and (of course) the data. Given the scales and aggregation formulae, the marked devaluation of longevity stems from the fact that $I_{LE} > I_Y$ for all except eight of the 169 countries, implying that $VLE_{old} > VLE_{new}$. (This difference in the distributions was already evident in Figure 1.) Whether this holds depends on the assumed bounds built into the HDI. For example, a higher upper bound for *LE* would have lowered the value of life implicit in the old HDI; I find that VLE_{old} would have been quite close to the level of VLE_{new} at $LE^{max} = 100$. The somewhat arbitrary and time varying choice of bounds has played an important role in the HDI's devaluations of longevity.

The income gradient in the HDI's monetary valuations of longevity appears to be substantially greater than the gradient in the marginal costs of longevity. Dowrick, Dunlop and Quiggin (DDQ) (1998) estimate marginal costs of an extra year of life expectancy for 58 countries in 1980, which I have simply converted to 2008 prices using the US CPI. There are a number of comparability problems between the DDQ estimates and my calculations of *VLE*, so these calculations should only be considered as broadly indicative for the present purposes.[16] The DDQ estimates are also given in Figure 4. Their estimated marginal cost of a one year increase in life expectancy is 400 times higher in the country with the highest cost (Denmark in their

[16] Probably most importantly, updating solely for inflation in the US misses the structural changes in growing developing economies, which entail changes in their relative prices; in particular, we can expect that the cost of attaining higher longevity may have risen more in rapidly growing economies such as China than these estimates indicate. This is suggested by comparisons of PPP estimates across different rounds of the International Comparison Program; see Ravallion (2010b).

sample) than the lowest (Madagascar). This is far less than my calculations of the differential in the valuation of longevity implicit in the HDI. The DDQ estimates are only roughly similar to the HDI's valuations for the poorest countries, but the HDI's valuations greatly exceed marginal costs among most countries, and the gap is very large for the richest countries.

Across individuals, one expects the value attached to extra longevity to rise with income. Even if (instantaneous) utility depends only on consumption, a high income allows more to be consumed in the extra years of life, giving higher expected utility.[17] Similarly, one would expect people in rich countries to be willing to pay more for extra longevity, and they clearly do. However, such observations do not justify building an income gradient (let alone a steep gradient) into the valuation of longevity. The HDI is clearly intended to embody social values, which need not accord with private ones.

With reference to the private valuations of "statistical life"—such as derived from contingent valuation questions in surveys or wage premia paid for risky jobs—Ackerman and Heinzerling (2001, p.18) note a similar concern:

> "Calculation of the link between average income and the value of a statistical life could, if applied indiscriminately, lead to the unacceptable implication that rich people, or residents of rich nations, are worth more than the poor."

While the HDI is not deriving its valuations of longevity from such sources, the fact that it puts a higher value to an extra year of life for people in rich countries than poor ones is arguably no less of an example of the "unacceptable implication" that Ackerman and Heinzerling refer to.

This troubling tradeoff in the 2010 HDI will clearly influence its rankings of performance in human development. However, a more worrying concern arises if the index influences (domestic and international) policy making. The HDI's embedded tradeoffs imply that, in the interests of promoting human development—or at least improving its HDI—the government of a poor country should not be willing to pay more than a very small sum (in $'s and as a percent of national income) for an extra year of expected lifespan for its citizens, while the government of a rich country would be encouraged to spend vastly more for the same gain in longevity—17,000 times more if one compares my calculation of VLE_{new} for the richest country with the poorest.

[17] Suppose instead that (i) utility is strictly increasing in both life expectancy and income; (ii) the marginal utility of higher life expectancy does not fall with higher income, and that (iii) there is declining marginal utility of income. Then the MRS will be an increasing function of income.

Serious objections would naturally be raised to any proposal for public action within one country that rested on assigning a lower value to life to poor citizens than to rich ones, let alone a relative value that is such a tiny fraction. The same objections arise in a global context.

One is led to question whether these valuations are consistent with promoting "human development." Yet, the 20 HDRs have largely avoided making explicit this potentially troubling tradeoff, although the basic problem was noted in early commentaries (Ravallion, 1997).

4. The HDI's valuations of schooling

The fact that the HDI's education variables have changed is not of obvious concern in this context, so I will only use the new schooling variables in the 2010 HDI. Applying equation (4), I find that that the new HDI's aggregation method has put a higher weight on schooling for 119 of the 169 countries (i.e., all those with $HDI_{new} > I_S$).

The ratio of the old and new weights in (4) does not depend on precisely how a gain in schooling is allocated between mean actual years of schooling and mean expected years (assuming, naturally, that it is allocated the same way for both calculations). However, in calculating the HDI's new valuation of schooling one does need to know that allocation. I shall assume that an extra year is added to both mean current schooling (*MS*) and the expected years of schooling (*ES*).[18] While I will use the new education variables, I will keep their old aggregation function, including the use of the arithmetic mean of the (scaled) schooling variables. Then the HDI's implicit valuations of extra schooling are given by:

$$VS_{old} = Y\left(lnY^{max} - lnY^{min}\right)((MS^{max})^{-1} + (ES^{max})^{-1})/2 \qquad (7.1)$$

$$VS_{new} = Y\left(lnY - lnY^{min}\right)(MS^{-1} + ES^{-1})/2 \qquad (7.2)$$

Figure 7 plots VS_{old} and VS_{new} against (log) GNI. (Later I will explain the series in Figure 7 labeled "Chakravarty index.") Similarly to longevity, we see a marked income gradient, although flat at low incomes. The new HDI values an extra year of schooling at $1.68 per person per year in Zimbabwe, about 1% of mean income; the next lowest is for the Congo where

[18] There is some support for this assumption in the data; the regression coefficient of expected schooling on mean current schooling is 0.88, which is close to unity, although it is still significantly less than unity (t=2.54, based on a robust standard error; n=169).

VS_{new}=\$33 per year, or 11% of annual income. At the other extreme, VS_{new} rises to \$53,000 per year in the country with the second highest GNI per person, representing 67% of that country's GNI. The valuation of schooling has increased in 94 countries, though the increase is more marked amongst high-income countries. Given the cross-country differences in schooling, the valuation of schooling as a proportion of GNI does not rise with GNI above some point; Figure 8 plots VS_{new}/Y against GNI. (The highest VS_{new}/Y is for Burkina Faso, but this is an outlier.)

While the HDI's implicit valuations of longevity seem low, it's valuations on schooling seem high. In constructing a composite index such as the HDI, there is a (rather poorly-understood) issue about what dimensions are intrinsically, versus instrumentally, important. We can all agree that a longer life is valued intrinsically, independently of income. However, it is not quite so clear that education has such a large intrinsic value (as assumed by the HDI), rather than being (very) important instrumentally to income and (hence) welfare.

In defense of the HDI, one might argue that the benefits of extra schooling are not fully reflected in current incomes; better educated parents pass advantages onto their children, leading to higher future incomes. (Possibly the new HDI's introduction of the variable for expected schooling is trying to capture this effect.) But it is a moot point just how much extra one would allow for such an effect, on top of the economic return to schooling. The HDI is presumably measuring a country's current human development not its future value.

If we compare the HDI's valuations on schooling with the returns implied by earnings regressions, the HDI's valuations are clearly very much higher. The regression coefficient of log earnings on years of schooling is typically around 0.1; see Psacharopoulos and Patrinos (2002). So it seems that the HDI is putting a much larger value on the returns to schooling than is reflected in current earnings. Indeed, the HDI's valuation in developing countries appears to be roughly four times the labor market returns to schooling.[19]

Finally, Figure 9 compares the new HDI's valuations for longevity and schooling. What is most striking is how much higher the HDI's implicit valuation of schooling is than its

[19] For high-income countries, the ratios of the valuation of extra schooling to mean income in Figure 6 are roughly seven times the coefficients on years of schooling reported by Psacharopoulos and Patrinos (2002, Table 4, p.14). However, Banerjee and Duflo (2005) question whether the evidence supports the claim that returns to education vary much across countries.

valuation of longevity. A shorter but better schooled life is preferred by the designers of the HDI. One is left wondering how many of the world's poor—many living short lives by rich-country standards—would agree.

5. Could the HDI's troubling tradeoffs have been avoided?

Instead of using the geometric mean, suppose that the HDR's team had generalized its old additive HDI in the natural form proposed by Chakravarty (2003), giving the "generalized (old) HDI:"

$$HDI^C = [f(I_{LE}) + f(I_S) + f(I_Y)]/3 \tag{8}$$

where *f* is some smooth, twice-differentiable, concave function mapping from the [0,1] to [0,1] with *f*(0)=0 and *f*(1)=1. Chakravarty (2003) shows that the form in (8) satisfies three axioms: normalization (if all three components, $f(I_x)$, take the same value then that value is the HDI), consistency in aggregation (the HDI for a sum of component indices is equal to the corresponding sum of the HDIs across the components) and symmetry (the HDI is unaffected by permutations of its components).[20] Consistency of aggregation forces the HDI to be linearly additive in the $f(I_x)$'s as in equation (8). Chakravarty proposed a parametric special case of (8) in which $f(I_x) = I_x^r$ for $(0 < r < 1)$, giving an index that I will label HDI_r^C. The old HDI is the limiting case when r =1, and only then does the index impose perfect substitutability (constant MRS) between the I_xs. I will present empirical results here for r=0.5 and 0.25.

With two further modifications, this special case of the Chakravarty index can take us a long way toward avoiding, or at least attenuating, the troubling tradeoffs in UNDP's (2010) new HDI. The first change is to replace *lnY* with *Y* in equation (1.2) so that $I_Y = (Y - Y^{min})/(Y^{max} - Y^{min})$.[21] This change is important, since it removes a source of the positive income effect on the weights implicit in the new HDI. The second change is to use the arithmetic mean of the two schooling variables, *MS* and *ES* (and their bounds), rather than their geometric mean.

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[20] Chakravarty (2003) actually proves a more powerful result: an even more general index will satisfy these three axioms if and only if it takes the form of equation (8).

[21] Note that this still allows diminishing marginal returns to income; the new HDI's functional form—in which income is logged within the scaled index, and then the index is raised to the power of 1/3—is arguably an "overkill" since one only needs one source of nonlinearity.

With these modifications, we can avoid the troubling property of the 2010 HDI in Figure 3, whereby the marginal effect on the index of an extra year of life rises with national income per capita (and the HDI itself). Indeed, we now have the reverse slope, with higher weight on longevity in poorer countries; Figure 10 gives the weights on longevity implied by HDI_r^C, for *r*=0.5 and 0.25. Instead of a higher weight on longevity in richer countries, we now find that the weight rises from 0.0026 in one of the richest countries to 0.0042 in the poorest (*r*=0.5). The pattern is similar using *r*=0.25, though the negative gradient is less steep.

The implied tradeoffs with income are given by:

$$Vx_r = \left(\frac{I_Y}{I_x}\right)^{1-r} \frac{(Y^{max} - Y^{min})}{(x^{max} - x^{min})} \quad (x = LE, S) \tag{9}$$

We still find higher monetary valuations on longevity and schooling in richer countries, but HDI_r^C gives higher valuations for poor countries than HDI_{new} and the troubling income gradient is much attenuated. Figure 11 compares the valuations on longevity in HDI_{new} with those implied by HDI_r^C for *r*=0.5 and 0.25; Figure 7 gives the corresponding valuations for schooling (only for *r*=0.5 to avoid cluttering up the graph; the series for *r*=0.25 is similar to the pattern in Figure 11). In both cases, the implied valuations rise with income per capita, but much less steeply than implied by the 2010 HDI. The lower value of r reduces the income gradient.

The Chakravarty index also puts higher valuations on schooling than longevity, similarly to the 2010 HDI. This property appears to be hard to avoid given the differences in distributions noted in Figure 1 and the assumed bounds. Of course, increasing the weight on I_{LE}^r relative to that on I_S^r will narrow the gap in the valuations of schooling and longevity. However, I found that on even doubling the weight on the life expectancy component (equally weighting the other two components) the valuation on schooling still exceeded that on longevity.

Figure 12 compares HDI_{new} with HDI_r^C. (The Annex also gives $HDI_{0.5}^C$ by country.) The overall means are similar for *r*=0.5 (an un-weighted mean of 0.643 for $HDI_{0.5}^C$, versus 0.637 for HDI_{new}), but higher for *r*=0.25 (mean of 0.773). Switching to HDI_r^C increases the index for low HDI countries, and decreases the upper values for *r*=0.5, and so gives lower overall inequality in the HDIs across countries; for example, the CV falls from 0.291 to 0.194 for *r*=0.5 and 0.121 for *r*=0.25. While it is clear that the two HDIs in Figure 12 are highly correlated (r=0.980 *r*=0.5 and

0.987 for *r*=0.25), there are some large changes. For *r*=0.5, Zimbabwe's index rises by over 300%, from the lowest value (by far) of 0.140 based on HDI_{new} to 0.454; it also rises relatively, to be the 12th lowest—reflecting the fact that the additivity property of the Chakravarty index puts a higher premium on Zimbabwe's schooling attainment. Using *r*=0.25, the upward revision to Zimbabwe's index is even more dramatic, with $HDI_{0.25}^{C}$=0.583. The largest decrease is that for New Zealand, for which the index falls by 0.094 in switching to $HDI_{0.5}^{C}$, and the ranking falls from third place to 18th. The differences are small at high HDIs using *r*=0.25 (Figure 12).

6. Conclusions

The Human Development Index was introduced in 1990 as an alternative to using national income per capita as the metric of development success. Until 2010 the index was an equally-weighted mean of scaled attainments in three dimensions: life expectancy, education and income. The simplicity of the HDI gave it a transparency that was clearly appealing to many users, although the HDI was never quite as simple as one might think at first glance, given the transformations embedded in its components. Over 20 years, the Human Development Reports (and numerous offshoot reports at national level) have applauded those countries that do well in the HDI, and offered advice to others on how they might do better in the HDI stakes.

A new version of the index was introduced in the 2010 edition of the HDR. The main change was to switch from the original additive aggregation function (the arithmetic mean of the three components) to a multiplicative function (their geometric mean). The main reason given for this change was to allow for imperfect substitutability between the HDI's three components.

However, good intentions alone do not make for good measurement. The 2010 HDI is both more complicated and more problematic in its tradeoffs across core dimensions. Longevity in poor countries has been substantially devalued, though it seems unlikely that this was intended. The HDI's valuation of longevity in the poorest country is now a mere 0.006% of its value in the richest country—a far greater difference than in their average incomes (for which the poorest country has 0.2% of the national income per capita of the richest). A poor country experiencing falling life expectancy due to (say) a collapse in its already weak health-care system could still see its HDI improve with even a small rate of economic growth. By contrast, the valuations of extra schooling have risen for most countries and they seem high—some four times higher than the valuations typically placed by the labor market on extra schooling.

There are some contentious value judgments buried in the maths of the HDI. 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." Given what we know about the marginal costs of extending life expectancy, 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. And it is unclear why we would want to put so much higher a value on schooling than implied by its economic returns.

Setting the tradeoffs in a composite index is never going to be easy and it is ultimately up to users to judge for themselves if they accept the HDI's valuations. However, the troubling tradeoffs in the new HDI are not in fact essential to relaxing the perfect substitutability property of the old HDI. The less appealing properties of the new index could have been avoided to a large extent, while allowing imperfect substitutability, by using an alternative aggregation function already found in the literature—in fact a straightforward generalization of the old HDI.

An important lesson for future composite indices is the need for transparency about the implicit tradeoffs, especially in more complicated indices. Those tradeoffs are the key to understanding the properties and implications of the index. I would hazard to guess that if the authors of the 2010 Human Development Report had calculated the tradeoffs implicit in their index they would have had second thoughts about it, and looked for alternatives.

References

Ackerman Frank and Lisa Heinzerling, 2001, “If It Exists, It’s Getting Bigger: Revising the Value of a Statistical Life,” Global Development and Environment Institute Working Paper No. 01-06, Tufts University.

Anand, Sudhir and Amartya Sen, 2000, “The Income Component of the Human Development Index,” *Journal of Human Development* 1(1): 83-106.

Banerjee Abhijit V. and Esther Duflo, 2005, “Growth Theory through the Lens of Development Economics,” In: Philippe Aghion and Steven N. Durlauf, Editor(s), *Handbook of Economic Growth*, Elsevier.

Becker, Gary, Tomas Philipson and Rodrigo Soares, 2005, “The Quantity and Quality of Life and the Evolution of World Inequality,” *American Economic Review* 95(1): 277-291.

Chakravarty, Satya R., 2003, “A Generalized Human Development Index,” *Review of Development Economics* 7(1): 99-114.

Desai, Meghnad, 1991, “Human Development: Concepts and Measures,” *European Economic Review* 35: 350-357.

Dowrick, Steve, Yvonne Dunlop and John Quiggin, 1998, “The Cost of Life Expectancy and the Implicit Social Valuation of Life,” Scandinavian Journal of Economics 100(4): 673-691.

______________, _____________ and ____________, 2003, “Social Indicators and Comparisons of Living Standards,” *Journal of Development Economics* 70: 501-529.

Høyland, Bjørn, Karl Ove Moene and Fredrik Willumsen, 2010, “The Tyranny of International Index Rankings,” mimeo, Department of Economics, University of Oslo.

Jones, Charles and Peter Klenow, 2010, “Beyond GDP? Welfare Across Countries and Time.” Mimeo, Stanford University.

Psacharopoulos, George and Harry Patrinos , 2002, “Returns to Investment in Education: A Further Update,” Policy Research Working Paper 2881, World Bank, Washington DC.

Ravallion, Martin, 1997, “Good and Bad Growth: The Human Development Reports,” *World Development*, 25(5): 631-638.

_______________, 2010a, “Mashup Indices of Development,” Policy Research Working Paper 5432, World Bank, Washington DC.

_______________, 2010b, “Price Levels and Economic Growth: Making Sense of the PPP Changes between ICP Rounds,” Policy Research Working Paper 5229, World Bank.

Sagar, Ambuj D. and Adil Najam, 1998, "The Human Development Index: A Critical Review," *Ecological Economics* 25: 249-264.

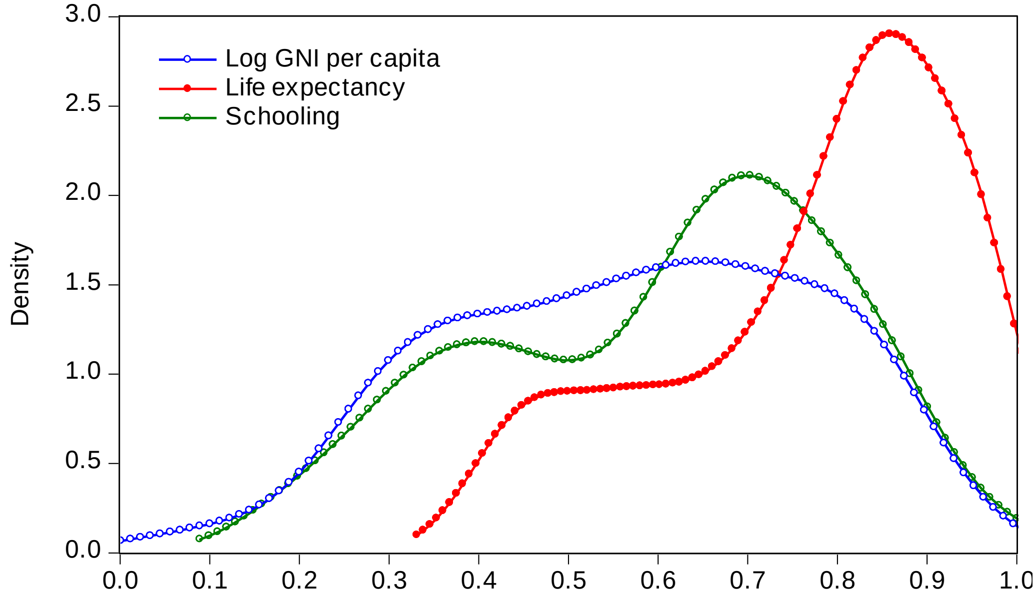
Srinivasan, T.N. 1994, "Human Development: A New Paradigm or Reinvention of the Wheel?" *American Economic Review, Papers and Proceedings*, 84(2): 238-249.

United Nations Development Programme, undated, *Ideas, Innovation and Impact: How Human Development Reports Influence Change.* UNDP, New York.

___________________________________, 2010, *Human Development Report: The Real Wealth of Nations*, New York: Palgrave Macmillan for the UNDP.

Viscusi, Kip and Joseph Aldy, 2003, "The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World," *Journal of Risk and Uncertainty* 27(1): 5-76.

Figure 1: Densities of the three scaled indicators used by the 2010 HDI



Note: Kernel density functions using Epanechnikov kernel (calculated using Eviews 7).
Source: Author's calculations from the data for 2008 provided in UNDP (2010).

Figure 2: The effect on the MRS of allowing imperfect substitution depends on the country

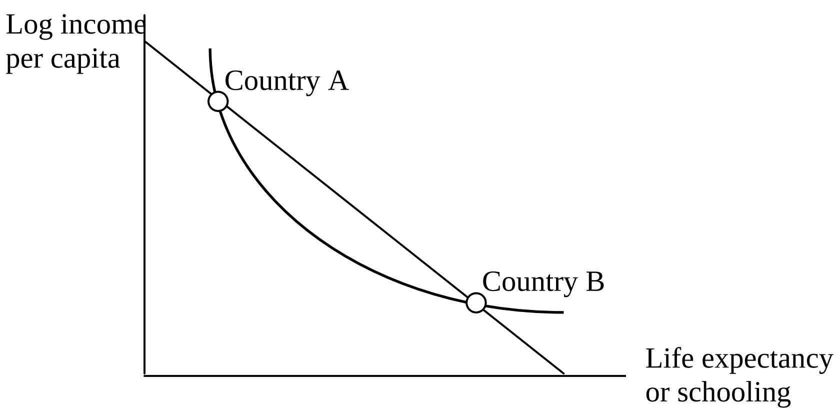
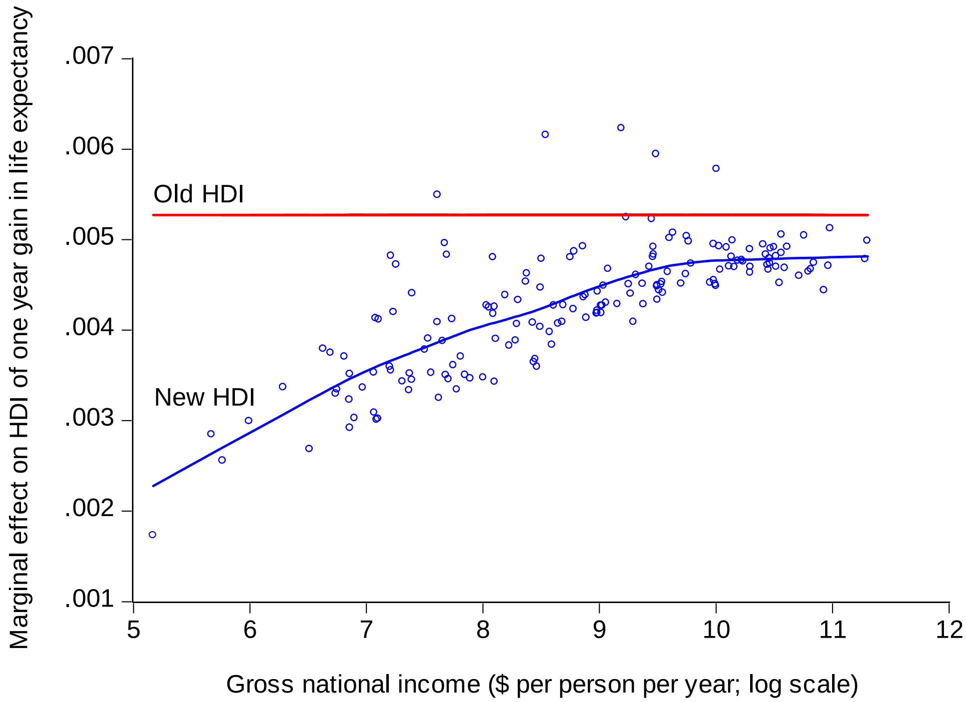


Figure 3: Weights on life expectancy in the old and new HDI



Source (this figure and all following ones): Author's calculation from data for 2008 provided in the 2010 HDR. The fitted line is a locally smoothed (nonparametric) regression.

Figure 4: Implicit valuations in HDI and marginal costs of an extra year of life expectancy

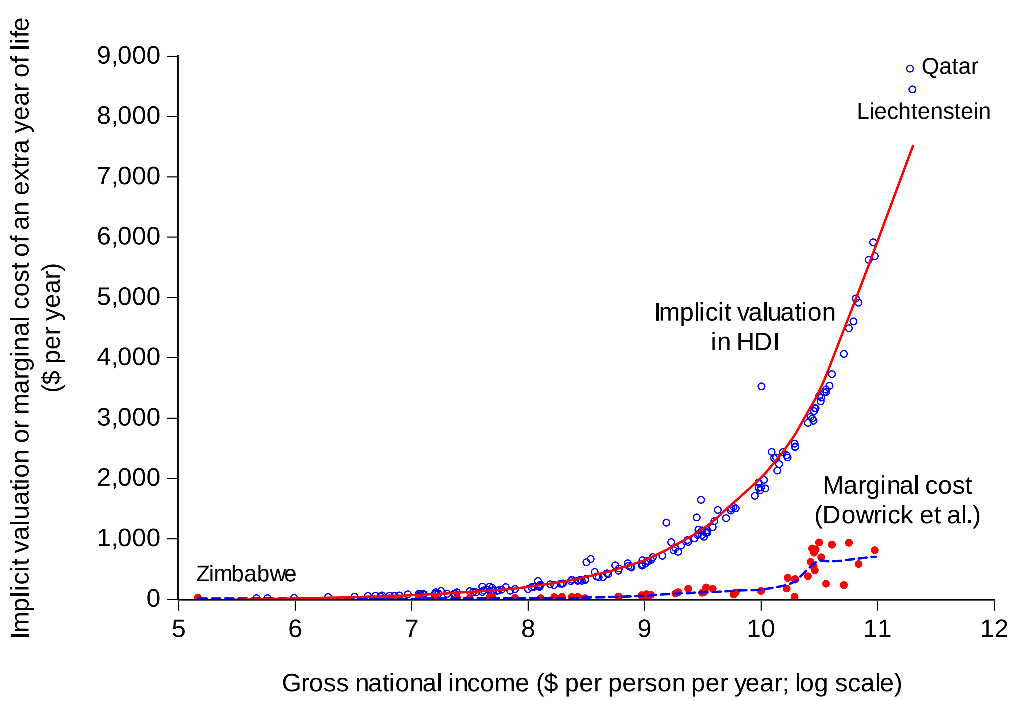


Figure 5: Value of an extra year of life expectancy as percent of gross national income

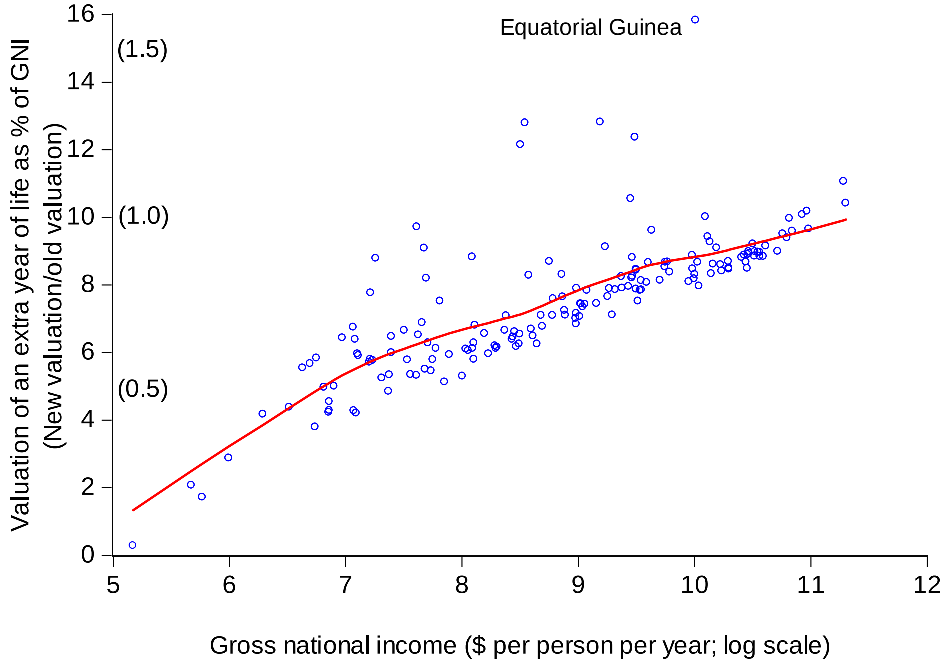


Figure 6: HDI's revised valuations of life expectancy in the poorest half of countries

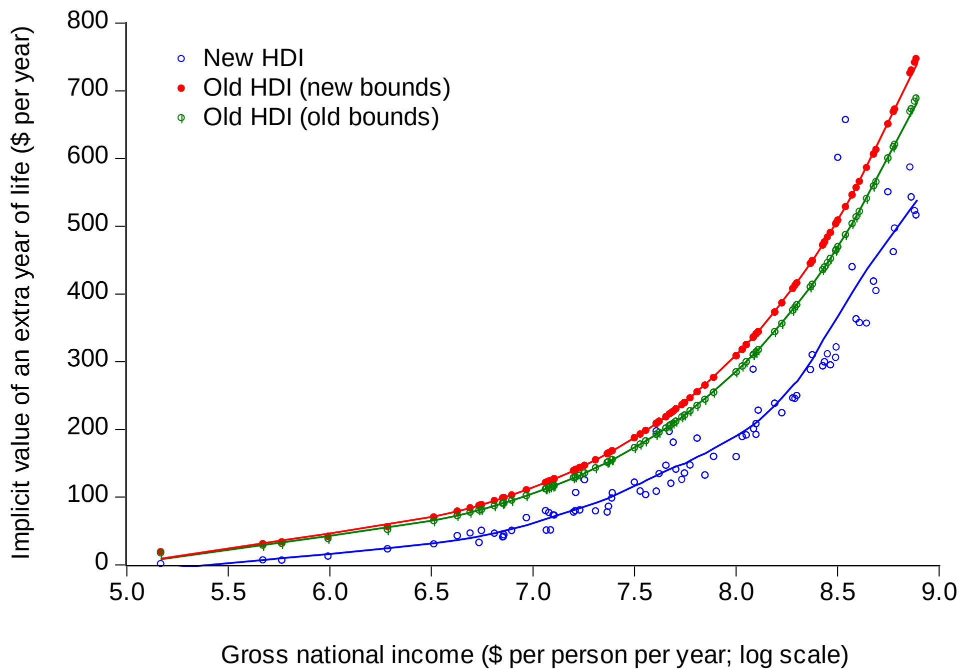


Figure 7: Implicit monetary values attached to an extra year of schooling by the 2010 HDI

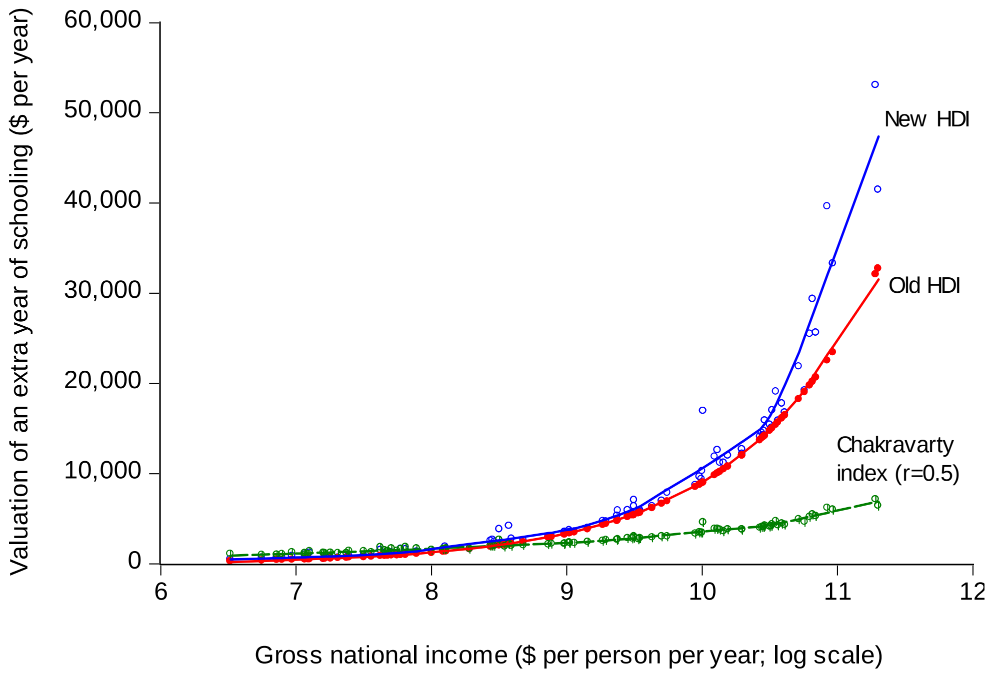


Figure 8: HDI's valuation of an extra year of schooling as a percent of national income

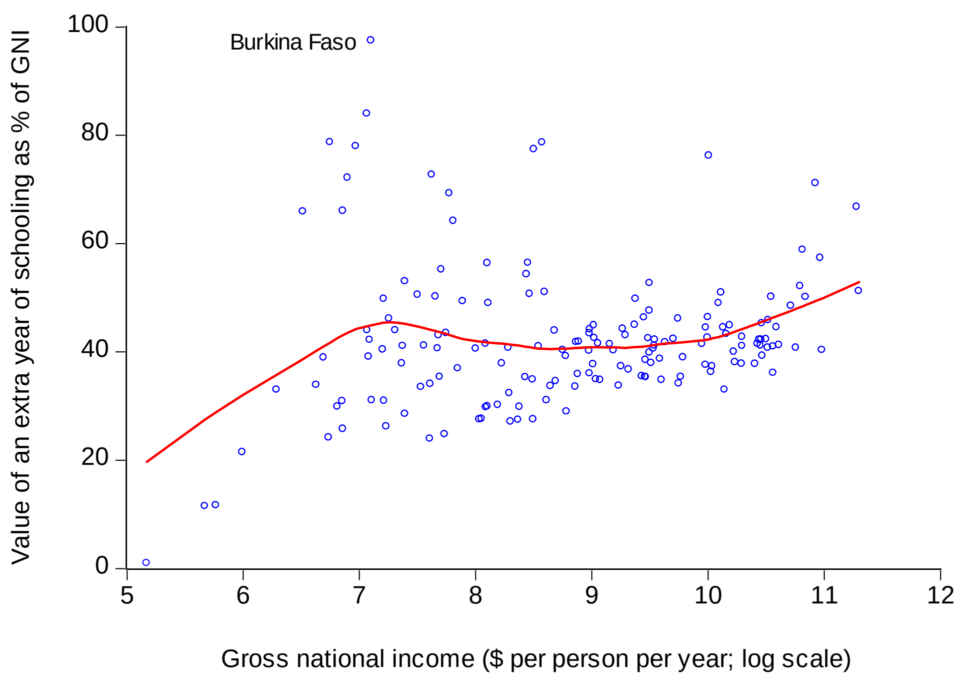


Figure 9: HDI's valuations of schooling and longevity across countries

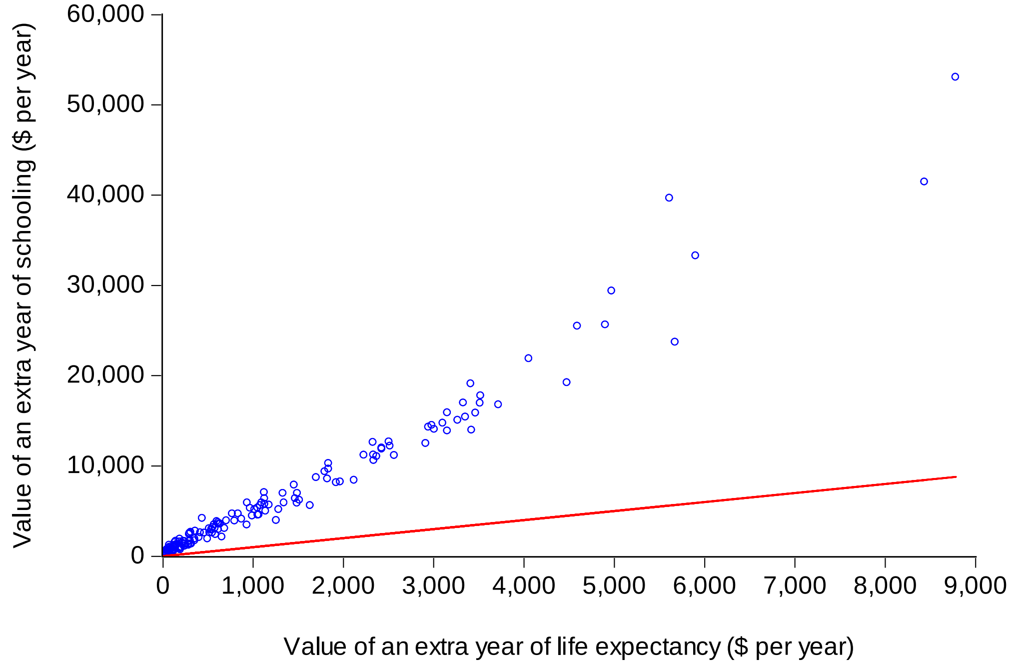


Figure 10: Weights on life expectancy in an alternative HDI using the Chakravarty index

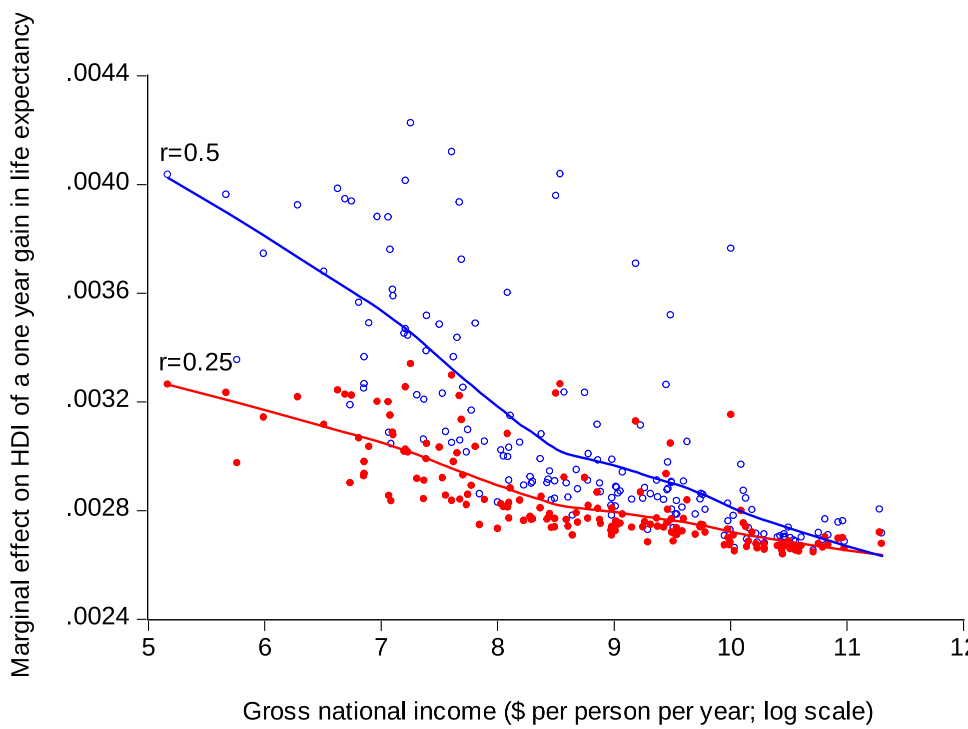


Figure 11: Valuations of longevity in the 2010 HDI vs. alternative HDI

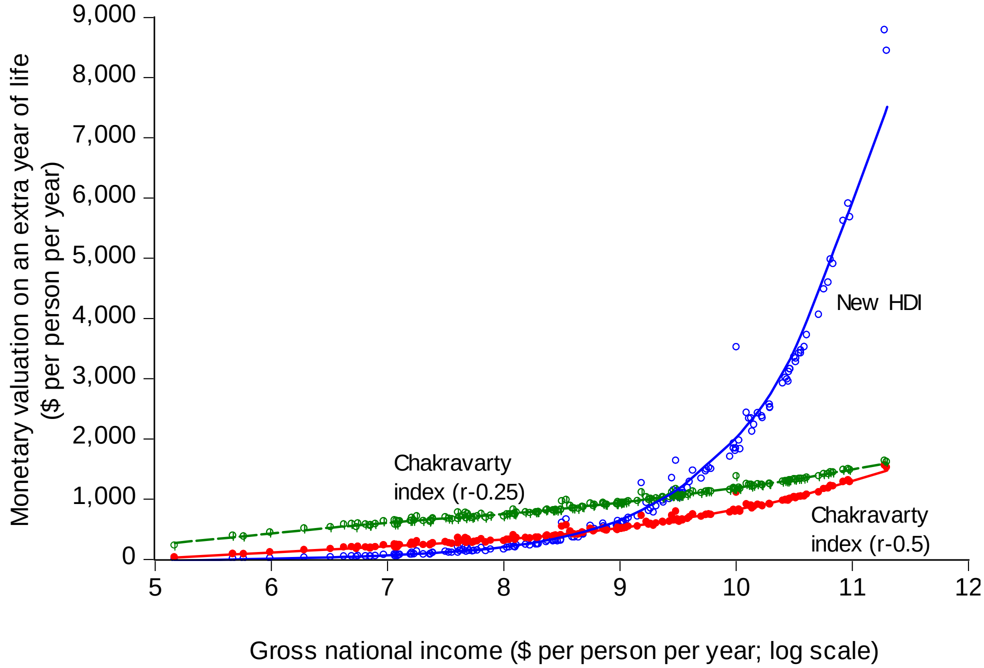
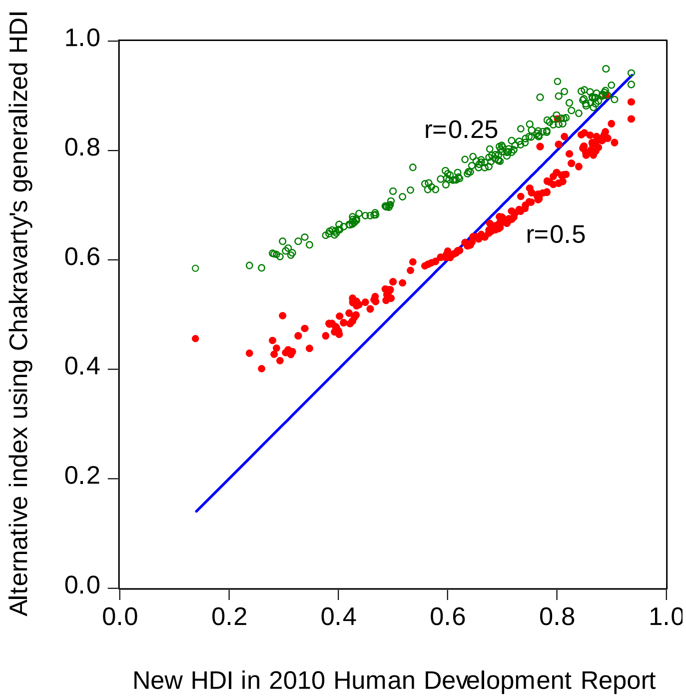


Figure 12: Comparison of the 2010 HDI with alternative HDI using the Chakravarty index



Annex: Human Development Index by Country and its Implicit Tradeoffs

HDI rank	Country	Human Development Index 2010	Gross national income per capita (US$ PPP 2008)	Implicit value of an extra year of life expectancy (US$ PPP, 2008)	Implicit value of an extra year of schooling (US$ PPP, 2008)	Alternative HDI using Chakravarty's generalized HDI (*r*=0.5)
1	Norway	0.938	58809.53	5676.31	23703.14	0.887
2	Australia	0.937	38691.71	3421.38	13962.64	0.856
3	New Zealand	0.907	25437.50	2119.82	8388.97	0.813
4	United States	0.902	47093.85	4478.40	19194.40	0.848
5	Ireland	0.895	33077.57	2913.07	12483.41	0.821
6	Liechtenstein	0.891	81011.42	8439.05	41445.94	0.899
7	Netherlands	0.890	40657.78	3719.45	16763.15	0.832
8	Canada	0.888	38668.37	3464.53	15830.11	0.827
9	Sweden	0.885	36936.27	3269.29	15057.89	0.822
10	Germany	0.885	35308.04	3153.65	13867.94	0.818
11	Japan	0.884	34692.46	2944.15	14268.21	0.817
12	Korea (Republic of)	0.877	29517.62	2566.25	11151.29	0.804
13	Switzerland	0.874	39849.09	3522.89	17750.42	0.824
14	France	0.872	34340.71	2980.43	14496.23	0.812
15	Israel	0.872	27831.34	2339.34	10600.29	0.797
16	Finland	0.871	33871.73	3008.29	14054.14	0.811
17	Iceland	0.869	22917.03	1826.53	8555.26	0.790
18	Belgium	0.867	34872.70	3103.36	14723.96	0.810
19	Denmark	0.866	36404.41	3353.66	15402.79	0.813
20	Spain	0.863	29661.16	2518.96	12172.00	0.799
21	Hong Kong, China	0.862	45090.48	4055.56	21856.34	0.826
22	Greece	0.855	27580.38	2370.80	11034.24	0.790
23	Italy	0.854	29619.21	2507.96	12664.21	0.795
24	Luxembourg	0.852	51109.19	4902.85	25604.28	0.831
25	Austria	0.851	37055.90	3329.38	16972.02	0.806
26	United Kingdom	0.849	35087.16	3153.20	15864.71	0.803
27	Singapore	0.846	48893.19	4592.41	25475.05	0.827
28	Czech Republic	0.841	22678.39	1965.98	8231.51	0.769
29	Slovenia	0.828	25857.03	2227.93	11182.50	0.775
30	Andorra	0.824	38056.49	3413.24	19086.43	0.792
31	Slovakia	0.818	21657.78	1921.00	8138.31	0.755
32	United Arab Emirates	0.815	58005.80	5903.94	33267.11	0.823
33	Malta	0.815	21004.33	1699.77	8690.60	0.754
34	Estonia	0.812	17167.68	1487.76	5855.15	0.742
35	Cyprus	0.810	21962.46	1796.11	9358.27	0.753
36	Hungary	0.805	17472.12	1516.02	6172.92	0.739
37	Brunei Darussalam	0.805	49914.55	4973.92	29356.66	0.809
38	Qatar	0.803	79426.35	8783.13	53049.90	0.856
39	Bahrain	0.801	26663.87	2425.78	11974.10	0.758
40	Portugal	0.795	22105.19	1836.83	10251.37	0.751
41	Poland	0.795	17803.06	1492.03	6939.45	0.736
42	Barbados	0.788	21672.62	1836.05	9633.26	0.741
43	Bahamas	0.784	25200.64	2337.02	11208.73	0.743
44	Lithuania	0.783	14823.72	1283.76	5161.69	0.723
45	Chile	0.783	13561.02	1019.85	5140.75	0.721
46	Argentina	0.775	14603.33	1178.66	5649.88	0.720
47	Kuwait	0.771	55718.61	5613.54	39630.67	0.805
48	Latvia	0.769	12944.18	1068.14	4565.53	0.711
49	Montenegro	0.769	12490.82	993.23	4435.56	0.709

50	Romania	0.767	12843.70	1054.06	4539.88	0.709
51	Croatia	0.767	16388.59	1332.95	6944.98	0.719
52	Uruguay	0.765	13808.44	1081.52	5596.90	0.716
53	Libyan Arab Jamahiriya	0.755	17067.63	1456.92	7872.34	0.721
54	Panama	0.755	13346.85	1050.64	5316.92	0.704
55	Saudi Arabia	0.752	24726.01	2329.44	12592.96	0.729
56	Mexico	0.750	13971.41	1096.99	5897.98	0.704
57	Malaysia	0.744	13926.86	1131.77	5733.77	0.698
58	Bulgaria	0.743	11139.16	875.50	4088.97	0.692
59	Trinidad and Tobago	0.736	24233.27	2427.76	11862.34	0.714
60	Serbia	0.735	10449.37	799.50	3896.45	0.687
61	Belarus	0.732	12925.70	1139.08	4976.54	0.690
62	Costa Rica	0.725	10869.63	772.51	4680.14	0.684
63	Peru	0.723	8424.21	619.21	2941.36	0.677
64	Albania	0.719	7976.33	545.63	2871.56	0.673
65	Russian Federation	0.719	15258.16	1467.10	6371.23	0.687
66	Kazakhstan	0.714	10234.32	933.95	3452.71	0.673
67	Azerbaijan	0.713	8746.57	685.12	3042.79	0.669
68	Bosnia and Herzegovina	0.710	8221.59	580.86	3097.88	0.670
69	Ukraine	0.710	6535.14	496.17	1893.01	0.665
70	Iran	0.702	11764.21	969.75	5290.62	0.675
71	Macedonia	0.701	9486.86	706.88	3925.63	0.667
72	Mauritius	0.701	13343.58	1128.13	6353.35	0.677
73	Brazil	0.699	10606.97	836.84	4692.70	0.671
74	Georgia	0.698	4901.91	320.60	1350.18	0.657
75	Venezuela	0.696	11846.23	936.48	5891.66	0.677
76	Armenia	0.695	5494.61	356.40	1706.02	0.656
77	Ecuador	0.695	7931.24	556.11	3186.96	0.664
78	Belize	0.694	5693.06	355.77	1916.05	0.658
79	Colombia	0.689	8588.94	637.55	3567.00	0.661
80	Jamaica	0.688	7206.85	521.82	2587.66	0.653
81	Tunisia	0.683	7979.31	571.47	3465.21	0.661
82	Jordan	0.681	5955.98	403.56	2056.91	0.650
83	Turkey	0.679	13359.24	1127.01	7031.20	0.665
84	Algeria	0.677	8320.16	618.51	3540.00	0.653
85	Tonga	0.677	4038.39	248.82	1095.64	0.647
86	Fiji	0.669	4315.42	287.22	1183.58	0.641
87	Turkmenistan	0.669	7052.09	586.07	2368.95	0.641
88	Dominican Republic	0.663	8272.56	615.31	3713.07	0.645
89	China	0.663	7258.47	515.29	3035.41	0.642
90	El Salvador	0.659	6498.11	460.96	2545.60	0.638
91	Sri Lanka	0.658	4886.32	305.40	1703.59	0.637
92	Thailand	0.654	8000.62	631.83	3531.18	0.641
93	Gabon	0.648	12746.55	1344.54	5904.01	0.641
94	Suriname	0.646	7092.90	542.06	2963.10	0.631
95	Bolivia	0.643	4357.24	308.97	1299.76	0.626
96	Paraguay	0.640	4585.32	292.73	1618.00	0.626
97	Philippines	0.638	4002.08	244.75	1294.56	0.624
98	Botswana	0.633	13204.19	1633.21	5605.66	0.630
99	Moldova	0.623	3149.33	190.72	870.18	0.616
100	Mongolia	0.622	3619.27	237.33	1091.62	0.616
101	Egypt	0.620	5889.20	417.97	2584.28	0.615
102	Uzbekistan	0.617	3084.89	188.27	849.43	0.612
103	Micronesia	0.614	3265.55	199.79	971.52	0.610
104	Guyana	0.611	3302.06	207.51	988.85	0.608
105	Namibia	0.606	6323.11	549.78	2550.19	0.603

106	Honduras	0.604	3750.11	223.51	1419.53	0.608
107	Maldives	0.602	5408.10	361.96	2760.11	0.614
108	Indonesia	0.600	3956.84	245.08	1612.44	0.609
109	Kyrgyzstan	0.598	2291.23	125.07	567.96	0.606
110	South Africa	0.597	9812.13	1257.63	3947.21	0.603
111	Syrian Arab Republic	0.589	4759.93	293.98	2413.75	0.603
112	Tajikistan	0.580	2019.88	107.47	483.51	0.596
113	Viet Nam	0.572	2994.76	158.76	1214.34	0.593
114	Morocco	0.567	4627.57	298.70	2514.32	0.591
115	Nicaragua	0.565	2567.40	131.63	947.65	0.590
116	Guatemala	0.560	4693.74	310.64	2645.98	0.587
117	Equatorial Guinea	0.538	22217.60	3517.38	16938.12	0.594
118	Cape Verde	0.534	3305.62	191.53	1862.77	0.579
119	India	0.519	3337.37	227.19	1633.98	0.556
120	Timor-Leste	0.502	5303.20	439.10	4169.13	0.559
121	Swaziland	0.498	5132.03	656.42	2104.38	0.528
122	Lao PDR	0.497	2321.00	134.37	1008.58	0.544
123	Solomon Islands	0.494	2171.56	119.52	935.34	0.544
124	Cambodia	0.494	1867.66	108.01	625.40	0.541
125	Pakistan	0.490	2678.26	158.95	1321.20	0.535
126	Congo	0.489	3257.64	287.54	1351.59	0.524
127	Sao Tome and Principe	0.488	1917.63	102.58	788.84	0.545
128	Kenya	0.470	1627.74	105.34	464.00	0.522
129	Bangladesh	0.469	1587.24	76.96	600.51	0.532
130	Ghana	0.467	1385.47	79.92	362.56	0.525
131	Cameroon	0.460	2196.89	180.09	776.82	0.509
132	Myanmar	0.451	1595.53	85.15	655.08	0.521
133	Yemen	0.439	2386.63	146.08	1652.56	0.517
134	Benin	0.435	1499.11	78.61	659.13	0.514
135	Madagascar	0.435	953.06	40.80	245.20	0.523
136	Mauritania	0.433	2118.32	145.71	1063.74	0.498
137	Papua New Guinea	0.431	2227.10	140.01	1229.15	0.494
138	Nepal	0.428	1200.79	50.53	506.32	0.521
139	Togo	0.428	843.78	32.06	204.09	0.523
140	Comoros	0.428	1176.07	50.33	516.88	0.528
141	Lesotho	0.427	2021.15	196.36	688.58	0.487
142	Nigeria	0.423	2156.50	195.96	875.52	0.482
143	Uganda	0.422	1224.06	72.29	379.96	0.501
144	Senegal	0.411	1815.78	120.80	917.62	0.484
145	Haiti	0.404	949.00	40.11	292.97	0.496
146	Angola	0.403	4941.20	600.42	3825.19	0.462
147	Djibouti	0.402	2471.38	185.87	1585.79	0.469
148	Tanzania	0.398	1344.29	76.77	543.43	0.475
149	Côte d'Ivoire	0.397	1624.86	97.39	861.41	0.476
150	Zambia	0.395	1358.52	105.48	420.94	0.467
151	Gambia	0.390	1357.68	78.66	675.75	0.482
152	Rwanda	0.385	1190.34	76.06	465.36	0.481
153	Malawi	0.385	910.97	45.29	272.01	0.482
154	Sudan	0.379	2051.14	133.69	1491.15	0.460
155	Afghanistan	0.349	1419.08	124.65	654.38	0.437
156	Guinea	0.340	953.46	43.34	629.57	0.473
157	Ethiopia	0.328	992.03	49.59	715.36	0.460
158	Sierra Leone	0.317	808.72	45.86	314.82	0.431
159	Central African Republic	0.315	757.85	42.03	256.68	0.426
160	Mali	0.309	1171.31	79.04	983.35	0.434
161	Burkina Faso	0.305	1214.83	72.41	1184.36	0.429

162	Liberia	0.300	319.81	5.51	37.20	0.496
163	Chad	0.295	1066.75	68.59	831.27	0.414
164	Guinea-Bissau	0.289	538.09	22.48	177.42	0.437
165	Mozambique	0.284	854.09	49.86	672.17	0.426
166	Burundi	0.282	401.57	11.54	86.22	0.451
167	Niger	0.261	675.38	29.55	445.12	0.399
168	Congo	0.239	291.23	6.04	33.38	0.428
169	Zimbabwe	0.140	176.17	0.51	1.68	0.454

Sources: HDI and GNI from HDR web site; valuations are the author's calculations from the data on the same site.