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# A Human Development Index by Income Groups

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## **Abstract**

One of the most frequent critiques of the HDI is that it does not take into account inequality within countries. We suggest a relatively easy and intuitive approach which allows to compute the three components and the overall HDI for quintiles of the income distribution. This allows comparisons of the level in human development of the poor and non-poor within and across countries. An empirical illustration shows large discrepancies in human development within countries especially in Africa. These discrepancies are lower the higher the HDI, but only weakly so. Inequality in income is generally higher than inequality in education and life-expectancy.

**Key words:** Human Development, Income Inequality, Differential Mortality, Inequality in Education.

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# 1 Introduction

The Human Development Index (HDI) is a composite index that measures the average achievement in a country in three basic dimensions of human development: a long and healthy life, as measured by life expectancy at birth; knowledge, as measured by the adult literacy rate and the combined gross enrollment ratio for primary, secondary and tertiary schools; and a decent standard of living, as measured by GDP per capita in purchasing power parity US dollars (UNDP, 2006). Based on available statistics UNDP was able to provide an HDI for 177 countries in the latest Human Development Report (UNDP, 2006). The HDI is today widely used in academia, the media and in policy circles to measure and compare progress in human development between countries and over time.

Despite its popularity, which is among other things due to its transparency and simplicity, the HDI is criticized for several reasons.<sup>1</sup> First, it neglects several other dimensions of human well-being, such as for example human rights, security and political participation (see e.g. Anand and Sen (1992), Ranis, Stewart and Samman (2006)). Second, it implies substitution possibilities between the three dimension indices, e.g. a decline in life expectancy can be off set by a rise in GDP per capita.<sup>2</sup> Related to that critique is the third point, which charges that the HDI uses an arbitrary weighting scheme of the three components (see e.g. Kelley (1991), Srinivasan (1994) and Ravallion (1997)). Finally and fourth, the HDI is often criticized because it only looks at average achievements and, thus, does not take into account the distribution of human development within a country (see e.g. Sagar and Najam (1998)). It is this last issue that we address in this study.

When constructing distribution-sensitive measures of human development, limited data availability on the distribution of human development achievements seriously constrains the analysis. Household income surveys are today widely undertaken and, hence provide data on income distribution, but it is much more difficult to get data on inequality in life-expectancy, educational achievements and literacy. Inequality in these dimensions seems, at least in developing countries, also to be very high. There is also broad empirical evidence that mortality as well as educational attainment vary with income and wealth in both rich and poor countries (see e.g. Cutler, Deaton and Lleras-Muney (2006) and Filmer and Pritchett (1999)).

In the past several attempts have been made to integrate inequality into the human development index. Anand and Sen (1992) and Hicks (1997) suggested to discount each dimension index by one minus the Gini coefficient for that dimension before the arithmetic mean over all three is taken. Therefore, high inequality in one dimension lowers the index value for that dimension and, hence its contribution to the HDI. Although the idea of such a discount factor is rather intuitive, the Gini-corrected HDI has not been widely used.<sup>3</sup> One reason might be that it is not easy to compute the Gini coefficient for education and life-expectancy due to data limitations and conceptual problems. Another reason might be that it is not clear how to interpret the interaction between the Gini coefficient and the average achievement in a component.

The gender related development index, or GDI, was another attempt in that direction. Its motivation was the 1995 Human Development Report's emphasis on gender inequalities. The GDI adjusts the HDI downward by existing gender inequalities in life-expectancy, education and incomes. The GDI calculates each dimension index separately for men and women and then combines both by taking the har-

monic mean, penalizing differences in achievement between men and women. The overall GDI is then calculated by combining the three gender-adjusted dimension indices by taking the arithmetic mean. This concept could of course also be applied using other segmentation variables than gender, such as different ethnic or income groups. This would presume the existence of human development achievement data by income group, which is the topic of our study. However for gender in particular, it is not clear how gender related inequality in income can reasonably be measured.<sup>4</sup> In most cases men and women pool incomes in households. Usually not much information is available how the pooled income is then allocated among household members. That and other critical issues related to the GDI are discussed in detail by Klasen (2006a, 2006b).

Another attempt was undertaken by Foster, López-Calva and Székely (2003). They chose an axiomatic approach to derive a distribution sensitive HDI. They suggest a three-step procedure. First, each dimension index is calculated on the lowest possible aggregation level, given the data availability. For instance, income at the level of households and life-expectancy at the level of municipalities (taken from census data). Second, for each dimension an overall index is computed by taking the generalized mean  $\mu_q$ . The formula for the generalized mean is  $\mu_q = [(x_1^q + \dots + x_n^q)/n]^{1/q}$ . For  $q = 1$ ,  $\mu$  yields the arithmetic mean, but for negative values for  $q$ ,  $\mu$  gives more emphasis on lower levels of  $x$ . The higher the absolute value of  $q$ , the more weight is given to low levels of  $x$ . Third, the overall HDI is computed by taking again the generalized mean instead of the simple arithmetic mean. The advantage of this approach is its axiomatic foundation. For instance, the index is decomposable by sub-groups, which is not the case for the Gini-corrected HDI. The problem with this approach is, however, that the generalized mean may not seem very intuitive for many users of the HDI. It obviously also raises the question of how to determine the ‘right’ inequality aversion parameter  $q$ . An additional problem is, that again no generally applicable methodology is suggested, which could help to compute the three dimension indices on the lowest disaggregation level.

The approach chosen in this paper differs from the others in that, first, we focus of inequality in human development across the income distribution and, second, we do not try to incorporate the aggregate well-being costs associated with existing inequalities, but rather generate a separate HDI for different segments of the income distribution. More precisely, we take household income and demographic data to compute the three dimension indices for quintiles of the income distribution. This allows on the one hand to track the progress in human development separately for ‘the poor’ and ‘non-poor’ and on the other hand to compare the level of human development of the poor to the level of the average population and the level of the non-poor. In contrast to previous attempts, we also present, at least for developing countries, a clear methodology how the three dimension indices for different segments of the income distribution can be calculated with commonly available data sources. Applying our methodology to developed countries entails some data availability and comparability problems which we discuss below. Due to these problems, we are only able to provide rough estimates for two developed countries.

The objective of this paper is first of all illustrative. We will show that our methodology also has some shortcomings, and, hence, all presented results should be interpreted with caution and in the light of our assumptions. The remainder of this paper is organized as follows. Section 2 presents our methodology. Section 3 presents the sample of countries for which we illustrate it. Section 4 discusses

the results. Section 5 offers a critical assessment of our methodology. Section 6 concludes.

## 2 Methodology

### 2.1 General idea and overview

The basic idea of our method is to use disaggregated data to calculate the three dimension indices which constitute the HDI for different segments of the income distribution. This will allow us to get an idea of the heterogeneity and inequality in human development which exists within a country. As data sources, we use household surveys. As segments of the income distribution, we define income quintiles.

Since the early nineties, two types of surveys are undertaken in almost all developing countries. First, there are so-called *Living Standard Measurement Surveys* (LSMS) or a lighter version of it called *Priority Surveys* (PS). Even in countries where none of these two surveys are available, there exist normally at least some other type of living standard survey. These surveys provide, apart from information on household and individual characteristics, data on educational achievement, school enrollment and household income or household expenditure. In what follows, we call this type of survey simply ‘household income survey’ or ‘HIS’. Second, there are so called ‘Demographic and Health Surveys’ or ‘DHS’ in short. These surveys are undertaken by the *Macro International Inc., Calverton, Maryland* (usually in cooperation with local authorities and funded by USAID) and provide among other things detailed information on child mortality, health, and fertility. How to proceed for industrialized countries, where usually other types of surveys are undertaken, will be discussed later.

Hence, we will use the HIS to calculate the quintile specific education and GDP indices and the DHS to calculate the quintile specific life expectancy index. The main problems in proceeding so, are that both surveys do not interview the same households (or if so, these households cannot be matched) and that the DHS does not contain any information on household income or household expenditure, i.e. it is not possible to sort directly the DHS households and individuals by income quintiles.

To solve this problem, we use a simple variant of so-called data matching techniques. The principle of this technique is to estimate the correlation between income and a set of household characteristics which are available in the HIS and the DHS and then to use this correlation pattern to predict income for the households covered by the DHS. However, given that the quality of such a matching process depends heavily on the data quality and data consistency of both types of surveys, we present a second and alternative approach where we use a so-called ‘asset index’ as our segmentation variable. This measure is often used to get an idea of the living standard of households interviewed in the DHS.

Once the three dimension indices are calculated, we simply calculate the quintile specific HDI, which we name QHDI, by taking the arithmetic average of the three dimension indices. In what follows, each step of our method is explained in detail.

## 2.2 Imputing income for DHS households

### 2.2.1 A regression based approach

The first approach we present is similar to that used in the poverty mapping literature (see e.g. Elbers, Lanjouw and Lanjouw (2003)).<sup>5</sup> The HIS provides information about household income and/or household expenditure. If income is used, the aggregate should contain earned (e.g. wages and profits) as well as unearned income (e.g. transfers). If expenditures are used, the aggregate should contain the expenditure for all items purchased plus the value of the self-produced consumption. According to usual practice in poverty analysis (see e.g. Deaton and Zaidi (2002)) expenditures on durables should be excluded. For house owners, hypothetical rents should be imputed. Regional variations in the cost of living should be eliminated using appropriate price deflators. Once the welfare aggregate is calculated, we divide it by household size to receive a per capita measure. We do not use any particular equivalence scale to ensure consistency with the general HDI, which also uses a per capita measure for the income index. In what follows, our per capita welfare measure is denoted  $y_h$ , where the index  $h$  stands for households  $h = 1, \dots, K$ .

Once,  $y_h$  is calculated, a common set of variables  $\Omega_h$  in the HIS and the DHS has to be identified. The variables of  $\Omega$  have to be correlated with  $y_h$  and should at least contain (i) some characteristics of the household head such as age and educational achievement, (ii) characteristics of the household like the number of children, the number of male and female adults in working age and regional variables (such as urban vs. rural, region or province of residence), and (iii) housing conditions like materials of the floor, the roof and the walls, type of electricity and water connection and possibly the number of rooms per person.

Once all these variables are calculated,  $y_h$  is regressed in logarithmic form on this set of variables using OLS estimators:

$$\ln y_h^{HIS} = \beta^{HIS} \Omega^{HIS} + u_h, \quad (1)$$

where  $\beta^{HIS}$  is a vector of parameters and  $u_h$  is the residual.

Using the vector of estimated parameters  $\hat{\beta}^{HIS}$ , hypothetical incomes for the households covered by the DHS can be calculated by:

$$\ln \hat{y}_h^{DHS} = \hat{\beta}^{HIS} \Omega^{DHS}. \quad (2)$$

Given that regressions as in Equation (1) rarely explain more than half or three quarter of the total variance in  $\ln y_h$ , one could generate residuals to account for the unobserved determinants of  $y_h$ . We think that would be important, when the objective was to calculate any inequality measure. However, given our objective, we think it is sufficient to assume that the included variables contain enough information on the true income quintile and that in contrast hypothetical residuals may well preserve the natural variance in the data, but at the price of a higher probability of missclassifications over income quintiles.<sup>6</sup>

Once the hypothetical incomes for the DHS are imputed, it is possible for both surveys to calculate the cumulative distribution functions of income (person weighted)  $F(\ln y_h^{HIS})$  and  $F(\ln \hat{y}_h^{DHS})$ . Using these distributions it can be determined for each household in which income quintile ( $Q = 1, 2, \dots, 5$ ) it is situated.

However, what could pose a problem is, first, that household expenditure may in some cases not be a good proxy of permanent income due to measurement error and

limited possibilities of households to smooth consumption, and, second that in some cases the comparability of the HIS and DHS is not high enough, and, hence predicted incomes in a DHS give a biased impression of the distribution of income. Therefore, we present, as mentioned above, a second alternative to classify households in the DHS by income quintile which is based on an asset index approach.

### 2.2.2 An asset index based approach

In order to construct an asset index for DHS households, first, a set of household assets has to be identified. We suggest the ownership of a radio, TV, refrigerator, bicycle, motorized vehicle, floor material of housing, type of toilet, type of water source and some other assets depending on the country. Second, these assets have to be aggregated into one single metric index for each household using principal component analysis, or, alternatively, the closely related factor analysis (see Filmer and Pritchett (2001) and Sahn and Stifel (2000, 2003)). We used principal component analysis. Once the asset index is built, one can construct, similar to the regression-approach, the cumulative distribution function of the asset index and, hence, households in the DHS can be classified into asset quintiles. Under the assumption that the ownership of assets is a good proxy for income, it can be assumed that the asset quintiles yield a consistent classification to that obtained via observed income in the HIS. Hence, in that case matching between both surveys using these quintiles is possible.

We will use both approaches, the regression based approach and the asset index approach. In principle, the regression based approach is to be favored as income is one of the three components of the HDI and therefore it is consistent to use that approach. Moreover the asset index is sometimes biased, because it reflects not correctly differences in income between rural and urban areas, due to usually huge differences in prices and the supply of such assets as well as differences in preferences for assets between both areas. On the other hand, the income regression approach yields biased results whenever the distribution of explanatory variables in the regression is not consistent in the HIS and DHS, due either to measurement error or due to different definitions of the variables used in both surveys. As will be shown below, we suspect such a problem to exist particularly in some very poor African countries, and hence in this case it might be that the asset index is a better predictor of true income in these circumstances than predicted income using the estimated regression.

## 2.3 Calculating the life expectancy index by income quintiles

To calculate a life expectancy index by income quintile we combine information on child mortality with model life tables. As mentioned above, the HIS provides usually no information on mortality. The DHS provides only information on child mortality, but not on mortality by all age groups, which would be necessary to construct a life table and to calculate life expectancy directly.

In a first step, we calculate under one child mortality rates by income quintile. To do this we use the information on all children born in the five years preceding the survey. For each child  $i$  we calculate the survival time  $S_i$  expressed in months  $m$  and the survival status  $d_i$ . The status variable takes the value one if the child died at the end of  $S_i$  and the value zero, if the child was still alive at the age of one. Then we use a simple non-parametric life table estimator to estimate the survival

probability for each month after birth,  $p_m$ . Through cumulative multiplication we derive for each income quintile the under one mortality rate  $q_1$ :

$$q_1^Q = 1 - \prod_{m=1}^{12} p_m^Q, \quad (3)$$

We also estimate  $q_1$  over the whole sample, to be able to construct the aggregate life expectancy index.

In a next step, we use the estimated mortality rate  $q_1$  and Ledermann model life tables to calculate quintile specific life expectancy. Ledermann (1969) used historical mortality data for many countries and periods to estimate the relationship between life-expectancy and age-specific mortality rates. He found the following relationship (note that the log function uses the basis 10):

$$\log \hat{q}_j = \hat{a}_{j,0} + \hat{a}_{j,1} \log(100 - e_0), \quad (4)$$

where  $\hat{q}_j$  is the predicted mortality rate for the age group  $j$ ,  $e_0$  is the life expectancy at birth and  $\hat{a}_{j,0}$  and  $\hat{a}_{j,1}$  are the estimated regression coefficients by Ledermann. Ledermann considered age groups defined over five-year intervals, except for the first age group, which he divided into children zero to one year old and one to five years old.<sup>7</sup> However, a drawback of both these types of tables is that their estimation included almost no countries of today's developing world and no countries affected by the AIDS epidemic. In particular the latter omission might be problematic, given that AIDS usually affects strongly the age-mortality pattern by increasing mortality among children below the age of 5 (through mother-child transmission) and mortality among adults in age of activity.

To calculate quintile specific life expectancy, we take the inverse of Equation (4) and the regression coefficients for the age group 1 year old:

$$\hat{e}_0^Q = 100 - \left[ \frac{q_1^Q}{10^{\hat{a}_{1,0}}} \right]^{\frac{1}{\hat{a}_{1,1}}} \quad \forall Q = 1, 2, \dots, 5. \quad (5)$$

with  $\hat{a}_{1,0} = -1.98384$  and  $\hat{a}_{1,1} = 2.40372$  (Ledermann, 1969).

Aggregate life expectancy can be calculated using  $q_1$  instead of  $q_1^Q$ .

Then we calculate the quintile specific life expectancy index,  $L^Q$ , using the usual minimum and maximum values for life expectancy employed to calculate the HDI:

$$L^Q = \frac{\hat{e}_0^Q - 25}{85 - 25} \quad \forall Q = 1, 2, \dots, 5. \quad (6)$$

The aggregate life expectancy index  $L$  can be calculated using  $\hat{e}_0$  instead of  $\hat{e}_0^Q$ .

In a last step, we rescale linearly  $L^Q$  and  $L$  to achieve consistency with the aggregate HDI calculated by UNDP. As rescaling factor we use the ratio between our aggregate life expectancy index  $L$  and the aggregate life expectancy index calculated by UNDP for the particular year in question.<sup>8</sup>

## 2.4 Calculating the education index by income quintiles

To calculate the quintile specific education index, we use the information on literacy and school enrollment provided by the HIS.



### 2.4.1 Calculating the adult literacy index

The questions providing information about adult literacy may significantly vary from one HIS to the other. Sometimes adults are simply asked whether they are able to read and write. Other surveys are much more specific in asking whether the person is able to read a newspaper and to write a letter. This is even sometimes directly tested. In addition, in some countries one has to distinguish between having knowledge of any local language or of the official language of the country. Finally in some surveys, such information is completely missing. In this latter case, it is possible to use educational achievement as proxy for literacy. However, it is far from evident to determine after how many years of school a person is literate. This varies a lot from country to country or even within a country (for West-Africa, see e.g. Michaelowa (2001)). We proceeded as follows. If an adult declared to be able to read and/or write in any language (with or without proof), we considered him or her as literate. If that information was not available, we considered somebody as literate if he or she achieved at least a grade which corresponds to five years of schooling. Adults are defined as persons above the age of 15.

Quintile specific adult literacy is then calculated by the following equation:

$$a^Q = \frac{1}{n^Q} \sum_{i(\forall j > 15)} I(a_i^Q > \bar{a}) \quad \forall Q = 1, 2, \dots, 5, \quad (7)$$

where  $n^Q$  is the total number of adults in quintile  $Q$  and  $I$  is an indicator function which takes the value one if literacy status of adult  $i$ ,  $a_i$  is over the above defined threshold value  $\bar{a}$  and zero otherwise. We calculate also the aggregate adult literacy rate  $a$ .

Then we calculate the quintile specific adult literacy index,  $A^Q$ , using again the corresponding usual minimum and maximum values employed in the HDI:

$$A^Q = \frac{a^Q - 0}{1 - 0} \quad \forall Q = 1, 2, \dots, 5. \quad (8)$$

The aggregate adult literacy index  $A$  can be calculated using  $a$  instead of  $a^Q$ .

In a last step, we rescale again linearly  $A^Q$  and  $A$  to achieve consistency with the aggregate HDI calculated by UNDP for the relevant year. As rescaling factor we use the ratio between our aggregate literacy index  $A$  and the aggregate literacy index calculated by UNDP.

### 2.4.2 Calculating the enrollment index

To calculate the quintile specific gross enrolment index, we calculate first the combined gross enrolment rate for each quintile. Each individual attending school or university whether general or vocational is considered as enrolled. We define this rate over all individuals of the age group five to 23 years old. Age is for each individual the age at the date of the interview. This yields:

$$g^Q = \frac{1}{n^Q} \sum_{i(\forall 5 \leq j \leq 23)} I(g_i^Q > 0) \quad \forall Q = 1, 2, \dots, 5, \quad (9)$$

where  $n^Q$  is the total number of individuals of age five to 23 in quintile  $Q$  and  $I$  is an indicator function which takes the value one if an individual  $i$  independent of age, is enrolled, i.e.  $g_i > 0$ . We calculate also the aggregate gross enrolment rate  $g$ .

Then we calculate the quintile specific gross enrollment index,  $G^Q$  using the usual minimum and maximum values used for the calculation of the HDI:

$$G^Q = \frac{g^Q - 0}{1 - 0} \quad \forall Q = 1, 2, \dots, 5. \quad (10)$$

The aggregate gross enrollment index  $G$  can be calculated by using  $g$  instead of  $g^Q$ . Finally, we also rescale  $G^Q$  and  $G$  to the level of the HDI enrollment index.

### 2.4.3 Calculating the education index

The quintile specific education index  $E^Q$  is calculated using the same weighted average as the HDI:

$$E^Q = (2/3) \times A^Q + (1/3) \times G^Q \quad \forall Q = 1, 2, \dots, 5. \quad (11)$$

The aggregate education index  $E$  can be calculated by using  $A$  and  $G$  instead of  $A^Q$  and  $G^Q$ .

## 2.5 Calculating the GDP index by income quintiles

To calculate the GDP index by income quintile, we use our income variable from the HIS. One main difference with the two other dimension indices is that mean income calculated from the HIS can be *very* different from GDP per capita derived from National Accounts data, which is used for the GDP index in the general HDI. This has two reasons: first, because of conceptual differences and, second, because of measurement error on both levels. GDP measures the value of all goods and services produced for the market within a year in a given country evaluated at market prices. Income in the household survey is either measured, as mentioned above, via household expenditure (including self-consumed production) or via the sum of earned and unearned household income. Therefore, non distributed profits of enterprises, property income and so on will not be included in the household income variable. Moreover, on the household survey side, there may be measurement errors, because it is difficult to get accurate responses from households concerning wages, profits and expenditures. On the National Accounts side, while supply-side information on output and income for some sectors is based on high-quality surveys or census data for agriculture and industry, information about subsistence farmers and informal producers is harder to obtain and usually of lower quality.<sup>9</sup>

We proceed as follows. First, to eliminate differences in national price levels we express household income per capita  $y_h$  calculated from the HIS, in USD PPP using the conversion factors based on price data from the latest International Comparison Program surveys provided by the World Bank (2005):

$$y_h^{PPP} = y_h \times PPP. \quad (12)$$

Second, we rescale  $y_h^{PPP}$  using the ratio between  $\bar{y}^{PPP}$  and GDP per capita expressed in PPP (taken from the general HDI), i.e. we only take the information on the distribution of income from the HIS and stick with GDP per capita as the level of income:

$$ry_h^{PPP} = y_h^{PPP} \times \left[ \frac{GDPPC^{PPP}}{\bar{y}^{PPP}} \right]. \quad (13)$$

Once, these adjustments are done, it is straightforward to calculate the quintile specific GDP index, again using the usual minimum and maximum values of the HDI:

$$Y^Q = \frac{\log \bar{r}y^{Q,PPP} - \log(100)}{\log(40,000) - \log(100)} \quad \forall Q = 1, 2, \dots, 5, \quad (14)$$

where  $\bar{r}y^{Q,PPP}$  is the quintile specific arithmetic mean of the rescaled household income per capita.

It should be noted that in richer countries the GDP per capita measure for the richest quintile,  $\bar{r}y^{5,PPP}$ , could easily exceed 40,000 USD PPP and, hence, the index could take a value greater than 1.<sup>10</sup>

## 2.6 Calculating the overall HDI and the HDI by income quintiles

Once the quintile specific dimension indices have been calculated, determining the QHDI is straightforward. It is the simple average of the three dimension indices:

$$\begin{aligned} HDI^Q &= (1/3) \times L^Q + (1/3) \times E^Q + (1/3) \times Y^Q \\ &\quad \forall Q = 1, 2, \dots, 5. \end{aligned} \quad (15)$$

The aggregate HDI is as usual given by:

$$HDI = (1/3) \times L + (1/3) \times E + (1/3) \times Y. \quad (16)$$

To get a sense of the inequality in human development within a country, one may compute the ratio between the HDI for the richest quintile and the poorest quintile:

$$RQHDI^{5,1} = \frac{HDI^{Q=5}}{HDI^{Q=1}}, \quad (17)$$

or the ratio of the quintile specific HDI to the aggregate HDI:

$$RQHDI^{1,mean} = \frac{HDI^{Q=1}}{HDI} \quad \text{and} \quad RQHDI^{5,mean} = \frac{HDI^{Q=5}}{HDI}. \quad (18)$$

All these indicators can of course also be calculated for each dimension index. Hence, the QHDI cannot only be used to inform about the level of human development of the poor, the rich and the groups in-between, but also about the inequality in human development within a society. Moreover, the quintile specific indices can be compared across countries. This may lead to results where country A has a higher overall HDI than country B, but that in country B human development of the poor is on a substantially higher level than in country A.

## 2.7 Calculating the HDI by income quintiles for OECD countries

The application of our approach to OECD countries entails some additional problems. The data availability is very different in developing and industrialized countries. For a long time, access to disaggregated and harmonized income, education and health data was much better in industrialized countries than in developing countries, but it seems today to be the other way around. For many developing countries there exist today at least roughly comparable income, education and health data thanks to the household income surveys and Demographic and Health Surveys. In

many industrialized countries, such standardized surveys are either absent or not easily accessible. Moreover, due to very low infant and child mortality levels in rich countries, we could not easily apply our methods of deducing life expectancy from infant or child mortality rates available in household survey data as the absolute number of infant and child deaths are too low in such surveys to calculate life expectancies (and its differential by income) with any reliability. Thus we will briefly discuss data availability and outline an approach to construct quintile-specific HDIs in rich countries and illustrate it for Finland and the USA. However, these calculations are not fully comparable to the calculations for developing countries and thus should be viewed as tentative.

Matters are easiest for the income component. Here we can rely on the Luxembourg Income Study (LIS), which produces harmonized micro data sets on income, demographics, labor market status and expenditures on the level of households and individuals for 30 OECD countries.<sup>11</sup> These data are of very high quality and probable more reliable than the income/expenditure data available in many developing countries. For our examples, Finland and the USA, we took the LIS income data for the year 2000 and simply rescaled it to fit UNDP's GDP index.

Unfortunately, the data sets contained in LIS do not have educational enrolment or adult literacy information and only provide information on educational achievements by levels of education passed. Therefore, for Finland and the USA, we assume no inequality in adult literacy and use the schooling achievement differential by income for 2000 as reported in the Luxembourg Income Study to estimate income differentials in enrolments, after which we rescale again. Alternatively, enrolment rates by income quintile could probably be generated from national household income surveys (or coordinated surveys such as the European Household Panel Survey) but this would mean that we rely on two different income measures to calculate the two different components (as we had to do with the HIS and the DHS for developing countries).<sup>12</sup>

By far the most difficult issues arise however with the life expectancy component. As already stated, using quintile specific child mortality to derive an estimate of quintile specific life expectancy from household surveys would not be possible as child mortality in most OECD countries is so low that no meaningful differentials by income could be identified. Moreover, infant and mortality in these countries is mostly related to premature births, genetic defects, complications during birth and accidents all of which are not closely related to income. In fact, it is likely that existing income differentials in life expectancy in rich countries are largely due to mortality beyond childhood.

In principle, one could try to rely on census or census-like sample surveys with large numbers of observations. An alternative would be to rely on death registrations. These data sources are generally used in rich countries to calculate mortality rates and associated life expectancy statistics. But these data sources usually do not include incomes and cannot be used to calculate income differentials. Two exceptions are the USA and Finland where specialized analyses on the link between incomes and mortality were undertaken. We therefore use the results from Rogot *et al.* (1997) and Martikainen *et al.* (2001) on the life expectancy differential by incomes. These data are based on linked income survey data with vital registration data and are covering the adult mortality experience for 1979-85 for the USA, and 1991-96 for Finland.<sup>13</sup> Through matching the mortality experience by income quintile with the Model Life Tables 'North' (Coale and Demeny, 1983), we derive

life expectancy at birth for the two countries, after which we re-scale as described above.<sup>14</sup>

Given these caveats, we included only Finland and the USA in our analysis and focus otherwise solely on low and middle income countries and leave the calculation of a QHDI for OECD countries for future work.

### 3 Sample of countries

Besides Finland and the USA, we illustrate our approach for a sample of 13 developing countries: seven countries from Sub-Saharan Africa (Burkina Faso, Côte d’Ivoire, Cameroon, Guinea, Madagascar, Mozambique, South-Africa and Zambia), three countries from Latin America (Bolivia, Colombia, and Nicaragua), and two countries from South-East Asia (Indonesia and Vietnam). These countries are listed in Table A1 (Appendix). We tried to restrict the sample to countries where a HIS and DHS were undertaken within a two-year time period. For two countries both surveys were undertaken in the same year. For three countries there is a gap of one year and for four countries a gap of two years. Only in three countries (Guinea, Indonesia, and Madagascar) we were not able to follow this rule and have actually a gap between both surveys of three to four years. Moreover, we tried to include countries where both surveys are not older than five years. This was however not possible for four countries (Côte d’Ivoire, Guinea, Madagascar, South-Africa), where the HIS or the DHS (or both) were undertaken at the end of the 1990s. The survey dates should also be taken into account when comparing our unscaled QHDI with the usual HDI. The published HDI in the UNDP’s Human Development Report 2005 (UNDP, 2005) refers to the year 2003. But a closer look at the data sources shows that literacy rates and life-expectancy estimates were usually based on censuses or surveys conducted between 2000 and 2004. In several countries the data sources even stem from data collected in the 1990s (e.g. Belarus, Burkina Faso, Kazakhstan, Mali). Hence, time consistency between the different dimension indices and actuality of the data is not a problem specific to our approach, but rather is present for both the usual HDI and the QHDI.

### 4 Results

Table 1 shows the HDI by income quintile, the HDI, and the ratio of the HDI for the richest quintile to the poorest quintile and the HDI ranking for the richest and poorest quintile (using the HDI values from the 2005 report) for the sample countries. These results are based on the data matching method, which uses the asset index (cf. Section 2.2). The countries are sorted by descending HDI. The results reveal very stark differences in human development between the richest and the poorest quintile. For example, in Guinea, Burkina Faso, Zambia, and Madagascar, the HDI for the richest income quintile is about twice as high as in the poorest quintile. In a second group of countries, including Bolivia, Cameroon, Nicaragua, Côte d’Ivoire, Mozambique, and South Africa, the gap between the rich and the poor is also very large, between 50% and 65%. In a third group of countries, comprising Colombia, Vietnam, and Indonesia, the differential in the HDI for the richest and poorest quintile is smaller but still substantial at about 30%-50%. In the two rich countries included, the differences are smaller than in developing countries but large differences

remain between the quintiles, particularly in the USA.

The rank positions of the different quintiles further illustrate this point. For example, the richest quintile in Bolivia is at rank 34, i.e. among the countries with high human development, actually at the same level as Poland, whereas the poorest quintile is at rank 132. The average HDI Bolivia was in the last year's report at rank 112. In some Sub-Saharan African countries such as Cameroon, Guinea and Madagascar the richest quintile achieves a level similar to those countries with medium human development, i.e. far above the threshold of 0.5. In contrast the poorest quintiles of these countries all rank among the 15 countries with the lowest HDI. Put differently, the differences within countries are as high as the differences between high and medium as well as medium and low human development countries. Also among rich countries, the differences are sizable. While the richest quintile in the USA (followed by Finland) would top the list of human development achievements, the poorest quintile in the USA only achieves rank 48, considerably worse off than the richest quintile in South Africa, Colombia, Bolivia, or Indonesia. These differences are also nicely illustrated in Figure 1.

[please insert Table 1 about here]  
[please insert Figure 1 about here]

When examining the individual components (see Tables A2a, A2b, A3, A4 in Appendix), it becomes clear that the biggest effect of inequality on the quintile-specific HDI is in the income component. As Table A4 shows, in many countries the richest quintile has an income index (Y) that is often more than twice or even up to five times as high as among the poorest quintile. Here many of the Sub-Saharan African countries have the highest inequality, followed closely by the Latin America while the two East Asian countries have ratios of less than 2. This may seem surprising since it is well-known that Latin American countries have, on average, (slightly) higher income inequality than Sub-Saharan African countries. The reason why this is not reflected here is that the income index uses a logarithmic transformation of incomes under the assumption that the well-being effects of higher incomes among the rich is declining with higher incomes. Thus what is being measured here is not the differential in incomes but, in line with the general treatment of the income component in the HDI, the differential in important aspects of quality of life such as nutrition, housing, clothing, and other aspects that are closely correlated with incomes. In that sense it is particularly worrying that the differential is so stark in Africa and Latin America.

The differential in educational achievements (E) between the richest and the poorest quintile are also sizable, but smaller than in the income index (see Table A3). In some Sub-Saharan African countries such as Burkina Faso and Madagascar the rich have nearly twice the educational achievement of the poor. But in many other countries such as South Africa, Vietnam, Nicaragua and Colombia, the differentials are not very large reflecting substantial efforts to improve education across the entire income spectrum. One should note, however, that education is only using literacy and enrolment rates and says little about educational quality which is likely to differ much more strongly between the rich and the poor.

The differential in life expectancy achievements (L) between the richest and poorest quintile are also substantial, but generally the smallest of the three components. In Appendix we present the results for both matching approaches, the income regression based approach (see Table A2a) and the asset index based approach (see

Table A2b). While one reason for the smaller inequality in the life-expectancy index compared to the two other dimension indices may be related to data quality issues and the assumptions that were made in order to derive at these estimates (see also Section 5), it appears that inequality in life expectancy is indeed smaller in the developing countries we consider than other forms of inequality. Three cautionary notes are important, however. To some extent, such smaller inequality is to be expected given that life expectancy is effectively bounded above, i.e. there are limits to life expectancy that even high income people run up against. Second, the differences in actual life expectancy (rather than the life expectancy index) are still substantial with gaps between the poorest and richest quintile amounting to more than 10 years in 5 countries. Third, even seemingly smaller differentials in life expectancy may be seen as just as important, or even more important, than larger differentials in the other components. After all, the chance to live and be free from the fear of premature mortality is a fundamental precondition for all other aspects of life.

Among rich countries, all three differentials are considerably smaller. Income differentials (especially when expressed using the logarithmic transformation) are considerably smaller suggesting smaller differentials in income-sensitive human development achievements than elsewhere. Education differentials are, as expected, also smaller as schooling up to secondary level and thus basic literacy is near universal and only slight differentials exist at the post-secondary level. Also life expectancy differentials by income (based on cause of death information for the 1980s or early 1990s) are smaller in developing countries but remain sizable. In both the USA and Finland, the top quintiles enjoys about five more years of life than the poorest quintile. Given the wealth of these countries and the ability to provide health care to all, such differentials seem still unacceptably large.

The correlation between the level of the HDI and inequality in human development seems to be negative but only weakly so as Figure 2 illustrates. However, it should again be noted that inequality in richer countries is a bit attenuated given the logarithmic transformation of incomes and the assumption of no inequality in adult literacy in Finland and the USA.

[please insert Figure 2 about here]

## 5 Limits and shortcomings of the suggested approach

Computing an index of well-being for different income groups is a serious challenge. The exercise is first of all constrained by data availability. In addition there is clearly a trade-off between transparency, simplicity and an intuitive interpretation on the one hand and accuracy and computational complexity on the other hand. In our approach we rather tried to elaborate an index which is relatively transparent, simple to calculate and easy to interpret. In consequence, we were forced to make many simplifications. The most important ones are discussed in what follows. Hence, the paper should first of all be seen as an illustrative exercise, which hopefully enhances the discussion and sensitizes policy makers for inequality in human development within countries. But it should not be seen by economists and demographers as an attempt to reflect accurately and exactly inequality and income differentials in health and education.

First, our segmentation variable, household income, has obviously a different temporal dimension than our indicators for life expectancy and education. Household income as measured in household surveys is clearly a period estimate, even if it is approximated by household expenditure, which could be seen as a rough measure of permanent income. Hence, assuming that people stay at this level throughout life, which is implicitly done the way we use it, is probably false and is likely to overstate lifetime income inequality. Whether this also leads to an overestimation in the income differentials of life expectancy and education is unclear. However, if such a bias exists, it would at least partly be offset by a bias in the opposite direction: If the difference between permanent income and period income is mainly driven by age and if education and life expectancy are higher among younger cohorts, then the education and life expectancy differentials by income are underestimated.

This leads directly to the second problematic point. In industrialized countries, where education at least up to some grade and basic health provision is provided costless to everyone, income differentials in health and education may to a large extent be driven by preferences. However, this is certainly less the case for developing countries, where health and education are often very costly. Hence, the QHDI we suggest, might have a very different interpretation in industrialized and developing countries.

Third, the matching method we use to impute incomes for the DHS is, as mentioned above, based on a couple of strong assumptions. Among other things, we assume that the distribution of unobservable factors is the same in both surveys and uncorrelated with income. Both assumptions are certainly not met and, hence, life expectancy is not as exactly calculated for the same quintiles of households as education and average income.

Fourth, as the results show it is hard to get precise estimates of the human development index for very poor countries. This is on the one hand due to the general lower quality of data in poor countries and on the other hand in particular due to the difficulty to derive reliable estimates of life expectancy. This can be seen by inspection of Tables A2a and Table A2b. The life expectancy index decreases in some countries when going from a poorer quintile to a richer quintile (e.g. Burkina Faso, Guinea, Mozambique), in particular when the income regression based approach is used for computation.<sup>15</sup>

## 6 Conclusion

One of the most often heard critiques of the HDI is that this index does not take into account inequality in its three dimensions within countries. We suggested a relatively easy, transparent and intuitive approach which allows to compute the three dimension indices and the overall HDI for quintiles of the income distribution. This allows to compare the level in human development of the poor with the level of the non-poor within and across countries.

The illustration for a sample of 13 low and middle income countries, as well as 2 rich countries showed that inequality in human development within countries is indeed high, especially in Sub-saharan Africa. Inequality in income is generally higher than inequality in education and life-expectancy. The results also showed that the level of inequality is only weakly linked to the level of human development itself. The hypothetical ranking of the richest and the poorest quintile on the global HDI scale separates for many countries with medium human development more than



100 rank positions given the high density of countries in this group. Obviously, the differences in rank positions are lower for very rich and very poor countries given the lower and upper bound of the HDI.

The implementation of our approach is obviously more time consuming and data demanding than the calculation of the usual HDI. However the necessary data—a Household Income Survey and a Demographic and Health Survey—exists now in at least most of the low and middle income countries. As discussed above, for industrialized countries getting harmonized data on education and life expectancy differentials is surprisingly a bit more problematic.

Despite its shortcomings, we think it can make a useful contribution to the measurement of human development and should sensitize policy makers to inequality not only in income but also in education and life expectancy which are without any doubt two important determinants of individual well-being. We hope that this paper as well as the discussion of our results in the 2006 Human Development Report (UNDP, 2006) will contribute to a debate on these important issues.

## Appendix

### Data sources for developing countries

[please insert Table A1]

### Quintile specific dimension indices

[please insert Table A4]

[please insert Table A2]

[please insert Table A3]

## Notes

<sup>1</sup>For a critical review, see e.g. Sagar and Najam (1998).

<sup>2</sup>Moreover, if poor people face higher mortality, their deaths would increase per capita incomes of the survivors, generating a further distortion, particularly in HDI trends over time.

<sup>3</sup>See Grün and Klasen (2006) for an analysis of a Gini-adjusted GDP measure.

<sup>4</sup>Generally, the GDI uses information on earned income of males and females, based on sex-specific labor force participation rates and earnings differentials (UNDP, 2006).

<sup>5</sup>Grosse, Klasen and Spatz (2005) recently also used such a technique to match HIS and DHS data for Bolivia.

<sup>6</sup>Moreover, when imputing residuals for the DHS households, one would in addition have to take into account that the HIS and DHS have generally different sample sizes and a different regional stratification. Hence, the unobserved determinants of  $y_h$  will not be distributed identically (see Elbers, Lanjouw and Lanjouw, 2002).

<sup>7</sup>In principle, we could also use the Princeton model life tables (Coale and Demeny, 1983), but the problem with those tables is, that first they use not  $e_0$  but  $e_{10}$  as entry, i.e. life expectancy at the age of 10. Obviously, it is easier to estimate  $e_{10}$  given the probably higher measurement error in child mortality, but to construct the *QHDI* we need  $e_0$  not  $e_{10}$ . Second, Princeton tables end already at a life expectancy of 75 years. Third, Princeton tables are defined separately for men and women, and, hence we would need to estimate child mortality rates separately for boys and girls. This would reduce the number of death events in each income quintile to extremely low levels and therefore lead to very unstable life expectancy estimates. We checked however, whether our life expectancy estimates were consistent with those one would obtain using the Princeton Life Tables ‘West’. That was the case, and, hence, we are confident that our Lederman approach yields acceptable results.

<sup>8</sup>If the DHS and HIS are from different years, we re-scale to the later year. Consistency is not automatic, given that our approach and UNDP's approach are based on different data sources.

<sup>9</sup>A detailed discussion of all these problems can be found in Ravallion (2001) and Deaton (2005).

<sup>10</sup>In the last Human Development Report (UNDP, 2006) such index numbers are set to 1. In this study we do not follow this rule.

<sup>11</sup>For details see: <http://www.lisproject.org>.

<sup>12</sup>A different approach would be to use data from the 'International Adult Literacy Survey (IALS)' for the education component. This is an international comparative study designed to provide information about the skills of the adult populations. It was conducted in three phases (1994, 1996 and 1998) in 20 nations. For details see: <http://nces.ed.gov/surveys/all/>. There exists also a follow up survey called 'Adult Literacy and Lifeskills (ALL) Survey' but which exists so far only in six countries. A problem with using that information would be that it is not directly comparable to the literacy and enrolment measures used for all the other countries.

<sup>13</sup>The 'income' that is referred to in these studies does not closely match annual household per capita income that we would use for the income component which causes a further complication. See also discussion below.

<sup>14</sup>An alternative way would be to use similar data matching techniques that we used above to impute incomes into the DHS to impute incomes into census data and then generate life expectancy information by income quintile. That presupposes access to census data (which are not available or accessible in some countries) and a detailed analysis of the potential of such a method.

<sup>15</sup>Several explanations might be invoked. Given that we derived life expectancy from survey based estimates of child mortality, the potential measurement error is obviously high, due to in some cases rather small sample sizes and potentially very imprecise household's declarations regarding the death date of their children. These errors might themselves be correlated with income. The life table approach introduces an additional bias given that the used tables do not account for AIDS specific age-mortality patterns. Moreover, as already mentioned above, the suggested method to match data from the HIS and the DHS by income quintile might pose problems when the data quality is limited. This is in particular the case in some of the African countries. For instance, when the set of common variables  $\Omega$  is rather small or when the distribution of the variables included in  $\Omega$  differs in both surveys. This may arise if the variable definitions are not exactly the same in both surveys. Or if interviewers coded the answers not exactly identically, although the questions have been asked in exactly the same way. However, the usual aggregate estimates are, at least to some extent, also affected by these problems and hence there is also uncertainty regarding the general HDI in these countries.

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## Tables and figures

Table 1  
Quintile specific HDI by country  
( $L^Q$  computed using asset index)

Country	$Q = 1$	$Q = 2$	$Q = 3$	$Q = 4$	$Q = 5$	Overall HDI	Ratio $Q5/Q1$	Ranking All	Ranking $Q = 1$	Ranking $Q = 5$
Industrialized Countries										
USA (2000)	0.837	0.893	0.927	0.957	1.011	0.940	1.208	15	48	1
Finland (2000)	0.870	0.897	0.919	0.944	0.989	0.930	1.137	20	32	1
Developing Countries										
Colombia (2003/2005)	0.673	0.741	0.800	0.857	0.927	0.790	1.377	66	115	22
Vietnam (2004/2002)	0.627	0.680	0.718	0.765	0.828	0.713	1.321	108	125	51
Indonesia (2000/2003)	0.593	0.651	0.700	0.764	0.874	0.701	1.474	110	129	31
South Africa (2000/1998)	0.561	0.640	0.700	0.743	0.879	0.691	1.567	112	132	30
Bolivia (2002/2003)	0.550	0.640	0.704	0.741	0.863	0.690	1.570	113	132	34
Nicaragua (2001/2001)	0.531	0.629	0.678	0.720	0.830	0.667	1.563	116	135	51
Cameroon (2001/2004)	0.417	0.477	0.529	0.553	0.644	0.523	1.544	137	165	123
Madagascar (2001/1997)	0.343	0.463	0.496	0.563	0.684	0.488	1.994	152	173	114
Guinea (1995/1999)	0.340	0.457	0.490	0.594	0.696	0.467	2.047	156	174	111
Cote d'Ivoire (1998/1999)	0.343	0.416	0.434	0.515	0.561	0.430	1.636	163	173	132
Zambia (2002/2002)	0.317	0.390	0.431	0.476	0.583	0.426	1.839	164	175	129
Mozambique (2002/2003)	0.305	0.355	0.380	0.417	0.504	0.387	1.652	167	176	146
Burkina Faso (2003/2003)	0.257	0.306	0.331	0.365	0.489	0.348	1.903	172	178	151

*Note:* For developing countries the years in brackets refer to the respective survey years. The first year refers to the HIS data set, the second to the DHS data set. All indices are rescaled to UNDP's reported HDI value of the second survey year.

*Source:* Household Income Survey (HIS) and Demographic and Health Surveys (DHS) (see Table A1), Human Development Reports; calculations by the authors.

Table A1  
Data sources for developing countries

Country	Year	Type of survey
Burkina Faso	2003	Demographic and Health Survey (DHS)
	2003	Enquête Prioritaire sur les Conditions de Vie des Ménages (EP)
Bolivia	2003	Demographic and Health Survey (DHS)
	2002	Living Standard Measurement Survey (LSMS)
Côte d'Ivoire	1999	Demographic and Health Survey (DHS)
	1998	Enquête de Niveau de Vie des Ménages (ENV)
Cameroon	2004	Demographic and Health Survey (DHS)
	2001	Enquête Camerounaise auprès des Ménages (ECAM)
Colombia	2005	Demographic and Health Survey (DHS)
	2003	Encuesta de Calidad de Vida
Guinea	1999	Demographic and Health Survey (DHS)
	1995	Enquête Intégrale avec Module Budget et Consommation
Indonesia	2003	Demographic and Health Survey (DHS)
	2000	Indonesian Family Life Survey (3rd wave) (IFLS)
Madagascar	1997	Demographic and Health Survey (DHS)
	2001	Enquête auprès des Ménages (EPM)
Mozambique	2003	Demographic and Health Survey (DHS)
	2002	Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida
Nicaragua	2001	Demographic and Health Survey (DHS)
	2001	Encuesta Nacional de Hogares sobre Medición de Nivel de Vida (EMNV)
South Africa	1998	Demographic and Health Survey (DHS)
	2000	Income and Expenditure Survey
Vietnam	2002	Demographic and Health Survey (DHS)
	2004	Living Standard Measurement Survey (LSMS)
Zambia	2002	Demographic and Health Survey (DHS)
	2002	Living Conditions Monitoring Survey (LCMS)

Table A2  
 Quintile specific life expectancy indices by country

	$Q = 1$	$Q = 2$	$Q = 3$	$Q = 4$	$Q = 5$	All	Ratio $Q5/Q1$
(a) $L^Q$ computed using predicted income							
Industrialized Countries							
USA (2000)	0.823	0.858	0.877	0.891	0.903	0.870	1.098
Finland (2000)	0.852	0.871	0.890	0.910	0.931	0.890	1.094
Developing Countries							
Colombia (2003/2005)	0.814	0.781	0.801	0.799	0.788	0.797	0.968
Vietnam (2004/2002)	0.713	0.707	0.825	0.812	0.849	0.764	1.191
Indonesia (2000/2003)	0.650	0.651	0.711	0.711	0.799	0.697	1.229
South Africa (2000/1998)	0.416	0.468	0.532	0.542	0.523	0.481	1.257
Bolivia (2002/2003)	0.632	0.622	0.666	0.691	0.681	0.651	1.078
Nicaragua (2001/2001)	0.730	0.700	0.753	0.756	0.783	0.735	1.073
Cameroon (2001/2004)	0.370	0.335	0.337	0.323	0.342	0.344	0.924
Madagascar (2001/1997)	0.509	0.432	0.463	0.574	0.574	0.500	1.128
Guinea (1995/1999)	0.532	0.491	0.473	0.455	0.415	0.479	0.780
Côte d'Ivoire (1998/1999)	0.369	0.394	0.296	0.306	0.427	0.364	1.158
Zambia (2002/2002)	0.214	0.200	0.205	0.209	0.211	0.208	0.986
Mozambique (2002/2003)	0.329	0.309	0.263	0.226	0.219	0.281	0.666
Burkina Faso (2003/2003)	0.385	0.386	0.382	0.359	0.359	0.375	0.932
(b) $L^Q$ computed using asset index							
Colombia (2003/2005)	0.787	0.791	0.831	0.870	0.777	0.797	0.987
Vietnam (2004/2002)	0.684	0.751	0.799	0.835	0.877	0.764	1.282
Indonesia (2000/2003)	0.616	0.631	0.679	0.764	0.890	0.697	1.445
South Africa (2000/1998)	0.405	0.476	0.530	0.504	0.602	0.481	1.486
Bolivia (2002/2003)	0.600	0.627	0.682	0.667	0.811	0.651	1.352
Nicaragua (2001/2001)	0.678	0.745	0.756	0.759	0.828	0.735	1.221
Cameroon (2001/2004)	0.328	0.328	0.365	0.330	0.391	0.344	1.192
Madagascar (2001/1997)	0.429	0.509	0.498	0.556	0.567	0.500	1.322
Guinea (1995/1999)	0.415	0.458	0.431	0.562	0.624	0.479	1.504
Côte d'Ivoire (1998/1999)	0.317	0.384	0.340	0.464	0.384	0.364	1.211
Zambia (2002/2002)	0.185	0.215	0.209	0.196	0.246	0.208	1.330
Mozambique (2002/2003)	0.264	0.276	0.277	0.310	0.312	0.281	1.182
Burkina Faso (2003/2003)	0.345	0.386	0.373	0.368	0.420	0.375	1.217

*Note:* For developing countries the years in brackets refer to the respective survey years. The first year refers to the HIS data set, the second to the DHS data set. All indices are rescaled to UNDP's reported HDI value of the second survey year.

*Source:* Household Income Survey (HIS) and Demographic and Health Surveys (DHS) (see Table A1), Human Development Reports; calculations by the authors.

Table A3  
Quintile specific education indices by country

	$Q = 1$	$Q = 2$	$Q = 3$	$Q = 4$	$Q = 5$	All	Ratio $Q5/Q1$
Industrialized Country							
USA	0.935	0.955	0.975	0.992	1.022	0.980	1.085
Finland	0.973	0.970	0.979	0.993	1.024	0.990	1.052
Developing Country							
Colombia (2003/2005)	0.788	0.834	0.866	0.887	0.932	0.863	1.182
Vietnam (2004/2002)	0.783	0.807	0.821	0.867	0.880	0.831	1.123
Indonesia (2000/2003)	0.730	0.789	0.821	0.855	0.900	0.814	1.232
South Africa (2000/1998)	0.814	0.818	0.823	0.824	0.824	0.821	1.012
Bolivia (2002/2003)	0.721	0.833	0.888	0.922	0.954	0.870	1.323
Nicaragua (2001/2001)	0.621	0.635	0.666	0.688	0.722	0.665	1.162
Cameroon (2001/2004)	0.579	0.664	0.716	0.752	0.801	0.713	1.383
Madagascar (2001/1997)	0.462	0.598	0.612	0.648	0.822	0.593	1.780
Guinea (1995/1999)	0.304	0.433	0.442	0.486	0.462	0.410	1.520
Côte d'Ivoire (1998/1999)	0.367	0.417	0.448	0.490	0.546	0.443	1.488
Zambia (2002/2002)	0.586	0.657	0.707	0.771	0.831	0.704	1.420
Mozambique (2002/2003)	0.433	0.459	0.460	0.464	0.524	0.471	1.210
Burkina Faso (2003/2003)	0.194	0.207	0.228	0.259	0.373	0.260	1.922

*Note:* For developing countries the years in brackets refer to the respective survey years. The first year refers to the HIS data set, the second to the DHS data set. All indices are rescaled to UNDP's reported HDI value of the second survey year.

*Source:* Household Income Survey (HIS) and Demographic and Health Surveys (DHS) (see Table A1), Human Development Reports; calculations by the authors.

Table A4  
Quintile specific GDP indices by country

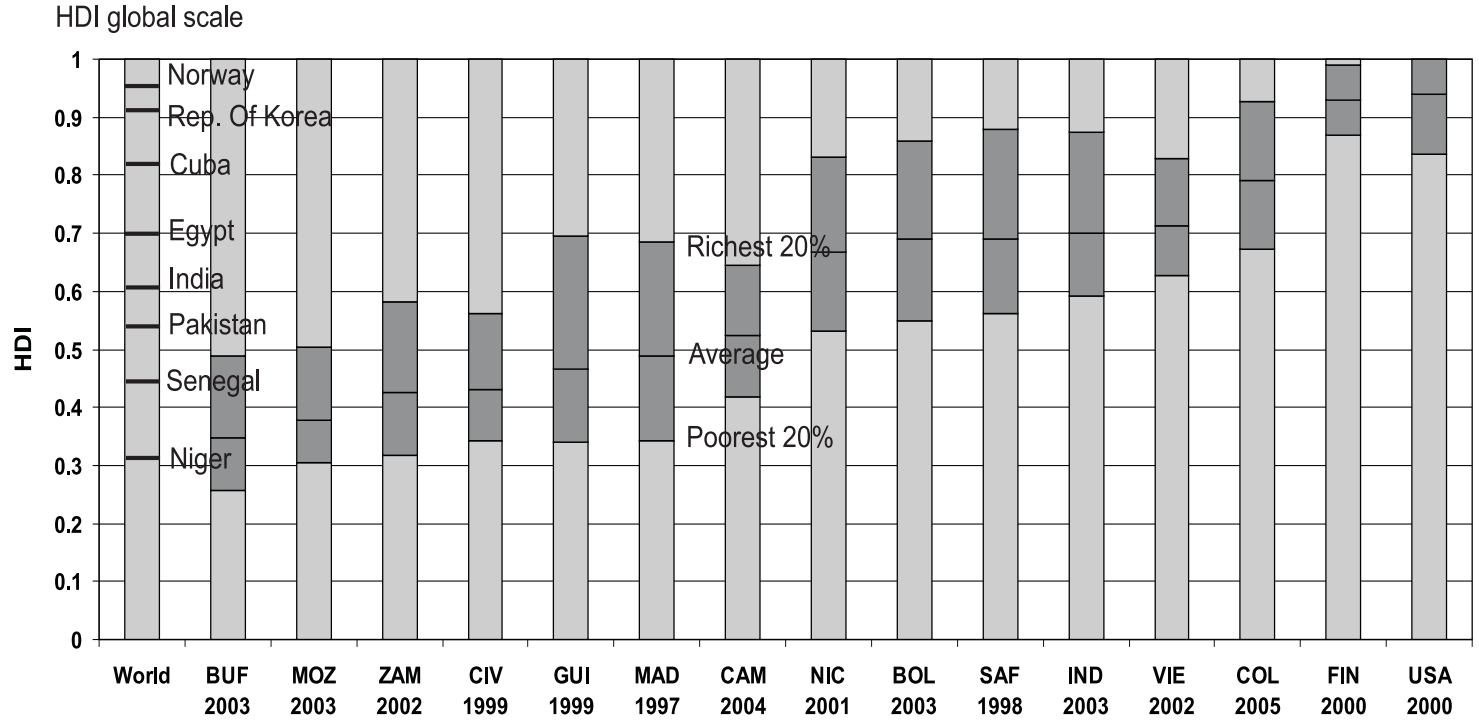
	$Q = 1$	$Q = 2$	$Q = 3$	$Q = 4$	$Q = 5$	All	Ratio $Q5/Q1$
Industrialized Country							
USA	0.756	0.869	0.932	0.992	1.112	0.974	1.480
Finland	0.821	0.883	0.921	0.964	1.043	0.940	1.146
Developing Country							
Colombia (2003/2005)	0.444	0.598	0.702	0.815	1.072	0.711	2.414
Vietnam (2004/2002)	0.415	0.482	0.534	0.592	0.726	0.543	1.759
Indonesia (2000/2003)	0.433	0.533	0.599	0.673	0.832	0.593	1.921
South Africa (2000/1998)	0.462	0.624	0.748	0.901	1.211	0.773	2.621
Bolivia (2002/2003)	0.329	0.459	0.543	0.634	0.825	0.548	2.508
Nicaragua (2001/2001)	0.296	0.507	0.611	0.714	0.939	0.599	3.172
Cameroon (2001/2004)	0.345	0.439	0.505	0.576	0.738	0.513	2.139
Madagascar (2001/1997)	0.139	0.281	0.377	0.484	0.664	0.370	4.777
Guinea (1995/1999)	0.300	0.480	0.598	0.735	1.002	0.514	3.340
Côte d'Ivoire (1998/1999)	0.344	0.446	0.515	0.591	0.753	0.483	2.189
Zambia (2002/2002)	0.179	0.297	0.376	0.462	0.672	0.366	3.754
Mozambique (2002/2003)	0.218	0.329	0.401	0.477	0.676	0.409	3.101
Burkina Faso (2003/2003)	0.232	0.325	0.393	0.470	0.675	0.409	2.909

*Note:* For developing countries the years in brackets refer to the respective survey years. The first year refers to the HIS data set, the second to the DHS data set. All indices are rescaled to UNDP's reported HDI value of the second survey year.

*Source:* Household Income Survey (HIS) and Demographic and Health Surveys (DHS) (see Table A1), Human Development Reports; calculations by the authors.

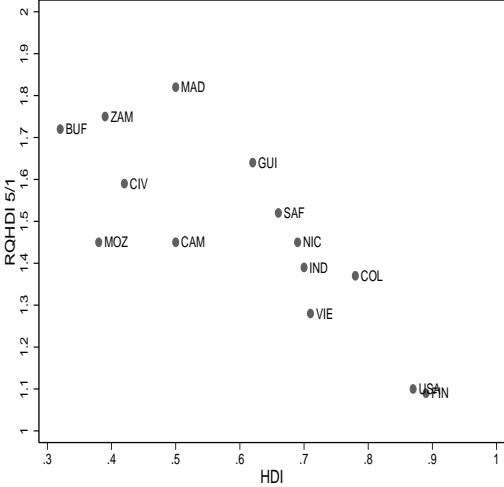


Figure 1  
Same country, different worlds—a human development index by income groups



Source: Computations by the authors. HDI global scale (HDR 2006).

Figure 2  
Correlation between the overall HDI and the ratio between the QHDI for the richest and the poorest quintile



Source: Computations by the authors.