

# An analysis of the ranking of the lowest developed countries on the Human Development Index

HDI rank	Human development index (HDI) value
160 Guinea	0.456
161 Rwanda	0.452
162 Angola	0.446
163 Benin	0.437
164 Malawi	0.437
165 Zambia	0.434
166 Côte d'Ivoire	0.432
167 Burundi	0.413
168 Congo (Democratic Republic of the)	0.411
169 Ethiopia	0.406
170 Chad	0.388
171 Central African Republic	0.384
172 Mozambique	0.384
173 Mali	0.380
174 Niger	0.374
175 Guinea-Bissau	0.374
176 Burkina Faso	0.370
177 Sierra Leone	0.336

Source: United Nations

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## Master thesis

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## **Abstract**

Since 1990 the United Nations publish the Human Development Index (HDI). This index ranks most world countries from higher developed to lower developed countries. The ranking is determined by the United Nations and occurs according a precise method. The index has developed to a popular composite indicator, a status symbol, for world development and is referred to in many news - and scientific sources. The precise method of ranking countries has changed over time. The United Nations and other experts have tried to produce improved methods for ranking countries on the Human Development Index. This research has investigated the impact on the ranking of the lowest developed countries if alternative methods for ranking countries within the index are used. The results of this research show that the lowest developed countries do improve their rank on the index, however this improvement on average is not higher than a few ranks. The tale of the Human Development Index, ranking the lowest developed world countries, looks quite the same, no matter which method of ranking is used.

## 1. Introduction

Imagine a congress with world leaders from all countries over the world. The representatives of the world most developed countries are seated in the front of the room. Those leaders have the best view of what is happening on the stage. The representatives of the lowest developed countries are seated in the back of the room. What should the representatives of the lowest developed countries long for...?

Of course this happening seems far from reality. Nevertheless the longings of the visitors in this happening could be comparable with the longings of country leaders when yearly the United Nations Human Development Index (HDI) is published. This index is ranking most of the world countries from high developed to low developed.

The HDI was constructed for the first time in 1990 and over time developed to a leading composite indicator and status symbol. The construction of the indicator has developed over time as well. Beside alternatives created by the United Nations, experts outside the United Nations have created alternatives as well. These alternatives were seen as improved Human Development Indexes. The main question for this research is however: **Do ‘improved constructions’ for the Human Development Index make the lowest developed countries ‘perform’ better?** Within this question the lowest developed countries are those countries ranked on the bottom of the HDI when the original construction of 1990 is used. Will these countries on average improve their rank on the index when an alternative HDI construction is used?

The research consists of both a theoretical and an empirical part. Chapter 2 and 3 focus on the theory behind the original HDI respectively on the theory behind its alternatives. Chapter 4, contains the empirical part of the research and compares, given real data, the original HDI with its alternatives and focuses on the results of the lowest developed countries. Chapter 5 represents the conclusions and recommendations on behave of this research. The research shows that on average the use of alternative HDI constructions instead of the original HDI construction of 1990 *does improve* the ranking of the lowest developed countries. However, *this improvement on average is only a few ranks.*

## 2. The Human Development Index (HDI)

In 2005 the President of India, Dr. Abdul Kalam, used the HDI as a standard to inform India about its current level of development and encouraged the country to work together in order to improve its rank on the index.<sup>1</sup> More recent, a Dutch newspaper<sup>2</sup> used the HDI to make clear the Netherlands were sixth in the list of best-living countries. Besides the ten best performing countries in the HDI the newspaper also mentioned: Sierra Leone, Niger and Afghanistan. These countries are ranked at the bottom of the list, an example of the fact that usually the top and bottom of the index get most attention.

A large survey of Sharpe et al. (2005) was done on the impact of indicators of well-being. An overall conclusion of this study is that the quantity of indicators in itself clarifies the impact of those indicators. For qualifying the value of indicators a report of European experts (Atkinson e. a., 2002) was used as a solid background. In the study of Sharpe et al. the HDI was classified as an international composite indicator of well-being and seen as 'the gold standard' for other indicators for a number of reasons:

- The HDI is the best-known composite indicator
- The HDI is making use of a simple framework (with variables income, wealth and education) which is intuitive and easy to understand
- The HDI is an indicator with much technical sophistication behind it and produced by high-profile UN agents including economist A.K. Sen, Nobel Prize winner in 1998.

More studies like Fakuda (2003), Davies (2008) and Egeiner e.a (2008) use the HDI as a starting point for policy makers to improve development. The HDI in itself is not able to change development. The indicator of the United Nations shows and compares development of most world countries on one list. The fact that the indicator since its birth in 1990 is used and referred to in news and in many social, economic and other (scientific) articles can in itself explain the status of the HDI.

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<sup>1</sup> Kalam (2005)

<sup>2</sup> Schildkamp V., Het Algemeen Dagblad; VN: *Nederland is fijn om in te wonen* (06-10-2009)

## 2.1 The construction of the HDI (HDI-0)

In 1990 the first Human Development Report (HDR) was published by the United Nations (UN) including the 'new' development indicator: the HDI. In the decades before the UN usually indicated the development of countries simply by showing their Gross National Product (GNP). According to the United Nations there was a need for a composite indicator going further than this financial indicator. The Human Development Index was aimed to show (policymakers) a general picture of country development instead of a perplex picture. For this reason the HDI should not be considered as a detailed development indicator, it shows a general picture. The United Nations decided to implement three dimensions of human life within the HDI: health, education and income. The first construction of the HDI (HDI-0) changed in the years after, however the HDI was a constant factor in all global, regional and national Human Development Reports the United Nations have published ever since, even in more than 140 different nations. The HDI-0, as summary measure of human development, has to have the following properties:

- To be computable for more than 140 countries
- To be determined by variables in three dimensions: health, education and income
- Only few independent variables should be included: the aim is to show main overall trends instead of perplex picture with much variables.

Given these properties, the United Nations decided to include three independent variables in the HDI-0, one in each dimension. For the health-dimension, life expectancy (at birth) was chosen. This variable in itself can indicate the quality levels of nutrition and good health for people in a country. For the education-dimension, the literacy rate was assumed to be the most important knowledge measure, a crude reflection of access to education. The log of real GDP per capita (PPP \$US) could represent the income-dimension. By taking the log relative financial development of countries could be measured. Countries with a log of real GDP per capita (PPP \$US) above 3,68 (that is 10.000 \$US) all scored the highest possible income-dimension. Adjusting real GDP (\$US) by purchasing power per capita (PPP) was done for the reason of dealing with the different price-, exchange- and tax levels in different countries.

The HDI-0 was constructed in three steps:

1. Defining the dimension index for all three dimensions for each country.

$$I_{ij} = \frac{\left( \max_j X_i - X_{i,j} \right)}{\left( \max_j X_i - \min_j X_i \right)}$$

Where:

$I_{ij}$  = The dimension index for the  $j$ th country with respect to the  $i$ th variable

( $X_1$ =life expectancy,  $X_2$ =literacy rate,  $X_3$ =the log of real GDP (PPP \$US))<sup>3</sup>

$X_{i,j}$  = the actual value for the  $j$ th country with respect to the  $i$ th variable

$\max_j X_i$  = The maximum value given the  $i$ th variable

$\min_j X_i$  = The minimum value given the  $i$ th variable

2. Defining an average dimension index ( $I_j$ ) by taking the average of the three dimensions resulting from step 1.

$$I_j = \left( \frac{1}{3} \right) \sum_{i=1}^3 I_{ij}$$

3. Measure the Human Development Index 1990 for the  $j$ th country ( $HDI - 0$ ) <sub>$j$</sub>  :

$$(HDI - 0)_j = 1 - I_j$$

Annex A gives an example of constructing the  $(HDI-0)_j$  for the  $j$ th country.

## 2.2 Improving the construction of the HDI after 1990

As the United Nations have a leading role in worldwide economic, political and scientific debate. The introduction of the human development index in 1990 was recognized by many soon, and critiques rise on the development indicator as well. Those critiques came from the outside and the inside of the United Nations. In the Human Development Report of 1990 the United Nations already contributed some critical notes on the HDI-0 while their main message was to make use of the HDI as a *main overall trends* indicator of international development.

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<sup>3</sup> The maximal log of real GDP (PPP \$US) in the income-dimension was 3,68



The first years after the introduction of the HDI in 1990 could be defined as 'growing-up years' for the indicator. Alternative literature in 1991 argued whether the HDI could be classified as a development indicator at all (Trabold-Nübler (1991) and Kelly (1991)) and literature (Lüchters and Menkhoff (1994)) speaks about 'the fourth premiere of the HDI' after the United Nations had made technical changes on the indicator for the fourth time. The same article of Lüchters and Menkhoff even desires for a fifth premiere at that time.

The rumor years have passed by and the HDI has been developed to a widely known and cited development indicator nowadays. Over time the United Nations have changed the construction of the HDI several times. The HDI-0 has been replaced by other constructions. Even alternative Human Development Indexes have been published outside the United Nations. Annex B shows what have been arguments for creating alternative Human Development Indexes, for example the need of absolute points of deprivation instead of real minima and maxima or arguments on adding specific data into the construction of the HDI such as the gross enrollment rate.

### 3. The alternative Human Development indexes

Since the introduction of HDI-0 several alternative constructions for this development index of the United Nations have been created. Still, the question is, whether these alternative constructions will change the position of the less developed countries on a development index. Table 1 shows an overview of 5 alternative HDI's that have been either used even before HDI-0 or offered after its introduction.

**Table 1: The involved (alternative) Human Development Indexes in this research**

Original name	Year of creation	Name in this research	Creator
<i>Original construction:</i> Human Development Index 1990	1990	HDI-0	United Nations
<i>Alternative constructions:</i> Gross National Income-index	before 1990	HDI-GNI	no specific creator
Human Development Index 1994	1994	HDI-94	United Nations
The inequality-adjusted index	1997	HDI-IAI	D. A. Hicks
Human Development Index 2007/2008	2007	HDI-0708	United Nations
The displaced-ideal method index	2008	HDI-DIM	H. Nathan et. al

Within the formulas used in this chapter various letters and subscripts are used. The letters and subscripts stand for:

$I_{ij}$  = The dimension index for the  $j$ th country with respect to the  $i$ th variable

( $X_1$ =life expectancy,  $X_2$ =literacy rate,  $X_3$ =the log of real GDP (PPP \$US))<sup>4</sup>

$X_{i,j}$  = the actual value for the  $j$ th country with respect to the  $i$ th variable

$\max_j X_i$  = The maximum value given the  $i$ th variable

$\min_j X_i$  = The minimum value given the  $i$ th variable

yos = Years of schooling

alr = Adult literacy rate

cger = Combined gross enrollment ratio

y = GDP (PPP \$US)

<sup>4</sup> The maximal log of real GDP (PPP \$US) in the income-dimension was 3,68

$y^*$  = Global average GDP (PPP \$US)

$W$  = Adjusted GDP (PPP \$US)

$G_{i,j}$  = Gini-coefficient for the  $j$ th country with respect to the  $i$ th variable

### 3.1 GNI-index (HDI-GNI)

This alternative is not especially created by someone but stands for using the Gross National Income (per capita) of a country as a measure of level of development.

The HDI-GNI is an index based on one variable: the Gross National Income (per capita) of a country. Before the HDI was introduced in 1990 the Gross National Product (GNP) or Gross National Income of countries was an often used measure for development of countries. After 1990 several scientists (Kelly (1991), McGillivray (1991), Cahill (2005) stressed to use the HDI-GNI instead of HDI-O after founding out HDI-O was highly correlated with the HDI-GNI although the question in literature was whether an development index relaying on only one variable was reasonable.

The main difference with HDI-O is that HDI-GNI depends on one variable while HDI-O includes more variables.

Since the HDI-GNI is equal to the level of GNI per capita (\$US), the construction is:

$$(HDI - GNI)_j = GNI_j$$

### 3.2 Human Development Index 1994 (HDI-94)

The construction of the HDI in 1993 was further improved by the United Nations in 1994, resulting in HDI-94 and in more or less the same construction was used until 2000. The main reason of creation was 'improving' the education- en income dimension of HDI-O. The education dimension of HDI-O was assumed to be more reasonable by adding another variable in the dimension. The income dimension was assumed to improve by dealing with a real maximum adjusted GDP (PPP \$US).

Further, countries with a lower income dimension index were assumed to gain more utility with an increase of for example 100 \$US (PPP) than countries with a higher index.

In HDI-O the education dimension consisted of one variable (literacy rate). To make this dimension more reasonable the United Nations supposed to add another variable within this dimension: years of schooling. Adult literacy however got a higher weight in the dimension index, namely 2/3 instead of 1/3 for years of schooling. This is imposing the United Nations assumed adult literacy to be a stronger indicator for the level of education in a country. The GDP levels were adjusted, such that lower developed countries relatively gain more than higher developed countries from the same absolute increase of GDP levels and vice versa. The income dimension in HDI-O dealt with a maximum log of GDP (PPP US \$US) that was not depending on real performance but decided by the United Nations. In HDI-94 this maximum was made equal to the adjusted GDP (PPP \$US) of the country with the highest adjusted GDP (PPP \$US). The adjusting procedure could be done by the help of the Atkinson formulation.

The HDI-94 was constructed in two steps:

1. Defining the dimension index for all three dimensions (health, education, income) for each country:

$$I_{ij} = \frac{(X_{i,j} - \min_j X_i)}{(\max_j X_i - \min_j X_i)}$$

For the education dimension index, the following formula should be used at step 1:

$$I_{education,j} = \left(\frac{1}{3}\right) \frac{(X_{yos,j} - \min_j X_{yos})}{(\max_j X_{yos} - \min_j X_{yos})} + \left(\frac{2}{3}\right) \frac{(X_{alr,j} - \min_j X_{alr})}{(\max_j X_{alr} - \min_j X_{alr})}$$

In Annex C the points of reference for HDI-94 can be found.

2. Defining HDI-94 by taking the average of the three dimensions (health, education and income) resulting from step 1:

$$(HDI - 94)_j = \left(\frac{1}{3}\right) \sum_{i=1}^3 I_{ij}$$

#### *Adjusting the GDP (PPP \$US)*

The education dimension index included the mortality rate. The education dimension index included both the adult literacy rate and years of schooling. For the income dimension index an adjusted GDP (PPP \$US) was used. The Atkinson formulation for the utility of income was used

in order to adjust the GDP (PPP). When  $y_j$  was lower or equal to the global average GDP (PPP \$US) this adjusted GDP (PPP) was equal to:

$$W(y) = \left( \frac{1}{1-\varepsilon} \right) * y^{1-\varepsilon}$$

When  $y_j$  was higher than the global average GDP (PPP \$US):

$$W(y) = y^* + 2(y - y^*)^{\frac{1}{2}} \quad \text{if } y \text{ is twice as large as } y^*$$

$$W(y) = y^* + 2(y^*)^{\frac{1}{2}} + 3(y - y^*)^{\frac{1}{3}} \quad \text{if } y \text{ is three times as large as } y^*$$

$$W(y) = y^* + 2(y^*)^{\frac{1}{2}} + 3(y^*)^{\frac{1}{3}} + 4(y - y^*)^{\frac{1}{4}} \quad \text{if } y \text{ is four times as large as } y^*$$

### 3.3 Inequality - Adjusted index (HDI-IAI)

According to Hicks (1997) the United Nations Human Development Index was measuring development between countries and could therefore be improved by adding a variable within the construction which measured inequality *within* countries as well. HDI-O focused on average data of countries. In order to measure real development of countries the internal inequality should be taken into the Human Development Index as well. With this assumption Hicks represented more literature (Sen (1976), Klasen (1994) and HDR (1993)) about the HDI and inequality within countries.

For deriving the three dimension indexes HDI-IAI adds 'Gini-coefficients'<sup>5</sup>, the only difference with HDI-O.

The HDI-IAI was constructed in two steps:

1. Defining the dimension index for all three dimensions (health, education, income) for each country:

$$I_{ij} = \frac{\left( X_{i,j} - \min_j X_i \right) (1 - G_{i,j})}{\left( \max_j X_i - \min_j X_i \right)}$$

For the education dimension index, the following formula should be used at step 1:

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<sup>5</sup> The Gini-coefficient indicates inequalities within countries according a wider used method.

$$I_{education,j} = \left(\frac{1}{3}\right) \frac{(X_{yos,j} - \min_j X_{yos})(1 - G_{i,j})}{(\max_j X_{yos} - \min_j X_{yos})} + \left(\frac{2}{3}\right) \frac{(X_{atr,j} - \min_j X_{atr})(1 - G_{i,j})}{(\max_j X_{atr} - \min_j X_{atr})}$$

The points of reference of HDI-IAI can be found in Annex C, the same points of reference count for HDI-IAI as for HDI-94.

2. Defining HDI-IAI by taking the average of the three dimensions (health, education and income) resulting from step 1:

$$(HDI - IAI)_j = \left(\frac{1}{3}\right) \sum_{i=1}^3 I_{ij}$$

For the constructing of HDI-IAI the same method was used in order to adjust GDP (PPP \$US) as was used for constructing HDI-94.

### 3.4 The Human Development Index 2007/2008 (HDI-0708)

The main reason for developing HDI-0708 is the fact that the former United Nations constructions HDI-0 and HDI-94 had points of reference which were depended on real maximum and minimum levels of each data variable. Development of countries was measured by comparing with other countries. In this most recent HDI-0708 the points of reference are fixed instead of the fluctuating real minimum and maximum levels. Further in HDI-0 the log of GDP (PPP \$US) is used again instead of adjusting GDP by the help of the Atkinson formulation.

The education dimension of the index consists of the variables adult literacy and the combined gross enrolment ratio. More weight has been given for the measure of adult literacy (2/3) than the combined gross enrollment ratio (1/3). In the combined gross enrolment ratio primary, secondary and tertiary gross enrollment are taken into account.

For deprivation now absolute points of reference are used instead of (changing) best and worst worldwide maximum and minimum values. Because of this change, countries now compare with fixed points of reference instead of comparing with others.

The HDI-0708 was constructed in two steps:

1. Defining the dimension index for all three dimensions (health, education, income) for each country:

$$I_{ij} = \frac{(X_{i,j} - \min X_i)}{(\max X_i - \min X_i)}$$

For the education dimension index, the following formula should be used at step 1:

$$I_{education,j} = \left(\frac{1}{3}\right) \frac{(X_{cger,j} - \min X_{cger})}{(\max X_{cger} - \min X_{cger})} + \left(\frac{2}{3}\right) \frac{(X_{alr,j} - \min X_{alr})}{(\max X_{alr} - \min X_{alr})}$$

The points of reference of HDI-0708 can be found in Annex D.

2. Defining HDI-0708 by taking the average of the three dimensions (health, education and income) resulting from step 1:

$$(HDI - 0708)_j = \left(\frac{1}{3}\right) \sum_{i=1}^3 I_{ij}$$

### 3.5 The displaced ideal Index (HDI-DIM)

In the (original) HDI the three components health, education and income are weighted equal in the final construction of the HDI. From step 2, a 10% improvement in the health component is assumed to be the same as a 10% improvement in the income components. In the same way an improvement within income component can be neutralized by a decrease in the education component. In other words: the three components are substitutes within the final construction of the HDI. Critiques on this substitutable character of the components were addressed in literature (Desai, 1991 and Revillon, 1997) and recently Natan e.a. (2008) have constructed an alternative HDI as a confirmation on this critique. Same or similar parameters are added linearly and averaged out. A one-dimensional thinking lies behind this construction and health, education and income are assumed to be perfectly substitutable. Nanthan e.a. have built forward on theory of Zeleny (1974) and Subramaniam and Majumbar (2002) to construct their alternative HDI.

In the final step of constructing the three dimension indexes (health, education and income) are not considered as substitutes in a linear function. The last step of construction is an exponential function. In this way differences between the dimension indexes no longer can be averaged out.

Instead of using the linear average method, the displaced ideal method is used in this alternative. Within the displaced ideal method countries that perform the best have less distance from ideal and all three components got a different weight in the final derivation of the HDI given the distance from ideal each country is facing in each component.

The HDI-DIM was constructed in two steps:

1. Defining the dimension index for all three dimensions (health, education, income) for each country:

$$I_{ij} = \frac{(X_{i,j} - \min X_i)}{(\max X_i - \min X_i)}$$

For the education dimension index, the following formula should be used at step 1:

$$I_{education,j} = \left(\frac{1}{3}\right) \frac{(X_{cger,j} - \min X_{cger})}{(\max X_{cger} - \min X_{cger})} + \left(\frac{2}{3}\right) \frac{(X_{alr,j} - \min X_{alr})}{(\max X_{alr} - \min X_{alr})}$$

Step 1 of HDI-DIM is equal to the first step of HDI-0708 with the same points of reference (as can be found in Annex D).

2. Defining HDI-DIM by the help of the displaced ideal method:

$$(HDI - DIM) = 1 - \frac{\sqrt{(1 - I_{health,j})^2 + (1 - I_{education,j})^2 + (1 - I_{income,j})^2}}{\sqrt{3}}$$

In this expression the numerator stands for the distance form ideal. The ideal situation occurs when all dimension indexes are equal to 1. The denominator normalizes.



## **4. Comparing empirically HDI-0 with its alternatives**

In this part of the research the original Human Development Index construction (HDI-0) is empirically compared with the alternatives which are described in chapter 3 of the research. Each construction results in a specific ranking of world countries. All alternative rankings are compared with the ranking resulting from HDI-0. For 172 countries real data of 1995 and 2005 is used in order to make this comparison. The focus of the empirical research is on the lowest developed countries in order to answer the main question of this research: do 'improved constructions' make the lowest developed countries 'perform' better?

### **4.1 The use of data**

For comparing the alternative constructions of the HDI with the original construction of 1990 real data has been used. Annex E and Annex F show all data that has been used for the empirical research. The United Nations is the main source of the data unless otherwise is noted in the Appendix. Most of the data which has been used in this research is used by the United Nations as well for creating their Human Development Indexes. For the research real data is used of two moments in history: 1995 and 2005. Most of the data could be found in the Human Development Reports of 1998 and 2007/2008. In this research the same data is used for comparing the different constructions of the HDI. For example: for HDI-0 and HDI-94 both make use of the literacy rate, the same literacy rate has been used.

### **4.2 The methodology of research**

In order to compare the rankings of the lowest developed countries according the alternative HDI's with the original HDI-0 a specific methodology has been used. The method of testing contains a few steps:

*Determine starting point and selection of 39 lowest developed countries*

In the first stage 172 countries, given data of 1995 and 2005, are ranked according to HDI-0. These rankings are shown in Annex G and Annex H form the starting point of the empirical research. While the research focuses on the rankings of the lowest developed countries the lowest 39 ranked countries according to the HDI-0 have been selected for further research. This number approaches 25% of all countries and is dividable in three groups; the upper class, the middle class and the lowest class. The three classes together form the lowest developed countries. In a later stage the results of the lowest developed countries could be analyzed in total or as a part of all lowest developed countries. Potential differences between the classes can be addressed.

#### *Compute all rankings according to the alternative HDI's*

In the second stage all rankings of the alternative HDI's have been computed. Each alternative HDI uses a specific construction in order to rank all countries. Two adjustments are:

- For HDI-94 schooling years should be used in order to compute the rankings. For the fact that this data could not be found for the majority of countries, the combined gross enrollment ratio has been used instead.
- For HDI-IAI only data could be found for 1995 and not for all countries. Therefore the comparison of this alternative only has been done for data of 1995 and some countries have not been taken into account.<sup>6</sup>

#### *Compare rankings of alternative HDI's with HDI-0 for individual countries*

The ranking of the 39 lowest developed countries according to the alternative HDI constructions have been compared with the ranking of HDI-0. Annex G and Annex H show for 39 individual countries the differences in ranking for each alternative HDI, the mean deviation and the standard deviation.

The *mean deviation* in the test rather rises or falls (given its positive or negative character) after comparing all alternative rankings with the original. The mean deviation is the mean difference between a country's rank according to HDI-0 and its rank according to the

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<sup>6</sup> See Annex G.

alternative HDI's. This measure has been chosen instead of the variance since the variance squares data.

The *standard deviation* however measures the mean intensity of the difference between the alternative HDI ranks and the original rank independent from the fact whether the difference implicates a fall or rise in ranks. For example; the average of minus 3 and 5 is equal to the average of minus 10 and 11, both are 1. The standard deviations in this example however do differ. The standard deviation of minus 3 and 5 is less than minus 10 and 11. For the standard deviation the research has been classified as researching the entire population instead of a sample since the dataset of involved countries contains almost all world countries. For this reason the denominator of the standard deviation is equal to  $n^7$ . Both measures could be described by the following formulas:

$$\text{mean deviation} = \sum_{i=1}^n \frac{\Delta_i}{n} \quad , \quad \text{standard deviation} = \sqrt{\sum_{i=1}^n \frac{(\Delta_i)^2}{n}}$$

Where  $\Delta_i$  stands for the difference between the rank of a country according an alternative HDI ( $HDI_i$ ) and the rank according HDI-0 ( $HDI_0$ ):  $\Delta_i = (HDI_0 - HDI_i)$ . And  $n$  stands for the total number of indicators used in the analysis.

#### *Compare rankings of alternative HDI's with HDI-0 for classes*

The final step has been to determine the mean and standard deviation per class and for the total group of lowest developed countries. Now the mean and standard deviation are measured by:

$$\text{mean deviation} = \sum_{i,j=1}^n \frac{\Delta_{i,j}}{n} \quad , \quad \text{standard deviation:} \sqrt{\sum_{i,j=1}^n \frac{(\Delta_{i,j})^2}{n}}$$

Where  $\Delta_{i,j}$  stands for each difference between the rank of a country belonging to a certain class ( $j$ ) using the alternative HDI ( $HDI_i$ ) and the rank of using HDI-0 ( $HDI_0$ ):  $\Delta_{i,j} = (HDI_0 - HDI_{i,j})$

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<sup>7</sup> See Aczel (2002), page 29

### 4.3 Results

In the empirical research the focus has been on the world lowest developed countries according the first Human Development Index (HDI-0). Will these countries 'perform' better when an alternative construction for the Human Development Index is used?

The mean deviation and standard deviation for each class and for the total group are showed in tables 2.A and 2.B. The mean deviation explains the average difference in ranking of a country comparing all alternative HDI's with HDI-0. The standard deviation explains the intensity of the differences in ranking.

**Table 2: Research results per class for 1995 (A) and 2005 (B)**

	Mean deviation	Standard deviation
<b>Table 1.A</b>		
<b>Upper class</b>	-0,40	6,58
<b>Middle class</b>	1,28	10,02
<b>Lowest class</b>	2,14	7,04
<b>Total group</b>	1,01	7,95

	Mean deviation	Standard deviation
<b>Table 1.B</b>		
<b>Upper class</b>	-2,27	9,85
<b>Middle class</b>	5,54	14,81
<b>Lowest class</b>	3,77	8,88
<b>Total group</b>	2,35	11,48

In tables 2.A and 2.B the mean deviation columns represent the average change in rank for a each country in a certain class comparing the alternative HDI's with HDI-0. Except for the upper class, given the negative results (-0,40 and -2,27), in each class countries on average improve their rank on the index when an alternative construction is used. These on average improvements vary from 1,28 ranks to 5,54 ranks. Focusing on the mean deviation for the total group, the research shows that on average the lowest developed countries improve their rank on the index when an alternative construction is used. However, the on average change is ranks for data of 1995 is 1,01 and for data of 2005 is 2,35.

In tables 2.A and 2.B the standard deviation columns represent the average intensity of each change in ranks. The standard deviation varies from 6,58 to 14,81. This implies that given the mean deviation, countries an average improve their position on the index with a few ranks while the individual differences comparing one alternative with HDI-0 on average varies with 6,58 to 14,81 ranks. Considering the results of Annex G and Annex H it have become clear that the results of alternative HDI-GNI differ more with the original HDI than the other alternatives.

While HDI-GNI is an outstanding alternative since it was used already before 1990. The same test has been done while leaving alternative HDI-GNI out. Tables 3.A and 3.B show the results when HDI-GNI is left out of the test.

**Table 3: Research results per class for 1995 (A) and 2005 (B)**

<b>Table 3.A</b>	<b>Mean deviation</b>	<b>Standard deviation</b>	<b>Table 3.B</b>	<b>Mean deviation</b>	<b>Standard deviation</b>
<b>Upper class</b>	-0,94	2,25	<b>Upper class</b>	-1,85	7,76
<b>Middle class</b>	0,09	6,35	<b>Middle class</b>	3,41	7,80
<b>Lowest class</b>	0,88	3,27	<b>Lowest class</b>	0,82	3,43
<b>Total group</b>	0,02	4,22	<b>Total group</b>	0,79	6,65

The results showed in tables 3.A and 3.B make the research conclude even more that on average the middle and lowest class countries improve their position on the index, given the mean deviation varying from 0,09 to 3,41, however this improvement is only a few ranks. The lowest class of lowest developed countries concerning countries like Sierra Leone, Mali, Chad, Burkina Faso and Mozambique on average improve their ranking with less than one rank if an alternative construction for the Human Development Index is used. This conclusion can be made considering the mean deviation of 0,88 for data of 1995 and 0,82 for data of 2005.

The standard deviation for all classes varies from 2,25 to 7,80. The decline of the standard deviations in tables 3.A and 3.B clarify the influence of HDI-GNI in table 2.A and 2.B. Now the on average intensity of a change in ranks for each country comparing the rank on an alternative HDI with HDI-O lies between 2,25 and 7,80 ranks.

Overall, the results of the empirical research make clear especially the lowest class of lowest developed countries do not gain if alternative HDI's are used. For these countries the construction of the Human Development Index can change, however their position on the Human Development Index will hardly 'improve'. In other words; the countries belonging to the lowest class of the lowest developed countries are unlikely to improve their class when alternative methods of ranking countries on development are used.

#### **4.4 A new alternative construction for the HDI**

This research concludes that most lowest developed countries, especially for the lowest of lowest developed countries, alternative constructions for the Human Development Index will not change their position on the index. For this reason it is plausible to use the simplest method for constructing the index for lowest developed countries or use the original HDI-0. One step further is using a construction that is more simple. One idea, for example, is constructing an index of (lowest) developed countries by summing the gross enrollment ratio and the life expectancy rate only. The result of this alternative construction for most of the lowest developed countries is quite the same. This implies more that ranking the lowest of the world lowest developed countries on an index can be done with several different methods, still the ranking for countries like Sierra Leone, Niger, Mozambique and others is quite the same: at the bottom of the list.

## 4. Conclusions and recommendations

In 1990 the United Nations introduced the Human Development Index. The aim of the index was to show (policy makers) main overall trends of human development. The indicator should generate a general picture instead of a too perplex picture of development of countries. Since the introduction the Human Development Index has developed to the best-known composite indicator for development of worldwide countries, a status symbol. During last two decades various alternative constructions for the HDI have been created by both the United Nations and others in order to improve the index.

The aim of this research was to investigate the relevancy for the lowest developed countries when alternative constructions for the HDI are used instead of the original construction (HDI-0). The main question of this thesis is:

**Do 'improved constructions' for the Human Development Index make the lowest developed countries 'perform' better?**

This research concludes that on average the lowest developed countries do perform better when an alternative construction is used instead of the original HDI. However on average countries only improve their ranking with by a few ranks. According this result most countries stay in the same class of lowest developed countries on the index. The results for the lowest class of lowest developed countries even clarify countries like Sierra Leone, Niger, Burkina Faso and a few other countries improve on average less than one rank when an alternative HDI construction is used than HDI-0.

During the congress of world leader most representatives of lowest developed countries will only slightly improve their seating, when the ranking is made according an alternative HDI construction instead of HDI-0. However, most of them will not improve their row of seats. The less developed are 'absolutely the less developed' no matter which HDI construction is used.

From this research follows that for ranking the lowest developed countries the simplest construction could be used since the results for most countries are quite the same.

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## Appendices

### Annex A: An example; Calculating the HDI (1990) for Nigeria

#### Data for general maxima, minima and specific statistics for Nigeria:

Maximum life expectancy (max $X_1$ )	= 78.4
Minimum life expectancy (min $X_1$ )	= 41.8
Maximum adult literacy rate (max $X_2$ )	= 100.0
Minimum adult literacy rate (min $X_2$ )	= 12.3
Maximum (log of) real GDP per capita (max $X_3$ )	= 3.68
Minimum (log of) real GDP per capita (min $X_3$ )	= 2.34
Nigeria's life expectancy ( $X_{1,Nigeria}$ ) <sup>8</sup>	= 51
Nigeria's adult literacy rate ( $X_{2,Nigeria}$ ) <sup>2</sup>	= 43
Nigeria's (log of) real GDP per capita ( $X_{3,Nigeria}$ ) <sup>2</sup>	= 2.82

#### Calculating Nigeria's HDI stepwise:

##### Step 1:

$$\begin{aligned} \text{Nigeria's life expectancy deprivation } (I_{1,Nigeria}) & \\ &= (78.4 - 51) / (78.4 - 41.8) = 0.74 \\ \text{Nigeria's literacy deprivation } (I_{2,Nigeria}) & \\ &= (100.0 - 43) / (100.0 - 12.3) = 0.65 \\ \text{Nigeria's GDP deprivation } (I_{3,Nigeria}) & \\ &= (3.68 - 2.82) / (3.68 - 2.34) = 0.64 \end{aligned}$$

##### Step 2:

$$\begin{aligned} \text{Nigeria's average deprivation } (I_{Nigeria}) & \\ &= (0.74 + 0.65 + 0.64) / 3 = 0.678 \end{aligned}$$

##### Step 3:

$$\begin{aligned} \text{Nigeria's Human Development Index (HDI)} & \\ &= 1 - (0.678) = \mathbf{0.322} \end{aligned}$$

Data source: Human Development Report 1990, United Nations

<sup>8</sup> For the calculating of Nigeria's HDI data was used form the Human Development Report (HDR) 1990. As well as in the HDR, both life expectancy data and real GDP data (PPP \$US) were from the year of 1987. The adult literacy data was from the year of 1985.

## Annex B: Main critiques on improvement of the HDI over time

Source:	Main argument for changing the actual HDI construction:
<ul style="list-style-type: none"> <li>- HDR 1990, United Nations</li> <li>- Sagar (1999)</li> <li>- Hicks (1997)</li> <li>- Pogge (2002)</li> </ul>	Measures within the HDI are averages that conceal wide disparities in the (overall) population. The HDI should deal with inequalities of (or within) countries
<ul style="list-style-type: none"> <li>- HDR 1991, United Nations</li> <li>- HDR 1994, United Nations</li> <li>- Trabold-Nübler (1991)</li> </ul>	In staid of actual best and worst worldwide values, for deprivation absolute points of reference should be used.
<ul style="list-style-type: none"> <li>- HDR 1992, United Nations</li> </ul>	The knowledge element in the HDI should be improved by more variables then 'literacy' only.
<ul style="list-style-type: none"> <li>- Kelly (1991)</li> <li>- McGillivray (1991)</li> <li>- Dasgupta and Weale (1992)</li> <li>- Anand e.a. (2000)</li> <li>- Cahill (2002 and 2005)</li> </ul>	A high correlation exists between statistics of GDP and HDI; why is HDI needed as a separate development indicator?
<ul style="list-style-type: none"> <li>- Sharma (1997)</li> <li>- Anand (2003b)</li> </ul>	The HDI should be gender sensitive
<ul style="list-style-type: none"> <li>- Acharya and Wall (1994)</li> <li>- Noorbakhsh (1998)</li> <li>- Gormley (1995)</li> <li>- Sagar and Najam (1998)</li> </ul>	The HDI should give more weight to high incomes. Can countries with averages incomes above the poverty line not develop in financial perspective?
<ul style="list-style-type: none"> <li>- Neumayer (2001)</li> <li>- Desai (1995)</li> </ul>	Sustainability should be included in the HDI
<ul style="list-style-type: none"> <li>- Lind (2008)</li> <li>- Mazumbar (2001)</li> </ul>	The independent variables of the HDI may be biased differentially from country to country; the index therefore could be uncertain for at least several percents.
<ul style="list-style-type: none"> <li>- Desai (1991)</li> <li>- Revallion (1997)</li> <li>- Nathan e.a. (2008)</li> </ul>	Health, knowledge and income are no substitutes. The weighting scheme of the HDI is too subjective.

**Annex C: The absolute points of reference within the HDI-94 and HDI-IAI**

Indicator	Maximum Value	Minimum Value
Life expectancy at birth (years)	85	25
Adult literacy rate (%)	100	0
Mean years of schooling	15	0
GDP per capita (PPP \$)	40,000	200

Source: HDR 1994

**Annex D: The absolute points of reference within the HDI-0708 and HDI-DIM**

Indicator	Maximum Value	Minimum Value
Life expectancy at birth (years)	85	25
Adult literacy rate (%) <sup>9</sup>	100	0
Combined gross enrolment ratio (%)	100	0
GDP per capita (PPP \$)	40,000	100

Source: HDR (2007/2008)

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<sup>9</sup> In the HDI (2007/2008) an upper bound of 99% is used, meaning the adult literacy rate is 100%

## Annex E: Countries and data (1995)

Country	Life expectancy at birth (years) 1995	Adult literacy rate (% aged 15 and above) 1995 <sup>o</sup>	Combined gross enrolment ratio for primary, secondary and tertiary education (%) 1995	GDP per capita (PPP US\$) 1995	GNI per capita (US\$) 1995 <sup>a</sup>	Gini index (distribution of income) 1995 <sup>b</sup>
1 Albania	70.6	85.0	59 c	2.853 g,h	806	28,20
2 Algeria	68.1	61.6	66	5.618	1.413	35,30
3 Angola	47.4	42.0 f	30 i	1.839	297	-
4 Antigua and Barbuda	75.0 f	95.0 f	76	9.131 g	6.868	-
5 Argentina	72.6	96.2	79 i	8.498	7.275	52,20
6 Armenia	70.9	98.8	78 c	2.208	398	44,40
7 Australia	78.2	99.0	79 c	19.632	20.452	35,20
8 Austria	76.7	99.0	87 c	21.322	29.263	30,00
9 Azerbaijan	71.1	96.3	72 c	1.463	394	36,00
10 Bahamas	73.2	98.2	72 i	15.738	11.815	-
11 Bahrain	72.2	85.2	84	16.751	10.023	-
12 Bangladesh	56.9	38.1	37 i	1.382	309	33,60
13 Barbados	76.0	97.4	77 i	11.306	6.472	-
14 Belarus	69.3	97.9	80 c	4.398	1.348	21,70
15 Belgium	76.9	99.0	86 c	21.548	28.685	25,00
16 Belize	74.2	70.0 f	74 i	5.623	2.632	-
17 Benin	54.4	37.0	38 i	1.800	316	-
18 Bhutan	52.0	42.2	31	1.382	507	-
19 Bolivia	60.5	83.1	69 i	2.617	870	58,90
20 Botswana	51.7	69.8	71 i	5.611	2.744	63,00
21 Brazil	66.6	83.3	72 i	5.928	4.689	60,00
22 Brunei Darussalam	75.1	88.2	74 i	31.165 g,h	16.950	-
23 Bulgaria	71.2	98.0 f	66 c	4.604	1.547	31,90
24 Burkina Faso	46.3	19.2	19 i	784	282	48,20
25 Burundi	44.5	35.3	23 i	637	158	33,30
26 Cambodia	52.9	65.0 f	62 i	1.110 g,h	265	40,40
27 Cameroon	55.3	63.4	45 i	2.355	619	44,60
28 Canada	79.1	99.0	100 n	21.916	19.442	31,50
29 Cape Verde	65.7	71.6	64 c	2.612	1.210	-



30	Central African Rep.	48.4	60.0	27	i	1.092	321	61,30		
31	Chad	47.2	48.1	27		1.172	201	-		
32	Chile	75.1	95.2	73		9.930	4.831	56,50		
33	China	69.2	81.5	64		2.935	601	40,30		
34	Colombia	70.3	91.3	69		6.347	2.377	57,10		
35	Comoros	56.5	57.3	39	i	1.317	384	-		
36	Congo	51.2	74.9	68		2.554	504	-		
37	Congo, Dem. Rep. of the	52.4	77.3	41	i	355	g	5.349	-	
38	Costa Rica	76.6	94.8	69		5.969	107	47,00		
39	Cote d'Ivoire	51.8	40.1	38		1.731	3.307	36,70		
40	Croatia	71.6	98.0	f	67	c	3.972	e	684	26,80
41	Cuba	75.7	95.7	66		3.100	4.022	-		
42	Cyprus	77.2	94.0	f	79		13.379	g,h	2.930	-
43	Czech Rep.	72.4	99.0	70	c	9.775	13.730	25,40		
44	Denmark	75.3	99.0	89	c	21.983	34.438	24,70		
45	Djibouti	49.2	46.2	20		1.300	g,h	33.748	-	
46	Dominica	73.0	f	94.0	f	77	6.424	g	819	-
47	Dominican Rep.	70.3	82.1	73		3.923	3.018	48,70		
48	Ecuador	69.5	90.1	71	i	4.602	1.880	43,70		
49	Egypt	64.8	51.4	69	i	3.829	1.690	28,90		
50	El Salvador	69.4	71.5	58		2.610	1.138	52,30		
51	Equatorial Guinea	49.0	78.5	64	i	1.712	g,h	1.670	-	
52	Eritrea	50.2	25.0	m	29	983	g,h	406	-	
53	Estonia	69.2	99.0	72	c	4.062	225	35,40		
54	Ethiopia	48.7	35.5	20		455	3.136	40,00		
55	Fiji	72.1	91.6	78	i	6.159	121	-		
56	Finland	76.4	99.0	97	c	18.547	2.541	25,60		
57	France	78.7	99.0	89	c	21.176	24.709	32,70		
58	Gabon	54.5	63.2	60	c	3.766	g	26.308	-	
59	Gambia	46.0	38.6	39	i	948	3.981	47,80		
60	Georgia	73.2	99.0	f	69	c	1.389	325	37,10	
61	Germany	76.4	99.0	81	c	20.370	529	30,00		
62	Ghana	57.0	64.5	44	i	2.032	30.663	32,70		
63	Greece	77.9	96.7	d	82	c	11.636	354	32,70	
64	Grenada	72.0	f	98.0	f	78	5.425	g	12.670	-
65	Guatemala	66.1	65.0	46		3.682	2.681	55,80		
66	Guinea	45.5	35.9	25		1.139	g	1.291	40,30	
67	Guinea-Bissau	43.4	54.9	29	c	811	523	47,00		
68	Guyana	63.5	98.1	64	j	3.205	198	40,20		
69	Haiti	54.6	45.0	29	i	917	725	-		
70	Honduras	68.8	72.7	60	i	1.977	294	53,70		
71	Hong Kong, China	79.0	92.2	67		22.950	785	43,40		
72	Hungary	68.9	99.0	67	c	6.793	23.439	30,80		

73	Iceland	79.2	99.0	83	c	21.064	4.137	-		
74	India	61.6	52.0	55		1.422	25.504	37,80		
75	Indonesia	64.0	83.8	62	i	3.971	383	36,50		
76	Iran, Islamic Rep. of	68.5	69.0	f	67	i	5.480	990	43,00	
77	Ireland	76.4	99.0	88	c	17.590	1.748	35,90		
78	Israel	77.5	95.0	f	75	c	16.699	16.778	35,50	
79	Italy	78.0	98.1	d	73	c	20.174	e	17.111	27,30
80	Jamaica	74.1	85.0	67		3.801	19.349	36,40		
81	Japan	79.9	99.0	78	c	21.930	2.234	24,90		
82	Jordan	68.9	86.6	66		4.187	41.959	36,40		
83	Kazakhstan	67.5	99.0	73		3.037	1.525	35,40		
84	Kenya	53.8	78.1	52	i	1.438	1.279	44,50		
85	Korea, Dem. People's Rep. of	71.6	95.0	75		4.058	g,h	469	31,60	
86	Kuwait	75.4	78.6	58		23.848	11.450	-		
87	Kyrgyzstan	67.9	97.0	f	73	c	1.927	18.224	40,50	
88	Lao People's Dem. Rep.	52.2	56.6	50	i	2.571	g	321	37,00	
89	Latvia	68.0	99.0	67		3.273	378	32,40		
90	Lebanon	69.3	92.0	75		4.977	g,h	2.003	-	
91	Lesotho	58.1	71.3	56	i	1.290	3.510	63,20		
92	Libyan Arab Jamahiriya	64.3	76.2	90	i	6.309	766	-		
93	Lithuania	70.2	99.0	f	70	c	3.843	5.251	32,40	
94	Luxembourg	76.1	99.0	58	c,i	34.004	1.786	26,90		
95	Macedonia, FYR	71.9	94.0	60	c	4.058	g,h	46.896	28,20	
96	Madagascar	57.6	45.8	m	31		673	2.259	46,00	
97	Malawi	41.0	56.4	76	i	773	215	50,30		
98	Malaysia	71.4	83.5	61		9.572	134	48,50		
99	Maldives	63.3	93.2	71		3.540	4.285	-		
100	Mali	47.0	31.0	18	i	565	1.529	50,50		
101	Malta	76.5	91.0	f	76	c	13.316	g,h	305	-
102	Mauritania	52.5	37.7	38		1.622	9.563	38,90		
103	Mauritius	70.9	82.9	61	i	13.294	614	-		
104	Mexico	72.1	89.6	67	i	6.769	3.577	54,60		
105	Moldova, Rep. Of	67.8	98.9	d	67	c	1.547	e	2.974	40,60
106	Mongolia	64.8	82.9	53		3.916	403	33,20		
107	Morocco	65.7	43.7	48		3.477	589	39,50		
108	Mozambique	46.3	40.1	25		959	1.299	39,60		
109	Myanmar	58.9	83.1	48		1.130	g,h	148	-	
110	Namibia	55.8	76.0	f	83		4.054	180	70,70	
111	Nepal	55.9	27.5	56	i	1.145	2.209	36,70		
112	Netherlands	77.5	99.0	91	c	19.876	199	32,60		
113	New Zealand	76.6	99.0	94	c	17.267	27.504	36,20		
114	Nicaragua	67.5	65.7	64	i	1.837	g	15.617	50,30	
115	Niger	47.5	13.6	15	i	765	603	50,50		

116	Nigeria	51.4	57.1	49	i	1.270	175	50,60		
117	Norway	77.6	99.0	92	c	22.427	247	25,80		
118	Oman	70.3	59.0	f	60	9.383	6.191	-		
119	Pakistan	62.8	37.8	41		2.209	637	31,20		
120	Panama	73.4	90.8	72		6.258	3.146	48,50		
121	Papua New Guinea	56.8	72.2	37		2.500	900	50,90		
122	Paraguay	69.1	92.1	63		3.583	1.698	59,10		
123	Peru	67.7	88.7	79		3.940	2.142	46,20		
124	Philippines	67.0	94.6	80		2.762	1.110	46,20		
125	Poland	71.1	99.0	79	c	5.442	3.551	32,90		
126	Portugal	74.8	89.6	d	81	c	12.674	11.239	35,60	
127	Qatar	71.1	79.4	71	i	19.772	g	15.930	-	
128	Romania	69.6	98.0	f	62	c	4.431	1.564	28,20	
129	Russian Federation	65.5	99.0	f	78	c	4.531	2.647	48,70	
130	Saint Kitts and Nevis	69.0	f	90.0	f	78	10.150	5.082	-	
131	Saint Lucia	71.0	f	82.0	f	74	6.530	g	3.511	42,60
132	Saint Vincent	72.0	f	82.0	f	78	5.969	g	2.236	-
133	Samoa (Western)	68.0	98.0	f	74	2.948	g	1.151	-	
134	Sao Tome and Principe	69.0	f	75.0	l	57	1.744	g,h	718	-
135	Saudi Arabia	70.7	63.0	f	57	8.516	7.915	-		
136	Senegal	50.3	33.1	33		1.815	573	41,30		
137	Seychelles	72.0	f	88.0	f	61	7.697	g	6.468	-
138	Sierra Leone	34.7	31.4	30	i	625	246	62,90		
139	Singapore	77.1	91.1	68	i	22.604	24.746	42,50		
140	Slovakia	70.9	99.0	72	c	7.320	k	3.692	25,80	
141	Slovenia	73.2	96.0	74		10.594	k	10.559	26,80	
142	Solomon Islands	71.1	62.0	f	47	2.230	988	59,30		
143	South Africa	64.1	81.8	81		4.334	3.572	59,30		
144	Spain	77.7	97.1	d	90	c	14.789	15.061	32,50	
145	Sri Lanka	72.5	90.2	67	i	3.408	731	34,40		
146	Sudan	52.2	46.1	32		1.110	381	-		
147	Suriname	70.9	93.0	71		4.862	1.653	-		
148	Swaziland	58.8	76.7	77		2.954	1.507	60,90		
149	Sweden	78.4	99.0	82	c	19.297	28.069	25,00		
150	Switzerland	78.2	99.0	76	c	24.881	45.546	33,10		
151	Syrian Arab Rep.	68.1	70.8	62		5.374	909	-		
152	Tajikistan	66.9	99.0	f	69	c	943	262	34,70	
153	Tanzania, U. Rep. of	50.6	67.8	33		636	177	38,20		
154	Thailand	69.5	93.8	55		7.742	2.873	41,40		
155	Togo	50.5	51.7	60	i	1.167	283	-		
156	Trinidad and Tobago	73.1	97.9	65	i	9.437	3.810	40,30		
157	Tunisia	68.7	66.7	69		5.261	1.915	41,70		
158	Turkey	68.5	82.3	60	i	5.516	2.731	41,50		

159	Turkmenistan	64.9	98.0 f	90 c	2.345 k	526	40,80
160	Uganda	40.5	61.8	38 i	1.483	282	37,40
161	Ukraine	68.5	98.0 f	76 c	2.361	937	32,50
162	United Arab Emirates	74.4	79.2	69 i	18.008 g,h	18.344	-
163	United Kingdom	76.8	99.0	86 c	19.302	19.612	36,10
164	Uruguay	72.7	97.3	76	6.854	26.927	40,80
165	USA	76.4	99.0	96 c	26.977	5.902	42,30
166	Uzbekistan	67.5	99.0 f	73 c	2.376	586	33,30
167	Vanuatu	66.3	64.0 f	52 i	2.507 g	1.267	-
168	Venezuela	72.3	91.1	67 i	8.090	3.307	48,80
169	VietNam	66.4	93.7	55	1.236 g,h	283	36,10
170	Yemen	56.7	38.0 l	49 i	856 g,h	321	39,50
171	Zambia	42.7	78.2	52 i	986	349	49,80
172	Zimbabwe	48.9	85.1	69	2.135	577	56,80

Source of data: **United Nations Human Development Report 1997** unless otherwise is noted:

a. Data from United Nations. Not from Human Development Reports.

b. Data from World Bank. For a part of the countries no GINI index have been constructed around 1995.

c. Carried over from UNDP 1997

d. UNESCO 1998

e. UNECE 1996

f. UNICEF 1998

g. Preliminary update of the Penn World Tables using an expanded set of international comparisons

h. Provisional

i. First- or second-level data, or both, have been estimated by UNESCO

j. Most students in secondary and higher education pursue their studies in nearby countries

k. OECD 1997

l. World Bank 1997

m. Human Development Report Office estimated based on national sources

n. Capped at 100

o. A maximum of 99.0 is applied by Human Development Report Office

## Appendix F: Countries and data (2005)

Country	Life expectancy at birth (years) 2005	Adult literacy rate (% aged 15 and above) 2005 <sup>a</sup>	Combined gross enrolment ratio for primary, secondary and tertiary education (%) 2005	GDP per capita (PPP US\$) 2005	GNI per capita (US\$) 2005 <sup>b</sup>
1 Albania	76.2	98.7	69 <sup>h</sup>	5.316	2.646
2 Algeria	71.7	69.9	74 <sup>e</sup>	7.062 <sup>n</sup>	2.975
3 Angola	41.7	67.4	26 <sup>e,h</sup>	2.335 <sup>n</sup>	1.667
4 Antigua and Barbuda	73.9 <sup>h,p</sup>	85.8 <sup>q</sup>	76 <sup>r</sup>	12.500 <sup>h</sup>	10.052
5 Argentina	74.8	97.2	90 <sup>h</sup>	14.280	4.568
6 Armenia	71.7	99,0 <sup>d</sup>	71	4.945	1.571
7 Australia	80.9	99,0 <sup>d</sup>	100 <sup>g</sup>	31.794	34.914
8 Austria	79.4	99,0 <sup>d</sup>	92	33.700	36.415
9 Azerbaijan	67.1	98.8	67	5.016	1.405
10 Bahamas	72.3	95.8 <sup>j</sup>	71	18.380 <sup>h</sup>	17.838
11 Bahrain	75.2	86.5	86	21.482	18.000
12 Bangladesh	63.1	47.5	56 <sup>h</sup>	2.053	395
13 Barbados	76.6	99,0 <sup>d,j</sup>	89 <sup>h</sup>	17.297 <sup>h,m</sup>	10.146
14 Belarus	68.7	99,0 <sup>d</sup>	89	7.918	3.090
15 Belgium	78.8	99,0 <sup>d</sup>	95	32.119	36.315
16 Belize	75.9	75.1 <sup>q</sup>	82 <sup>e</sup>	7.109	3.600
17 Benin	55.4	34.7	51 <sup>e</sup>	1.141	502
18 Bhutan	64.7	47,0 <sup>v</sup>	52 <sup>r</sup>	3.413 <sup>h,z</sup>	1.293
19 Bolivia	64.7	86.7	86 <sup>e,h</sup>	2.819	1.008
20 Botswana	48.1	81.2	70 <sup>e</sup>	12.387	4.445
21 Brazil	71.7	88.6	88 <sup>h</sup>	8.402	4.586
22 Brunei Darussalam	76.7	92.7	78	28.161 <sup>h,m</sup>	25.497
23 Bulgaria	72.7	98.2	82	9.032	3.543
24 Burkina Faso	51.4	23.6	29	1.213 <sup>n</sup>	392
25 Burundi	48.5	59.3	38 <sup>e</sup>	699 <sup>n</sup>	97
26 Cambodia	58,0	73.6	60 <sup>e</sup>	2.727 <sup>n</sup>	386
27 Cameroon	49.8	67.9	62 <sup>e</sup>	2.299	947
28 Canada	80.3	99,0 <sup>d</sup>	99 <sup>e,h</sup>	33.375	34.537

29	Cape Verde	71,0	81.2	l	66	5.803	n	1.919
30	Central African Rep.	43.7	48.6		30	1.224	e,h n	322
31	Chad	50.4	25.7		38	1.427	e n	326
32	Chile	78.3	95.7		83	12.027		6.615
33	China	72.5	90.9		69	6.757	e u	1.747
34	Colombia	72.3	92.8		75	7.304	n	2.611
35	Comoros	64.1	56.8	j	46	1.993	e n	475
36	Congo	54,0	84.7	l	51	1.262	e	1.343
37	Congo, Dem. Rep. of the	45.8	67.2		34	714	e,h n	114
38	Costa Rica	78.5	94.9		73	10.180	e n	4.434
39	Coted'Ivoire	47.4	48.7		40	1.648	e,h	893
40	Croatia	75.3	98.1		74	13.042	h	8.273
41	Cuba	77.7	99,0	d	88	6.000	o	4.009
42	Cyprus	79,0	96.8		78	22.699	e h	21.569
43	CzechRep.	75.9	99,0	d	83	20.538		11.637
44	Denmark	77.9	99,0	d	100	33.973	g	48.180
45	Djibouti	53.9	70.3	j	25	2.178	n	920
46	Dominica	75.6	88,0	h,q	81	6.393	e h	4.024
47	Dominican Rep.	71.5	87,0		74	8.217	e,h n	3.591
48	Ecuador	74.7	91,0		75	4.341	r	2.698
49	Egypt	70.7	71.4		77	4.337	e	1.370
50	El Salvador	71.3	80.6	l	70	5.255	n	2.474
51	Equatorial Guinea	50.4	87,0		58	7.874	e,h h,n	4.796
52	Eritrea	56.6	60.5	j	35	1.109	e n	249
53	Estonia	71.2	99,0	d	92	15.478		9.967
54	Ethiopia	51.8	35.9		42	1.055	e n	144
55	Fiji	68.3	94.4	j	75	6.049	e	3.672
56	Finland	78.9	99,0	d	100	32.153	g	37.405
57	France	80.2	99,0	d	97	30.386		34.286
58	Gabon	56.2	84,0	l	72	6.954	e,h	5.282
59	Gambia	58.8	42.5	j	50	1.921	e,h n	276
60	Georgia	70.7	99,0	d,v	76	3.365		1.454
61	Germany	79.1	99,0	d	88	29.461	e	34.079
62	Ghana	59.1	57.9		51	2.480	e n	468
63	Greece	78.9	96,0		99	23.381		21.805
64	Grenada	68.2	96,0	q	73	7.843	e h	4.563
65	Guatemala	69.7	69.1		67	4.568	e n	2.115
66	Guinea	54.8	29.5		45	2.316	e	356
67	Guinea-Bissau	45.8	44.8	j	37	827	e,h n	158

68	Guyana	65.2	99,0	j	85	4.508	n	1.089
69	Haiti	59.5	54.8	j	53	1.663	n	426
70	Honduras	69.4	80,0		71	3.430	n	1.361
71	HongKong, China	81.9	94.6	j	76	34.833		25.228
72	Hungary	72.9	99,0	d,j	89	17.887		10.310
73	Iceland	81.5	99,0	d	95	36.510		52.921
74	India	63.7	61,0		64	3.452	n	708
75	Indonesia	69.7	90.4		68	3.843		1.203
76	Iran, Islamic Rep. of	70.2	82.4		73	7.968		2.715
77	Ireland	78.4	99,0	d	100	38.505		41.279
78	Israel	80.3	97.1	k	90	25.864		19.373
79	Italy	80.3	98.4		91	28.529		30.044
80	Jamaica	72.2	79.9		78	4.291	e	3.317
81	Japan	82.3	99,0	d	86	31.267		36.433
82	Jordan	71.9	91.1		78	5.530		2.330
83	Kazakhstan	65.9	99,0	d	94	7.857		3.403
84	Kenya	52.1	73.6		61	1.240	e	523
85	Korea, Dem. People's Rep. of	77.9	99,0	d	96	22.029		16.508
86	Kuwait	77.3	93.3		75	26.321	n	34.330
87	Kyrgyzstan	65.6	98.7		78	1.927		457
88	Lao People's Dem. Rep.	63.2	68.7		62	2.039		460
89	Latvia	72,0	99,0	d	90	13.646		6.881
90	Lebanon	71.5	88.3	j	85	5.584		5.487
91	Lesotho	42.6	82.2		66	3.335	n	873
92	Libyan Arab Jamahiriya	73.4	84.2	l	94	10.335	e,h	7.186
93	Lithuania	72.5	99,0	d	91	14.494		7.393
94	Luxembourg	78.4	99,0	d	85	60.228	i	68.110
95	Macedonia, FYR	73.8	96.1		70	7.200		2.804
96	Madagascar	58.4	70.7		60	923	e	266
97	Malawi	46.3	64.1		63	667	e	154
98	Malaysia	73.7	88.7		74	10.882	h	5.131
99	Maldives	67,0	96.3		66	5.261	e	2.417
100	Mali	53.1	24,0		37	1.033		452
101	Malta	79.1	87.9		81	19.189		14.032
102	Mauritania	63.2	51.2		46	2.234	n	646
103	Mauritius	72.4	84.3		75	12.715	e	5.056
104	Mexico	75.6	91.6		76	10.751		7.245
105	Moldova, Rep. Of	68.4	99,0	d,l	70	2.100	e	875
106	Mongolia	65.9	97.8		77	2.107		926

107	Morocco	70.4	52.3	59	e	4.555		1.885
108	Mozambique	42.8	38.7	53		1.242	n	304
109	Myanmar	60.8	89.9	50	e	1.027	h,y	249
110	Namibia	51.6	85,0	65	e	7.586	n	3.036
111	Nepal	62.6	48.6	58	e	1.550		281
112	Netherlands	79.2	99,0	98		32.684		39.009
113	New Zealand	79.8	99,0	100	g	24.996		25.020
114	Nicaragua	71.9	76.7	71	e	3.674	n	865
115	Niger	55.8	28.7	23		781	n	250
116	Nigeria	46.5	69.1	56	e	1.128		747
117	Norway	79.8	99,0	99		41.420	f	65.555
118	Oman	75,0	81.4	67		15.602	h	11.553
119	Pakistan	64.6	49.9	40	e	2.370		823
120	Panama	75.1	91.9	80		7.605		4.341
121	Papua New Guinea	56.9	57.3	41	e,h	2.563	n	621
122	Paraguay	71.3	93.5	69	e,h	4.642	n	1.252
123	Peru	70.7	87.9	86	e	6.039		2.727
124	Philippines	71,0	92.6	81		5.137		1.263
125	Poland	75.2	99,0	87		13.847		7.687
126	Portugal	77.7	93.8	90		20.410		17.237
127	Qatar	75,0	89,0	78		27.664	h,m	51.564
128	Romania	71.9	97.3	77		9.060		4.438
129	Russian Federation	65,0	99,0	89	e	10.845		5.177
130	Saint Kitts and Nevis	70,0	97.8	73	e	13.307	h	8.217
131	Saint Lucia	73.1	94.8	75		6.707	h	5.085
132	Saint Vincent	71.1	88.1	69		6.568		3.525
133	Samoa (Western)	70.8	98.6	74	e	6.170		2.181
134	Sao Tome and Principe	64.9	84.9	65		2.178		712
135	Saudi Arabia	72.2	82.9	76		15.711	n	13.480
136	Senegal	62.3	39.3	40	e	1.792		733
137	Seychelles	72.7	91.8	82	e	16.106		7.980
138	Sierra Leone	41.8	34.8	45	h	806		259
139	Singapore	79.4	92.5	87	h,k	29.663		25.172
140	Slovakia	74.2	99,0	78		15.871		8.579
141	Slovenia	77.4	99,0	94		22.273		17.415
142	Solomon Islands	63,0	76.6	48		2.031	n	793
143	South Africa	50.8	82.4	77	h	11.110	n	4.952
144	Spain	80.5	99,0	98		27.169		25.667
145	Sri Lanka	71.6	90.7	63	e,h	4.595		1.254



146	Sudan	57.4	60.9	aa	37	e	2.083	n	917
147	Suriname	69.6	89.6		77	e	7.722		3.787
148	Swaziland	40.9	79.6		60	e	4.824		2.291
149	Sweden	80.5	99.0	d	95		32.525		40.435
150	Switzerland	81.3	99.0	d	86		35.633		54.877
151	Syrian Arab Rep.	73.6	80.8		65	e	3.808		1.361
152	Tajikistan	66.3	99.0	d	71		1.356		451
153	Tanzania, U. Rep. of	51.0	69.4		50	e	744		330
154	Thailand	69.6	92.6		71	e	8.677		2.664
155	Togo	57.8	53.2		55	e	1.506	n	339
156	Trinidad and Tobago	69.2	98.4	l	65	e	14.603		10.981
157	Tunisia	73.5	74.3		76		8.371		2.712
158	Turkey	71.4	87.4		69	e	8.407		4.961
159	Turkmenistan	62.6	98.8		73	r	3.838	h	1.115
160	Uganda	49.7	66.8		63	e	1.454	n	310
161	Ukraine	67.7	99.0	d	87		6.848		1.815
162	United Arab Emirates	78.3	88.7	l	60	e,h	25.514	n	30.553
163	United Kingdom	79.0	99.0	d	93	e	33.238		37.988
164	Uruguay	77.9	99.0	d	93		41.890	f	41.486
165	USA	75.9	96.8		89	e,h	9.962		4.832
166	Uzbekistan	66.8	99.0	d,j	74	e,h	2.063		539
167	Vanuatu	69.3	74.0		63	e	3.225	n	1.593
168	Venezuela	73.2	93.0		76	e,h	6.632		5.362
169	VietNam	73.7	90.3		64		3.071		610
170	Yemen	61.5	54.1	l	55		930		723
171	Zambia	40.5	68.0		61	e	1.023		580
172	Zimbabwe	40.9	89.4	l	52	e,h	2.038		171

Source of data: **United Nations Human Development Report 1997** unless otherwise is noted:

a. Data refer to national literacy estimates from censuses or surveys

b. Data from United Nations. Not from Human Development Reports.

d. For purposes of calculating the HDI, a value of 99.0% was applied

e. National or UNESCO Institute for Statistics estimate.

f. For purposes of calculating the HDI, a value of 40,000 (PPP US\$) was applied.

g. For purposes of calculating the HDI, a value of 100% was applied.

h. Data refer to a year other than that specified.

i. Statec 2006. Data refer to nationals enrolled both in the country and abroad and thus differ from the standard definition.

j. UNESCO Institute for Statistics 2003

k. Data are from national sources.

l. UNESCO Institute for Statistics 2007

m. Heston, Summers and Aten 2006. Data differ from the standard definition.

n. World Bank estimate based on regression.

- o. Efforts to produce a more accurate estimate are ongoing. A preliminary estimate of 6,000 (PPPUS\$) was used.*
- p. Data are from the Secretariat of the Organization of Eastern Caribbean States, based on national sources.*
- q. Data are from the Secretariat of the Caribbean Community, based on national sources.*
- s. UNDP 2007.*
- t. World Bank 2006.*
- u. World Bank estimate based on a bilateral comparison between China and the United States.*
- v. UNICEF 2004.*
- w. Data refer to 18 of the 25 states of the country only.*
- x. In the absence of an estimate of GDP per capita (PPP US\$), the HDRO estimate of 2,056 (PPP US\$) was used, derived from the value of GDP in US\$ and the weighted average ratio of PPP US\$ to US\$ in the Arab States.*
- y. Heston, Summers and Aten 2001. Data differ from the standard definition.*
- z. In the absence of an estimate of GDP per capita (PPP US\$), the HDRO estimate of 3,413 (PPP US\$) was used, derived from the value of GDP per capita in PPP US\$ estimated by Heston, Summers and Aten 2006 adjusted to reflect the latest population estimates from UN 2007e.*
- aa. Data refer to North Sudan only.*
- ab. UNDP 2006.*
- ac. For the purposes of calculating the HDI, a national estimate of 1,033 (PPP US\$) was used.*

**Annex G: Results per country with data of 1995**

Country	HDI-0 Rank	HDI-0 rank minus HDI-GNI rank	HDI-0 rank minus HDI-94 rank	HDI-0 rank minus HDI-IAI rank	HDI-0 rank minus HDI-0708 rank	HDI-0 rank minus HDI-DIM rank	Mean deviation	Standard deviation
<b>Upper class</b>								
Equatorial Guinea	134	1	1	c	1	-1	0,50	1,00
Lao People's Dem. Rep.	135	-5	1	-2	-1	-1	-1,60	2,53
Pakistan	136	18	0	0	-1	-1	3,20	8,07
India	137	-1	0	2	2	3	1,20	1,90
Comoros	138	1	-1	c	-1	-1	-0,50	1,00
Cambodia	139	-17	1	0	1	1	-2,80	7,64
Nigeria	140	-18	0	0	0	0	-3,60	8,05
Benin	141	-6	-2	c	-3	-1	-3,00	3,54
Zambia	142	0	-2	0	0	-4	-1,20	2,00
Bangladesh	143	-5	-2	0	0	0	-1,40	2,41
Cote d'Ivoire	144	27	-2	-2	-2	0	4,20	12,17
Central African Rep.	145	0	-8	-6	-6	-4	-4,80	5,51
Mauritania	146	26	-1	-3	-2	1	4,20	11,76
<b>Middle class</b>								
Togo	147	-5	5	c	6	6	3,00	5,52
Angola	148	-2	-6	c	-10	-8	-6,50	7,14
Uganda	149	-6	-9	-5	-7	-9	-7,20	7,38
Bhutan	150	20	-2	c	-2	0	4,00	10,10
Tanzania, U. Rep. Of	151	-15	3	4	2	0	-1,20	7,13
Sudan	152	13	-3	c	-2	0	2,00	6,75
Djibouti	153	43	-7	c	-7	-6	5,75	22,27
Senegal	154	28	-2	-4	-5	-3	2,80	12,95
Haiti	155	4	-2	c	0	2	1,00	2,45
Chad	156	-6	-5	c	-5	-4	-5,00	5,05
Congo Dem. Rep.	157	-15	16	c	12	2	3,75	12,54
Madagascar	158	-3	7	3	5	4	3,20	4,65
Yemen	159	13	10	6	12	12	10,60	10,89
<b>Lowest class</b>								
Nepal	160	-3	10	4	10	12	6,60	8,59
Guinea-Bissau	161	-3	-1	-1	-1	-2	-1,60	1,79
Mozambique	162	-7	-2	-2	-2	-2	-3,00	3,61

Guinea	163	34	-2	-2	-2	-2	5,20	15,31
Malawi	164	-6	5	6	7	3	3,00	5,57
Gambia	165	22	2	2	2	3	6,20	10,05
Eritrea	166	6	0	c	0	0	1,50	3,00
Burundi	167	-1	-1	-1	-1	0	-0,80	0,89
Ethiopia	168	-3	1	1	1	0	0,00	1,55
Mali	169	20	0	0	0	0	4,00	8,94
Burkina Faso	170	16	0	0	0	0	3,20	7,16
Niger	171	4	0	0	0	0	0,80	1,79
Sierra Leone	172	13	0	0	0	0	2,60	5,81

a. A positive figure indicates that the alternative HDI rank is better than the HDI-0 rank

b. Since Gini-coefficients are involved in HDI-IAI and for some countries no Gini-coefficients could be found, this alternative could not rank all lowest developed countries.

c. For this country no Gini-coefficient is available, therefore this country in this research could not be ranked in HDI-IAI.

**Annex H: Results per country with data of 2005**

Country	HDI-0 Rank	HDI-0 rank minus HDI-GNI rank	HDI-0 rank minus HDI-94 rank	HDI-0 rank minus HDI-0708 rank	HDI-0 rank minus HDI-DIM rank	Mean absolute deviation	Standard deviation
<b>Upper Class</b>							
Kenya	134	-7	-9	-11	-12	-9,75	9,94
Pakistan	135	6	-2	2	1	1,75	3,35
Mauritania	136	0	-2	1	3	0,50	1,87
Yemen	137	4	-13	-12	-12	-8,25	10,87
Ghana	138	-6	5	6	6	2,75	5,77
Sudan	139	15	-5	-5	-1	1,00	8,31
Bhutan	140	27	9	10	11	14,25	16,05
Zimbabwe	141	-26	2	-6	-12	-10,50	14,66
Eritrea	142	-23	-13	-11	-10	-14,25	15,16
Haiti	143	-6	-3	0	4	-1,25	3,91
Nepal	144	-16	-1	5	7	-1,25	9,10
Bangladesh	145	-5	5	7	10	4,25	7,05
Tanzania (United Republic of)	146	-9	-8	-9	-9	-8,75	8,76
<b>Middle Class</b>							
Papua New Guinea	147	10	5	5	11	7,75	8,23
Lesotho	148	21	18	14	3	14,00	15,57
Cameroon	149	28	13	8	8	14,25	16,44
Togo	150	-4	1	2	6	1,25	3,77
Uganda	151	-7	3	1	1	-0,50	3,87
Swaziland	152	55	26	15	5	25,25	31,43
Nigeria	153	22	1	-1	-1	5,25	11,03
Senegal	154	22	1	2	3	7,00	11,16
Congo Dem. Rep. of the	155	-16	-6	-8	-9	-9,75	10,45
Gambia	156	-5	5	5	8	3,25	5,89
Malawi	157	-12	0	-2	-3	-4,25	6,26
Burundi	158	-14	-5	-4	-4	-6,75	7,95
Angola	159	55	3	2	1	15,25	27,56
<b>Lowest class</b>							
Zambia	160	21	2	0	-1	5,50	10,56

Benin	161	19	-1	3	4	6,25	9,84
Côte d'Ivoire	162	37	2	1	3	10,75	18,59
Ethiopia	163	-7	-1	-1	0	-2,25	3,57
Niger	164	0	-6	-5	-6	-4,25	4,92
Guinea	165	12	6	9	9	9,00	9,25
Central African Republic	166	9	0	0	0	2,25	4,50
Guinea-Bissau	167	-1	0	-3	-2	-1,50	1,87
Mali	168	21	-1	0	0	5,00	10,51
Chad	169	13	1	4	4	5,50	7,11
Burkina Faso	170	19	-1	-1	-1	4,00	9,54
Mozambique	171	12	6	4	4	6,50	7,28
Sierra Leone	172	9	0	0	0	2,25	4,50