

**AN ALTERNATIVE APPROACH FOR ESTIMATING
HUMAN DEVELOPMENT INDEX**

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ABSTRACT

This paper presents an alternative methodology for estimating Human Development Index (HDI) which bridges the gap between the methods of computing HDI proposed by the United Nations Development Programme (UNDP) in 1990 and 1994 and uses unadjusted Per Capita Real Gross Domestic Product (PCRGDP). Empirical exercise highlights the technical superiority of the proposed method.

Key words: *Human Development Index (HDI), Alternative Human Development Index (AHDI), Fixed goal posts, Moving goal posts, D^2 - statistics.*

JEL Numbers : *I310, O110, and O570.*

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Introduction :

Human development Index (HDI) was introduced by the United Nations Development Programme (UNDP) in 1990 to represent three essential choices of the people “.... For the people to lead a long and healthy life, to acquire knowledge and to have access to resources needed for a decent standard of living” (UNDP, 1990, p.10). Longevity is measured by life expectancy at birth, knowledge is represented by a measure of educational achievement based on a sum of adult literacy rate and mean years of schooling and access to resources is measured by an adjusted real purchasing power parity gross domestic product per capita.

For the first four years UNDP used the maximum and the minimum values of the data series to standardize the variables. In 1994 the procedure of standardization was modified with the introduction of arbitrary fixed minimum and maximum values for each variable. Both methods have their merits and demerits. The present study proposes an alternative measure of estimating HDI which bridges the gap between the methods of computing HDI proposed by the UNDP in 1990 and 1994.

Methods Used by the UNDP for Construction of HDI :

During the first four years 1990 to 1993 the HDI was estimated by the UNDP in the following method. The maximum and minimum values for each of the three variables are determined from the actual data set for each year. The deprivation

measure (**I_{ij}**) then places a country (**j**) in the range of zero to one for each year for each variable (**i**). The deprivation index **I_{ij}** is estimated as :

$$I_{ij} = \frac{\max X_i - X_{ij}}{\max X_i - \min X_i}$$

Where,

X_{ij} is the value attained by the **j**th country in **i**th variable

maxX_i is the maximum value in the data series **i**

minX_i is the minimum value in the data series **i**.

The average deprivation indicator (**I_j**) for country **j** is obtained by taking a simple average of the three indicators :

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

The HDI is obtained by one minus **I_j**, i.e.

$$HDI = 1 - I_j$$

In 1994 Human Development Report it was noted : “ This scaling could produce a frustrating outcome, since a country might improve its performance on life expectancy or educational attainment but see its HDI score fall because the top or

bottom countries have done even better - in effect moving the goal posts” (HDR 1994, p.92). To take this point into account and to facilitate the individual country comparisons over time since 1994 the HDI for the **jth** country has been calculated employing the following formula :

$$\text{HDI} = (1/3) \sum_{i=1}^3 \left[\frac{\mathbf{X}_{ij} - \mathbf{MinF}_i}{\mathbf{MaxF}_i - \mathbf{MinF}_i} \right]$$

Where,

X_{ij} is the actual value of component **i** for country **j**

MinF_i is the minimum value fixed for the **ith** variable

MaxF_i is the maximum value fixed for the variable.

The values set for different indicators by the UNDP were as follows :

	Min	Max
Life expectancy	25 years	85 years
Adult literacy	0%	100%
Mean years of schooling	0%	15years
Combined enrollment ratio	0%	100%
Per capita income	PPP \$ 200	PPP \$ 40,000

The new method of fixed goal posts in the estimation of HDI facilitates the comparison of HDI trends for individual countries over time. But over the years ‘goal posts’ are moving for the world as a whole. For example, in 1960 minimum adult literacy attained was 5% and the maximum adult literacy attained was

recorded as 100% while in 1998 the minimum adult literacy achieved was found to be 14.7% and the maximum adult literacy observed was 100%. The range has changed significantly. The order of ranks of the countries in the case of the moving goal posts method and in case of the fixed goal posts method remains same, but a country's achievement of 20% literacy rate in the world situation where the minimum literacy rate is 0 significantly differs from a world condition with 14.7% minimum literacy level.

Moreover, UNDP's HDI is estimated with adjusted GDP per capita figure. The adjustment in HDI calculations is meant to discount high incomes that, allegedly, contribute insignificantly to human development. The discounting exponent in this adjustment is one sliding scale, becoming more and more severe the higher one gets above the threshold. This severely compresses the scale at higher levels, i.e. for the high incomes of most industrial and other well-off countries - going from the threshold income of PPP\$ 5835 to an income of PPP\$ 40,000 (~50% greater than the US per capita GDP in 1994) only contributes a utility-adjusted income of PPP \$319. Beyond the compression of a part of income range, the choice of the average global income starts losing utility is puzzling. In reality, the application of the GDP adjusted artificially depresses the relative affluence for wealthy nations so that the gap between the rich and poor countries seems much narrower than it actually is. Moreover, if we accept the view of the UNDP that human development is about 'expanding people's choices', we have to agree with Trabold-Nubler (1991, pp. 239-240), that, 'it is quite difficult to ascertain why additional income does not enlarge people's choices'. In fact, income has cross certain threshold to trade it for human development.

The New Approach :

This study offers an alternative measure for estimating HDI based on Professor Mahalanobis' D^2 statistics. It proposes the distance between the standardized actual values of the indicators and the standardized targeted values of the indicators as a measure of HDI. This, in fact, gives an idea that how far a country is away from the minimum World level and how far a country is from the target. The proposed measure of human development index might be labeled as *an Alternative Approach to Human Development Index or AHDI*. The detailed methodology is as follows:

Let the sample countries in a year are on an Euclidean multidimensional space. The well-being of a country represented by a vector X having n attributes and each x_{ij} stands for the attainment level of country j in attribute i . The lower and the upper bounds of attribute i are $x_{i\min}$ and $x_{i\max}$ respectively. That is, each $x_i \in [x_{i\min}, x_{i\max}]$ is a subject of the real line \mathbf{R}^1 . We assume $x_{i\min} < x_{i\max}$. If $x_{i\min} = x_{i\max}$, then the interval is a unit set ($x_{i\min}$).

Let us define an indicator I_i which is a real valued function I and which is associated with a value $I(x_i, x_{i\min}, x_{i\max})$ to each $x_i \in [x_{i\min}, x_{i\max}]$.

The i th indicator for j th country in period t is measured as :

$$I_{ijt} = \frac{X_{ijt} - X_{it\min}}{X_{it\max} - X_{it\min}} \quad \text{for each } t$$

I_{ijt} is characterized by the following properties :

(i) $1 \geq I_{ijt} \geq 0$, for all i, j, t

(ii) $I_{ijt} = 0$, if $x_{ij} = x_{imin}$

(iii) $I_{ijt} = 1$, if $x_{ij} = x_{imax}$

For each country j , for each period t , we have a vector $I_{jt} = I_{jt} (I_{1jt}, I_{2jt}, \dots, I_{njt})$.

Let X^* is a vector which comprises of the ideal values or targeted values for n attributes. That is, $X^* = X^* (x^*_1, x^*_2, \dots, x^*_n)$.

An ideal indicator corresponding to an attribute x_i for period t is :

$$I_{it}^* = \frac{x_i^* - x_{itmin}}{x_{itmax} - x_{itmin}}$$

Where,

x_i^* is the targeted value of the i th attribute

x_{itmin} is the minimum value attained by the i th attribute in year t

x_{itmax} is the maximum value attained by the i th attribute in year t .

I_{it}^* refers to an ideal value of the indicator in context of period t .

The properties of I_{it}^* are :

(i) $1 \geq I_{it}^* \geq 0$ for all i, t

(ii) $I_{it}^* > 1$, if $x_i^* > x_{itmax}$ for all i, t

(iii) $I_{it}^* < 1$, if $x_i^* < x_{itmax}$ for all i, t

Corresponding to an ideal vector $X^* = X^* (x_i^*, \dots, x_n^*)$ we have an ideal vector of indicator $I_i^* = I_i^* (I_{1t}^*, \dots, I_{nt}^*)$ for each t .

The distance between I_t^* and each I_{jt} is measured by

$$D_{jt} = \sqrt{\sum_{i=1}^n (I_{it}^* - I_{ijt})^2}$$

This could be written as :

$$D_{jt} = \sqrt{\sum_{i=1}^n [1 - (I_{ijt} / I_{it}^*)]^2}$$

Where D_{jt} represents the distance of a country j from the ideal vector in year t .

D_{jt} might be considered as the alternative deprivation index which is a function of the actual values of the time t for country j , the lower bounds and the upper bounds of the attributes for the same period of time and the target values of the attributes i.e.

$$D_{jt} = D_{jt} (X_{1jt}, X_{2jt}, \dots, X_{njt} ; X_{1tmax}, X_{2tmax}, \dots, X_{ntmax} ; X_{1tmin}, X_{2tmin}, \dots, X_{ntmin} ; X_1^*, X_2^*, \dots, X_n^*)$$

In this context, it is to be noted, that, as in the case of HDI the components of this index are treated as having equal weights. Application of the Principal Component Analysis supported this approach.

Rescaling of D by the following formula provides an alternative measure for the HDI :

$$RD_{jt} = 1 - \left(\frac{D_{jt} - D_{tmin}}{D_{tmax} - D_{tmin}} \right)$$

Where,

RD_{jt} denotes the rescaled D_{jt}

D_{jt} is the distance between country j and the ideal vector

D_{tmin} is the minimum value of D at time t ,

D_{tmax} is the maximum value of D at time t

RD_{jt} has the following properties :

- (i) $0 < RD_{jt} < 1$ for all i and all t
- (ii) $RD_{jt} = 0$, the country j has achieved the lowest level of human development in period t .
- (iii) $RD_{jt} = 1$, the country j has achieved the highest level of human development in period t .
- (iv) Lower the value of RD_{jt} , lower the level of development of the j th country.
- (v) Higher the value of RD_{jt} , higher the level of development of the j th country.

Empirical Tests :

Spearman's rank correlation coefficients between the rankings by the HDI and AHDI for 174 countries appearing in the Human Development Report 2000 as well as three development zones (High Human Development (HHD) zone, Medium Human Development (MHD) zone and Low Human Development (LHD) zone) and for the top 20% group the bottom 20% group evidence significant similarities between the two ranking orders (see Table I).

As is evident from Table II the global mean of AHDI is lesser than that of HDI, which seems to be more realistic. Moreover, the mean value of AHDI is above that of HDI for the HHD while those values are lower than the AHDI for the MHD and LHD. The standard deviations obtained for the AHDI are higher than those estimated for the HDI for all types of samples, indicating that the countries are more dispersed than observed in HDI.

Table III portrays that the global average estimated for AHDI is lesser than that for the HDI. It also pictures that the average AHDI is lesser than the average HDI for the bottom 20% and that is higher for the top 20%. In this context it is worthy to note that the average world HDI of 0.8115 obtained from the UNDP's HDI seems unduly optimistic. Second, comparing the performance of the top and the bottom quintiles, the narrow gap portrayed by the HDI seems equally fanciful in a world where these bottom 20%' survive on less than the equivalent of \$ 1 a day' (UNDP, 1997 p.5).

Concluding Remarks :

The present study proposes an alternative method of estimating the HDI. This modification improves the technical quality of the index if one intends to measure improvements in the human development over time for a country in the context of, and relative to, what has happened in the rest of the world. The degree of similarity in ranking to the HDI and AHDI was high for all countries while it differed to some extent among the groups indicating some differences in ranking results of these indices of human development. Growing disparity in income has overshadowed the gains in education and health. But the UNDP estimate hides this disparity behind 'utility adjustment'. The proposed alternative brings forth this disparity by pointing stark differences in the average values between the top 20% and the bottom 20% groups.

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Table I

Spearman's Rank Correlation Coefficients between AHDI and HDI

Sample	Global	HHDC	MHDC	LHDC	Top 20%	Bott 20%
1	2	3	4	5	6	7
Coeff.	0.9963	0.9708	0.9784	0.9857	0.8774	0.9886

Table II

Descriptive Statistics of AHDI and HDI

	Mean		St. Dev.	
	AHDI	HDI	AHDI	HDI
1	2	3	4	5
Global	0.614	0.687	0.256	0.175
High Dev	0.898	0.870	0.069	0.054
Middle Dev	0.621	0.691	0.117	0.082
Low Dev	0.216	0.406	0.089	0.615

Table III

Average Human Development Index

Sample	AHDI	HDI
1	2	3
Global	0.7295	0.8115
Top 20%	0.9733	0.9221
Bottom 20%	0.2633	0.4369

Corollary :

AHDI could be used to see the improvements and degradation of countries over two points of time.

Let $X_{jt} = X_{jt}(X_{1jt}, X_{2jt}, \dots, X_{njt})$ and $X_{j(t+1)} = X_{j(t+1)}(X_{1j(t+1)}, X_{2j(t+1)}, \dots, X_{nj(t+1)})$ represent the j th country in period t and period $(t+1)$. $X^* = X^*(X_1^*, X_2^*, \dots, X_n^*)$ is the common ideal vector. The corresponding distances are D_{jt} and $D_{j(t+1)}$. The change of position of j th country over the two periods t and $(t+1)$ is presented by

$$G_{jt, (t+1)} = D_{j(t+1)} - D_{jt}$$

G holds the properties as follows:

- (i) $G_{jt, (t+1)}$ lies between $-\infty$ and $+\infty$ for any pair of t and $(t+1)$
- (ii) $G_{jt, (t+1)} > 0$ implies the position of the j th country has deteriorated over the period t and $(t+1)$.
- (iii) $G_{jt, (t+1)} < 0$ implies the position of the j th country has improved over the period t and $(t+1)$.