

# Human Development Surface: An Alternative Approach to Measure Human Progress

Aalok Ranjan Chaurasia  
Ravendra Singh

## Abstract

This paper proposes an alternative approach for the construction of human development index which is based on the concept of human development surface. The proposed index is the weighted average of the power mean of the order  $\frac{1}{2}$  of the health index, education index and the income index which are used to construct the human development index by the United Nations and address problems associated with constructing the index using arithmetic mean or geometric mean as the aggregation function. The level of human development across countries based on the alternative human development index is found to be similar to that obtained by the conventional human development index. The decomposition of the increase in the index between 1990 and 2021 suggests that progress in the education index has been the main driver of human progress in the world during the last 30 years whereas the contribution of the progress in the health dimension and income dimension has been small.

## Introduction

The Human Development Index (*HDI*) is the most widely used index to measure and monitor human progress across the globe. Introduced by the United Nations in 1990, it is a response to the need of a measure that could better represent human progress in several basic capabilities than the conventional income-based measures (Kelly, 1991; Anand and Sen, 1994; Haq, 1995). It is the only index of human progress which is available on an annual basis since 1990 to chart the progress in human well-being. Although, the method of constructing the index has evolved over time, yet its basic conceptualization has remained unchanged since 1990 (Kovacevic, 2010; Chaurasia, 2013). The *HDI* has been successful in changing the way people think about development. The *HDI* and its three components serve as a report card of human progress. A high rank in *HDI* is used as a means of aggrandisement whereas a low rank is used to highlight development insufficiencies. The index has also been used to measure the impact of economic policies on the quality of life (Davis and Quinlivan, 2006). *HDI* is now a universal yardstick to measure and compare human progress across

countries and within countries. The popularity of *HDI* lies in its simplicity in characterising development and to its underlying message that development is much more than economic growth.

Despite its popularity as a standard yardstick for measuring and comparing human progress, *HDI* has widely been criticised primarily on the grounds of both conceptual foundation and method of construction. A comprehensive review of the criticism of *HDI* is given elsewhere (Kovacevic, 2010; Klugman et al, 2011). A major concern in the construction of *HDI* has been the selection of the aggregation function to combine the indexes of the three dimensions of human development. Initially, the simple arithmetic mean was used to construct *HDI* but, since 2010, geometric mean is being used which embodies imperfect substitutability across different dimensions of *HDI* (United Nations, 2010). However, concerns about the appropriateness of the geometric mean to construct the *HDI* have been raised in a recent paper and it is recommended that simple arithmetic mean should be used in place of geometric mean to construct *HDI* (Anand, 2018). Another technical criticism of *HDI* relates to the implied trade-offs across the three dimensions of human development used to construct *HDI*. The magnitude of this trade-offs depends upon the aggregation function (Ghislandi et al, 2019). It is also observed that the three dimensions of human development are highly correlated and, therefore, *HDI* may not reveal more than what is revealed by its individual dimensions (Ghislandi et al, 2019). Another point of discord is the relative importance given to the three dimensions of human development in the construction of *HDI*. Currently, all the three dimensions of human development are given equal importance in the construction of *HDI*. It may, however, be argued that from the perspective of human progress, more importance should be accorded to that dimension in which the progress is lagging compared to that dimension in which the progress is advanced in the construction of *HDI*.

Selection of the aggregation function to combine indexes of the three dimensions of human development into *HDI* is arbitrary and many alternatives have been proposed including arithmetic mean and the geometric mean. One alternative is to use the power mean or the generalised mean (Bullen, 2003). The use of power mean ensures that as the progress in any one dimension of human development advances, its relative importance in deciding *HDI* diminishes. Anand and Sen (1995, 1997) have recommended use of the power mean for the construction of the gender-sensitive development index and the human poverty index. One limitation of the power mean, however, is that there is inescapable arbitrariness in the selection of the power of the mean (Anand and Sen, 1997). Sagar and Najam (1998), on the other hand, have suggested the multiplicative aggregation function while Mishra and Nathan (2013) have proposed additive inverse of normalised Euclidean distance from the ideal for combining the indexes of different dimensions of human development into *HDI*. It may, however, be noted that the choice of the aggregation function has an influence on the value of the *HDI*, although, the upper and lower limits of *HDI* remain invariant. Using the same values of the three indexes that constitute *HDI*, the value of *HDI* is the highest when simple arithmetic mean is used as the aggregation function and the lowest when

the multiplicative aggregation function is used. When the geometric mean is used as the aggregation function, the value of *HDI* is lower than when simple arithmetic mean is used as the aggregation function but higher than when the multiplicative aggregation function is used. When the power of the generalised mean is used as the aggregation function, the value of *HDI* depends upon the power of the mean. There is, however, a degree of arbitrariness in selecting the power of the mean.

Alternatively, the three dimensions of human development can be represented on a plain to constitute the human development surface and then connecting the levels attained in each of the three dimensions by straight lines produces the human development triangle. The surface area of the triangle can be calculated to give a dimensionless, abstract mathematical expression of human development that encompasses progress in all the three dimensions of human development and may be termed as the 'surface measure of human development.' This approach of measuring human development has many advantages. First, it helps in the visualization of the progress in the three dimensions of human development which are interrelated. Second, the surface of the human development triangle may be perceived as an illustration of the human progress. Third, the change in human development between two points of time can be decomposed into the change in the progress in its three dimensions and the change in the surface area of the human development triangle reflects the overall human progress independently of countervailing effects of different dimensions of human development that might possibly have taken place. Fourth, the shape of the human development triangle and the surface area of the triangle can be used for comparisons across countries or regions.

In this paper, we develop an alternative index which is based on the concept of human development surface discussed above. The index, to be termed as *H* is based on the same three basic dimensions of human development – health, education, income - which have been used for the construction of *HDI* by the United Nations. We also compute the index *H* for 191 countries of the world for which *HDI* has been constructed by the United Nations and compare the index *H* with *HDI*. Our analysis shows that, although, the rank in the index *H* and the rank in *HDI* is the same in most of the countries, yet, there are many countries in which the rank in *H* is found to be different than the rank in *HDI*.

The paper is organised as follows. The next section of the paper describes the construction of the index *H*. Section three presents estimates of the index *HDS* along with estimates of *H* for the world, for selected regions of the world and for 191 countries for which estimates of *HDI*. Section four decomposes the change in the index *HDS* during the period 1990 through 2021 into the change attributed to health, education, and income to explore how progress in the three basic dimensions of human development - health, education and income has contributed to overall human progress as measured by the index *H*. The last section of the paper summarises the findings of the analysis along with the recommendation of using the concept of human development surface in measuring and monitoring human progress.

## Surface Measure of Human Development

Figure 1 depicts the conceptual basis for the construction of the surface measure of human development. The three dimensions of human development – health, education, and income – are presented on a plane. All the three dimensions range from 0 to 1 and the level attained in health dimension ( $h$ ), the level attained in education dimension ( $e$ ), and the level attained in the income dimension ( $i$ ) are linked by straight lines to constitute the human development triangle. This conceptualisation suggests that the surface area of the human development triangle or a suitable transformation of it may serve as the surface measure of human development.

It may be seen from the figure 1 that human development triangle comprises of three sub-triangles, one constituted by dimensions of education and health, the other by dimensions of health and income, and the third by the dimensions of income and education. All the three triangles have the same vertex and the angle at the vertex is the same for all three sub-triangles. This means that the area,  $A$ , of the human development triangle may be calculated as

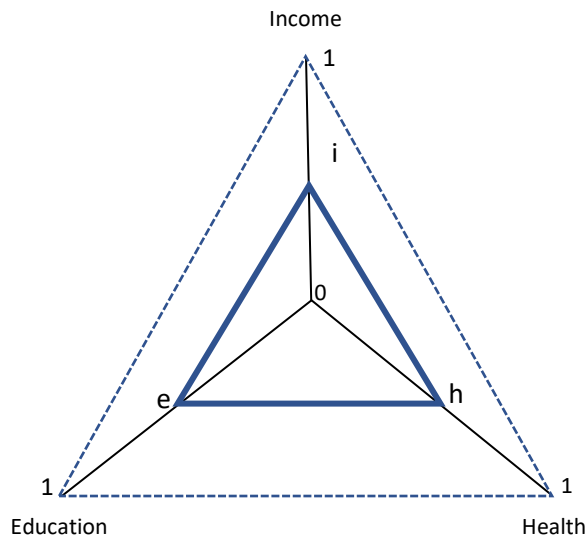


Figure 1: The human development triangle

$$A = \frac{h * e * \sin(360^\circ/3)}{2} + \frac{e * i * \sin(360^\circ/3)}{2} + \frac{i * h * \sin(360^\circ/3)}{2} \quad (1)$$

$$A = \frac{1}{2} (h * e + e * i + i * h) * \sin(360^\circ/3) \quad (2)$$

When  $h=e=i=0$ ,  $A=0$ . When  $h=e=i=1$ , the area of the human development triangle is the maximum and is given by

$$A_{max} = \frac{1*1*\sin(360^\circ/3)}{2} + \frac{1*1*\sin(360^\circ/3)}{2} + \frac{1*1*\sin(360^\circ/3)}{2} = \frac{3}{2}\sin(360^\circ/3) \quad (3)$$

Dividing (2) by (3), the normalised area of human development triangle,  $A_n$ , which varies between 0 (minimum) to 1 (maximum) is given by

$$A_n = \frac{A}{A_{max}} = \frac{\frac{1}{2}(h*e+e*i+i*h)*\sin(360^\circ/3)}{\frac{3}{2}\sin(360^\circ/3)} = \frac{(h*e+e*i+i*h)}{3} \quad (4)$$

The normalised area of the human development triangle,  $A_n$ , can be used as an index of human development. However, the problem in using  $A_n$  is that the progress scale based on  $A_n$  is concave, not linear. With the increase in the three indexes that constitute  $A_n$ , the increase in  $A_n$  also increases. For example, when  $h=e=i=0.200$ ,  $A_n=0.040$  and when  $h=e=i=0.300$ ,  $A_n=0.090$  which means that an improvement of 0.100 in each of the three indexes leads to an increase of 0.050 in  $A_n$ , in absolute terms. However, when  $h=e=i=0.700$ ,  $A_n=0.490$  and when  $h=e=i=0.800$ ,  $A_n=0.640$  so that the same improvement of 0.100 in each of the three indexes leads to an increase of 0.150 in the index  $A_n$ .

This problem associated with  $A_n$  can be addressed by using the positive square root of three indexes  $h$ ,  $e$ , and  $i$ . This transformation also gives more weight to that dimension of human development in which the progress lags comparative to that dimension in which the progress is advanced. The alternative human development index,  $H$ , may now be defined as

$$H = \frac{(\sqrt{h*e})+(\sqrt{e*i})+(\sqrt{i*h})}{3} \quad (5)$$

Notice that the index  $H$  may also be written as

$$H = h^{1/2} * \omega_h + e^{1/2} * \omega_e + i^{1/2} * \omega_i \quad (6)$$

where

$$\omega_h = \frac{(\sqrt{e}+\sqrt{i})}{6} \quad (7)$$

$$\omega_e = \frac{(\sqrt{h}+\sqrt{i})}{6} \quad (8)$$

$$\omega_i = \frac{(\sqrt{h}+\sqrt{e})}{6} \quad (9)$$

Equation (6) shows that the index  $H$  is the weighted power mean of the health index ( $h$ ), education index ( $i$ ), and the income index ( $e$ ) with power of the mean equal to (1/2) as recommended by Anand and Sen (1997). The weights assigned to different dimensions of human development in the construction of the index  $H$  are data driven and dynamic and are different for different population. For example, the weight assigned to health index ( $h$ ) is determined by the level attained in the dimension of education and in the dimension of income. This means that the construction of the index  $H$  also takes into account the association that exists between different

dimensions of human development. Considering the association between different dimensions of human development is important as this association may vary from population to population. It is also obvious that when the level attained in the three dimensions of human development is the same or when  $h=e=i$ , then  $H$  is the simple arithmetic mean of the three indexes. This means that the difference between the maximum of the three index and the index  $H$  depicts the inequality in the level attained in the three dimensions of human development.

The change in the index  $H$  between two points of time can be decomposed in terms of the change in its three components. It follows from equation (5) that

$$H_2 - H_1 = \frac{\sqrt{h_2 * e_2} + \sqrt{e_2 * i_2} + \sqrt{i_2 * h_2}}{3} - \frac{\sqrt{h_1 * e_1} + \sqrt{e_1 * i_1} + \sqrt{i_1 * h_1}}{3} \quad (10)$$

$$H_2 - H_1 = \frac{1}{3} \{ \sqrt{h_2 * e_2} - \sqrt{h_1 * e_1} \} + \frac{1}{3} \{ \sqrt{e_2 * i_2} - \sqrt{e_1 * i_1} \} + \frac{1}{3} \{ \sqrt{i_2 * h_2} - \sqrt{i_1 * h_1} \} \quad (11)$$

Now, following Kitagawa (1955)

$$\sqrt{h_2 * e_2} - \sqrt{h_1 * e_1} = \frac{1}{2} (\sqrt{h_2} - \sqrt{h_1}) * (\sqrt{e_2} + \sqrt{e_1}) + \frac{1}{2} (\sqrt{e_2} - \sqrt{e_1}) * (\sqrt{h_2} + \sqrt{h_1}) \quad (12)$$

$$\sqrt{e_2 * i_2} - \sqrt{e_1 * i_1} = \frac{1}{2} (\sqrt{e_2} - \sqrt{e_1}) * (\sqrt{i_2} + \sqrt{i_1}) + \frac{1}{2} (\sqrt{i_2} - \sqrt{i_1}) * (\sqrt{e_2} + \sqrt{e_1}) \quad (13)$$

$$\sqrt{i_2 * h_2} - \sqrt{i_1 * h_1} = \frac{1}{2} (\sqrt{i_2} - \sqrt{i_1}) * (\sqrt{h_2} + \sqrt{h_1}) + \frac{1}{2} (\sqrt{h_2} - \sqrt{h_1}) * (\sqrt{i_2} + \sqrt{i_1}) \quad (14)$$

Substituting from (12), (13) and (14) into (11) and rearranging, we get

$$H_2 - H_1 = \frac{1}{6} (\sqrt{h_2} - \sqrt{h_1}) * \{ (\sqrt{e_1} + \sqrt{e_2}) + (\sqrt{i_1} + \sqrt{i_2}) \} + \frac{1}{6} (\sqrt{h_2} + \sqrt{h_1}) * \{ (\sqrt{e_1} - \sqrt{e_2}) + (\sqrt{i_1} + \sqrt{i_2}) \} + \frac{1}{6} (\sqrt{h_2} + \sqrt{h_1}) * \{ (\sqrt{e_1} + \sqrt{e_2}) + (\sqrt{i_1} - \sqrt{i_2}) \} \quad (15)$$

or

$$H_2 - H_1 = (h_2 - h_1) * v_h + (e_2 - e_1) * v_e + (i_2 - i_1) * v_i \quad (16)$$

where

$$v_h = \frac{1}{6} \left\{ \left( \frac{\sqrt{e_1} + \sqrt{e_2}}{\sqrt{h_1} + \sqrt{h_2}} \right) + \left( \frac{\sqrt{i_1} + \sqrt{i_2}}{\sqrt{h_1} + \sqrt{h_2}} \right) \right\} \quad (17)$$

$$v_e = \frac{1}{6} \left\{ \left( \frac{\sqrt{h_1} + \sqrt{h_2}}{\sqrt{e_1} + \sqrt{e_2}} \right) + \left( \frac{\sqrt{i_1} + \sqrt{i_2}}{\sqrt{e_1} + \sqrt{e_2}} \right) \right\} \quad (18)$$

$$v_i = \frac{1}{6} \left\{ \left( \frac{\sqrt{e_1} + \sqrt{e_2}}{\sqrt{i_1} + \sqrt{i_2}} \right) + \left( \frac{\sqrt{h_1} + \sqrt{h_2}}{\sqrt{i_1} + \sqrt{i_2}} \right) \right\} \quad (19)$$

Equation (16) shows that the difference in the index  $H$  between two points in time is the weighted sum of the difference in the health index ( $h$ ), in the education index ( $e$ ), and in the income index ( $i$ ) with the weights for one index determined by the value of the other two indexes. When the three index are the same or when  $h=e=i$ , the difference in the index  $H$  between two points in time is nothing but the simple arithmetic mean of the difference between two points in time in the three indexes respectively.

## Human Development Across Countries

We have calculated the index  $H$  for the world, for groups of countries with very high, high, medium, and low level of human development as classified by the United Nations, for different regions of the world as classified by United Nations, and for each country using the same values of the health index ( $h$ ), the education index ( $e$ ), and the income index ( $i$ ) that have been used by the United Nations to calculate  $HDI$ . Table 1 presents estimates of  $HDI$  and the index  $H$  for the world and for different groups of countries and regions for the year 1990 and 2021 along with the summary measures of the inter-country variation in both indexes and the distribution of countries according to the level of human development. It may be seen from the table that the index  $H$  is higher than  $HDI$  in the world and in all groups of countries and regions of the world. However, the increase in the index  $H$  between 1990 and 2021 is more sedate than the increase in  $HDI$ . For example, in the Arab states, the  $HDI$  increased by 0.153 absolute points between 1990 and 2021, but the index  $H$  increased by only 0.148 absolute points. In Sub-Saharan Africa, on the other hand,  $HDI$  increased by 0.140 absolute points, but index  $H$  increased by 0.138 absolute points. It is obvious from the table that the selection of the aggregation function has an impact not only on the level of human development reflected by the composite index but also on the progress in human development. When the association between the three dimensions of human development is taken into consideration, the progress in human development (increase in the index  $H$ ) appears to be slower than the progress in human development when the three indexes are treated independently of each other (increase in  $HDI$ ). It is also clear that the difference in the level and the difference in the progress in human development based on the two indexes are different in different regions or groups of countries.

The index  $H$  and  $HDI$  are different in all the 191 countries for which  $HDI$  is estimated by the United Nations and in all countries, index  $H$  is higher than  $HDI$  (Table 2). However, the difference between the two indexes varies across countries. In Iceland, there is virtually no difference between the index  $H$  and  $HDI$ , although, the index  $H$  is marginally higher than  $HDI$  whereas this difference is the widest in Niger in the year 2021. The ranking of countries by the index  $H$  is also different from the ranking of countries by  $HDI$ , although, in most of the countries, the rank in index  $H$  is the same as the rank in  $HDI$  in the year 2021. There are, however, 40 countries where the rank in the index  $H$  in the year 2021 is not the same as the rank in  $HDI$ . In 21 of these countries, the rank in the index  $H$  is better than the rank in  $HDI$ , but in 19 countries, the rank in index  $H$  is poorer than the rank in  $HDI$ . On the other hand, the progress in human development during the period 1990 through 2021 as reflected by the increase in the index  $H$  is comparatively slower than the progress reflected by the increase in  $HDI$  in all but 13 countries. In these 13 countries, the progress in human development as reflected by the increase in the index  $H$  has been faster than the progress reflected by the increase in  $HDI$  between 1990 and 2021. There is no country where the progress in human development as reflected by the index  $H$  is the same as reflected by  $HDI$ .

Table 1: Estimates of the index  $H$ , and  $HDI$  for the world, for different groups of countries and for selected regions, 1990 and 2021.

World/Region	$HDI$		Index $H$	
	1990	2021	1990	2021
World	0.601	0.732	0.604	0.733
Countries with very high human development ( $HDI \geq 0.800$ )	0.784	0.896	0.785	0.896
Countries with high human development ( $0.700 \leq HDI < 0.800$ )	0.557	0.754	0.561	0.755
Countries with medium human development ( $0.550 \leq HDI < 0.800$ )	0.453	0.636	0.457	0.636
Countries with low human development ( $HDI < 0.550$ )	0.356	0.518	0.363	0.520
Regions				
Arab states	0.555	0.708	0.560	0.709
East Asia and Pacific	0.507	0.749	0.511	0.751
Europe and Central Asia	0.664	0.796	0.665	0.796
Latin America and the Caribbean	0.633	0.754	0.636	0.754
South Asia	0.442	0.632	0.446	0.633
Sub-Saharan Africa	0.407	0.547	0.410	0.547
Summary measures of inter-country distribution				
Minimum	0.216	0.385	0.230	0.388
Q1	0.479	0.599	0.483	0.601
Median	0.627	0.739	0.629	0.739
Q3	0.728	0.835	0.730	0.836
Maximum	0.872	0.962	0.872	0.962
IQR	0.248	0.236	0.247	0.235
Frequency distribution				
Countries with very high human development ( $HDI \geq 0.800$ )	16	66	16	66
Countries with high human development ( $0.700 \leq HDI < 0.800$ )	31	49	31	49
Countries with medium human development ( $0.550 \leq HDI < 0.800$ )	46	44	46	45
Countries with low human development ( $HDI < 0.550$ )	49	32	49	31
N	142	191	142	191

Source: Estimates of  $HDI$  are from United Nations database. Estimates of the index  $H$  are author's calculations.



Table 2: Estimates of *HDI* and index *H* for 191 countries, 1990 and 2021 and the increase in the two indexes between 1990 and 2021.

Country	<i>HDI</i>		Index <i>H</i>		Increase in	
	1990	2021	1990	2021	<i>HDI</i>	Index <i>H</i>
Afghanistan	0.273	0.478	0.291	0.480	0.205	0.190
Angola	na	0.586	na	0.586	na	na
Albania	0.647	0.796	0.649	0.797	0.150	0.148
Andorra	na	0.858	na	0.859	na	na
United Arab Emirates	0.728	0.911	0.737	0.911	0.183	0.174
Argentina	0.723	0.842	0.724	0.842	0.119	0.118
Armenia	0.656	0.759	0.657	0.760	0.103	0.103
Antigua and Barbuda	na	0.788	na	0.789	na	na
Australia	0.865	0.951	0.865	0.951	0.085	0.086
Austria	0.825	0.916	0.826	0.916	0.090	0.090
Azerbaijan	na	0.745	na	0.745	na	na
Burundi	0.290	0.426	0.295	0.431	0.137	0.137
Belgium	0.816	0.937	0.817	0.937	0.121	0.120
Benin	0.359	0.525	0.368	0.526	0.166	0.158
Burkina Faso	na	0.449	na	0.452	na	na
Bangladesh	0.397	0.661	0.401	0.662	0.264	0.261
Bulgaria	0.684	0.795	0.686	0.795	0.111	0.109
Bahrain	0.742	0.875	0.747	0.875	0.133	0.129
Bahamas	na	0.812	na	0.812	na	na
Bosnia and Herzegovina	na	0.780	na	0.780	na	na
Belarus	na	0.808	na	0.808	na	na
Belize	0.593	0.683	0.597	0.684	0.090	0.087
Bolivia (Plurinational State of)	0.550	0.692	0.550	0.692	0.142	0.142
Brazil	0.610	0.754	0.613	0.754	0.144	0.141
Barbados	0.725	0.790	0.726	0.790	0.064	0.064
Brunei Darussalam	0.770	0.829	0.775	0.831	0.059	0.056
Bhutan	na	0.666	na	0.668	na	na
Botswana	0.586	0.693	0.587	0.694	0.107	0.106
Central African Republic	0.338	0.404	0.342	0.405	0.066	0.063
Canada	0.860	0.936	0.860	0.936	0.077	0.076
Switzerland	0.851	0.962	0.853	0.962	0.111	0.110
Chile	0.706	0.855	0.707	0.855	0.149	0.148
China	0.484	0.768	0.489	0.770	0.284	0.281
Cote D'Ivoire	0.427	0.550	0.430	0.551	0.124	0.122
Cameroon	0.452	0.576	0.455	0.577	0.124	0.121
Congo (Democratic Republic of the)	0.386	0.479	0.387	0.481	0.093	0.094
Congo	0.522	0.571	0.523	0.572	0.049	0.049
Colombia	0.610	0.752	0.614	0.752	0.142	0.139
Comoros	na	0.558	na	0.560	na	na
Cabo Verde	na	0.662	na	0.664	na	na

Country	HDI		Index <i>H</i>		Increase in	
	1990	2021	1990	2021	HDI	Index <i>H</i>
Costa Rica	0.660	0.809	0.665	0.809	0.148	0.144
Cuba	0.680	0.764	0.682	0.765	0.083	0.083
Cyprus	0.716	0.896	0.719	0.896	0.180	0.176
Czechia	0.742	0.889	0.744	0.889	0.147	0.146
Germany	0.829	0.942	0.829	0.942	0.113	0.113
Djibouti	na	0.509	na	0.515	na	na
Dominica	na	0.720	na	0.721	na	na
Denmark	0.834	0.948	0.835	0.948	0.114	0.113
Dominican Republic	0.577	0.767	0.580	0.768	0.191	0.187
Algeria	0.591	0.745	0.596	0.747	0.154	0.151
Ecuador	0.651	0.740	0.652	0.740	0.089	0.088
Egypt	0.572	0.731	0.574	0.731	0.159	0.157
Eritrea	na	0.492	na	0.497	na	na
Spain	0.757	0.905	0.760	0.905	0.148	0.146
Estonia	0.732	0.890	0.733	0.890	0.158	0.158
Ethiopia	na	0.498	na	0.502	na	na
Finland	0.814	0.940	0.815	0.940	0.126	0.125
Fiji	0.642	0.730	0.643	0.731	0.088	0.088
France	0.791	0.903	0.793	0.903	0.112	0.110
Micronesia (Federated States of)	na	0.628	na	0.629	na	na
Gabon	0.610	0.706	0.613	0.706	0.096	0.093
United Kingdom	0.804	0.929	0.805	0.929	0.124	0.123
Georgia	na	0.802	na	0.802	na	na
Ghana	0.460	0.632	0.461	0.632	0.172	0.171
Guinea	0.269	0.465	0.282	0.468	0.195	0.186
Gambia	0.343	0.500	0.353	0.503	0.157	0.150
Guinea-Bissau	na	0.483	na	0.485	na	na
Equatorial Guinea	na	0.596	na	0.598	na	na
Greece	0.759	0.887	0.762	0.887	0.128	0.125
Grenada	na	0.795	na	0.795	na	na
Guatemala	0.484	0.627	0.492	0.630	0.144	0.138
Guyana	0.509	0.714	0.511	0.715	0.205	0.204
Hong Kong, China (SAR)	0.788	0.952	0.790	0.952	0.164	0.163
Honduras	0.516	0.621	0.521	0.623	0.105	0.102
Croatia	na	0.858	na	0.858	na	na
Haiti	0.429	0.535	0.433	0.536	0.106	0.103
Hungary	0.720	0.846	0.721	0.846	0.126	0.125
Indonesia	0.526	0.705	0.529	0.705	0.179	0.176
India	0.434	0.633	0.437	0.634	0.199	0.197
Ireland	0.737	0.945	0.740	0.946	0.208	0.205
Iran (Islamic Republic of)	0.601	0.774	0.603	0.774	0.173	0.171
Iraq	0.528	0.686	0.531	0.687	0.159	0.156

Country	HDI		Index <i>H</i>		Increase in	
	1990	2021	1990	2021	HDI	Index <i>H</i>
Iceland	0.811	0.959	0.812	0.959	0.148	0.147
Israel	0.787	0.919	0.788	0.919	0.132	0.131
Italy	0.778	0.895	0.781	0.895	0.116	0.114
Jamaica	0.659	0.709	0.662	0.709	0.050	0.048
Jordan	0.622	0.720	0.625	0.721	0.098	0.097
Japan	0.845	0.925	0.846	0.925	0.080	0.079
Kazakhstan	0.673	0.811	0.674	0.811	0.138	0.137
Kenya	0.474	0.575	0.478	0.575	0.101	0.097
Kyrgyzstan	0.638	0.692	0.638	0.693	0.054	0.055
Cambodia	0.378	0.593	0.382	0.596	0.215	0.214
Kiribati	na	0.624	na	0.625	na	na
Saint Kitts and Nevis	na	0.777	na	0.778	na	na
Korea (Republic of)	0.737	0.925	0.738	0.925	0.187	0.187
Kuwait	0.718	0.831	0.725	0.833	0.112	0.108
Lao People's Democratic Republic	0.405	0.607	0.408	0.610	0.202	0.202
Lebanon	na	0.706	na	0.708	na	na
Liberia	na	0.481	na	0.483	na	na
Libya	0.666	0.718	0.668	0.720	0.053	0.051
Saint Lucia	0.690	0.715	0.691	0.716	0.025	0.025
Liechtenstein	na	0.935	na	0.936	na	na
Sri Lanka	0.636	0.782	0.639	0.782	0.145	0.144
Lesotho	0.479	0.514	0.481	0.514	0.035	0.033
Lithuania	0.734	0.875	0.734	0.875	0.141	0.140
Luxembourg	0.786	0.930	0.791	0.930	0.144	0.140
Latvia	0.730	0.863	0.730	0.863	0.134	0.133
Morocco	0.447	0.683	0.458	0.684	0.235	0.227
Moldova (Republic of)	0.653	0.767	0.656	0.767	0.114	0.111
Madagascar	na	0.501	na	0.505	na	na
Maldives	na	0.747	na	0.750	na	na
Mexico	0.662	0.758	0.665	0.758	0.096	0.093
Marshall Islands	na	0.639	na	0.640	na	na
North Macedonia	na	0.770	na	0.770	na	na
Mali	0.237	0.428	0.256	0.433	0.191	0.177
Malta	0.730	0.918	0.733	0.918	0.188	0.185
Myanmar	0.333	0.585	0.338	0.586	0.252	0.248
Montenegro	na	0.832	na	0.832	na	na
Mongolia	0.579	0.739	0.579	0.739	0.160	0.160
Mozambique	0.238	0.446	0.242	0.448	0.208	0.207
Mauritania	0.397	0.556	0.414	0.559	0.159	0.145
Mauritius	0.626	0.802	0.629	0.802	0.176	0.173
Malawi	0.303	0.512	0.304	0.515	0.209	0.210
Malaysia	0.640	0.803	0.644	0.803	0.163	0.159

Country	HDI		Index <i>H</i>		Increase in	
	1990	2021	1990	2021	HDI	Index <i>H</i>
Namibia	0.579	0.615	0.581	0.615	0.036	0.035
Niger	0.216	0.400	0.230	0.407	0.185	0.177
Nigeria	na	0.535	na	0.535	na	na
Nicaragua	0.490	0.667	0.494	0.669	0.177	0.175
Netherlands	0.847	0.941	0.847	0.941	0.094	0.094
Norway	0.838	0.961	0.838	0.961	0.123	0.123
Nepal	0.399	0.602	0.403	0.603	0.202	0.201
New Zealand	0.806	0.937	0.806	0.937	0.131	0.131
Oman	na	0.816	na	0.816	na	na
Pakistan	0.400	0.544	0.412	0.548	0.144	0.136
Panama	0.669	0.805	0.671	0.806	0.137	0.135
Peru	0.621	0.762	0.621	0.762	0.142	0.141
Philippines	0.598	0.699	0.599	0.699	0.101	0.100
Palau	na	0.767	na	0.767	na	na
Papua New Guinea	0.370	0.558	0.383	0.560	0.187	0.177
Poland	0.716	0.876	0.717	0.876	0.160	0.160
Portugal	0.701	0.866	0.706	0.866	0.165	0.160
Paraguay	0.595	0.717	0.599	0.718	0.123	0.119
Palestine, State of	na	0.715	na	0.716	na	na
Qatar	0.758	0.855	0.764	0.857	0.097	0.094
Romania	0.703	0.821	0.704	0.821	0.118	0.118
Russian Federation	0.743	0.822	0.744	0.823	0.079	0.079
Rwanda	0.319	0.534	0.322	0.537	0.215	0.214
Saudi Arabia	0.678	0.875	0.686	0.875	0.197	0.189
Sudan	0.336	0.508	0.348	0.513	0.171	0.166
Senegal	0.373	0.511	0.384	0.517	0.138	0.132
Singapore	0.727	0.939	0.733	0.939	0.212	0.206
Solomon Islands	na	0.564	na	0.567	na	na
Sierra Leone	0.312	0.477	0.317	0.479	0.165	0.162
El Salvador	0.525	0.675	0.529	0.676	0.150	0.147
San Marino	na	0.853	na	0.855	na	na
Serbia	na	0.802	na	0.802	na	na
South Sudan	na	0.385	na	0.388	na	na
Sao Tome and Principe	0.485	0.618	0.488	0.619	0.134	0.132
Suriname	na	0.730	na	0.730	na	na
Slovakia	0.692	0.848	0.694	0.848	0.156	0.154
Slovenia	na	0.918	na	0.918	na	na
Sweden	0.810	0.947	0.812	0.947	0.137	0.135
Eswatini (Kingdom of)	0.545	0.597	0.548	0.597	0.052	0.049
Seychelles	na	0.785	na	0.785	na	na
Syrian Arab Republic	0.562	0.577	0.567	0.582	0.014	0.015
Chad	na	0.394	na	0.396	na	na

Country	HDI		Index <i>H</i>		Increase in	
	1990	2021	1990	2021	HDI	Index <i>H</i>
Togo	0.410	0.539	0.413	0.540	0.129	0.128
Thailand	0.576	0.800	0.582	0.801	0.224	0.219
Tajikistan	0.628	0.685	0.628	0.686	0.057	0.058
Turkmenistan	na	0.745	na	0.745	na	na
Timor-Leste	na	0.607	na	0.609	na	na
Tonga	0.645	0.745	0.645	0.746	0.100	0.100
Trinidad and Tobago	0.660	0.810	0.661	0.810	0.150	0.149
Tunisia	0.576	0.731	0.581	0.732	0.156	0.151
Turkey	0.600	0.838	0.606	0.838	0.238	0.232
Tuvalu	0.559	0.641	0.559	0.641	0.083	0.082
Tanzania (United Republic of)	0.371	0.549	0.374	0.551	0.177	0.177
Uganda	0.329	0.525	0.331	0.527	0.196	0.196
Ukraine	0.729	0.773	0.729	0.773	0.044	0.043
Uruguay	0.701	0.809	0.702	0.809	0.108	0.107
United States	0.872	0.921	0.872	0.921	0.049	0.050
Uzbekistan	na	0.727	na	0.727	na	na
Saint Vincent and the Grenadines	na	0.751	na	0.751	na	na
Venezuela (Bolivarian Republic of)	0.659	0.691	0.664	0.693	0.032	0.028
Viet Nam	0.482	0.703	0.488	0.704	0.221	0.216
Vanuatu	na	0.607	na	0.609	na	na
Samoa	na	0.707	na	0.708	na	na
Yemen	0.383	0.455	0.396	0.459	0.072	0.063
South Africa	0.632	0.713	0.633	0.714	0.081	0.080
Zambia	0.412	0.565	0.412	0.566	0.153	0.153
Zimbabwe	0.509	0.593	0.510	0.593	0.084	0.083

Source: Author

Remarks: na – Not available

## Decomposition of the Progress in Human Development

The progress in human development, during 1990-2021, as measured by the increase in the index *H* has varied widely across the countries included in the analysis. The progress could be measured in only 142 countries for which estimates of the index *H* could be calculated for both the years 1990 and 2021. In the remaining countries, data are not available to estimate the index *H* for the year 1990. These estimates suggests that the increase in the index *H* has been slowest in the Syrian Arab Republic where the index *H* increased by just 0.015 absolute points, from 0.567 in 1990 to 0.582 in 2021. In addition to the Syrian Arab Republic, there are 5 more countries where there has been virtual little progress in human development between 1990 and 2021 as the increase in the index *H*, in these countries has been less than 0.005 absolute points. On the other hand, the increase in the index *H* has been the most rapid in China where it

increased by almost 0.231 absolute points, from 0.489 in 1990 to 0.770 in 2021. In addition to China, there are 7 countries where the index  $H$  increase by at least 0.200 absolute points between 1990 and 2021.

The increase in the three dimensions that constitute the index  $H$  has also varied across countries. The health index decreased, instead increased, in 9 countries. The decrease in the index has been the most rapid in Lesotho where it decreased by almost 0.030 absolute points as the result of the decreased in the life expectancy at birth from around 59 years in 1990 to 53 years in 2021. On the other hand, the increase in the health index has been the most rapid in Malawi where the life expectancy at birth increased from around 43 years in 1990 to almost 63 years in 2021, an increase of almost 20 years. The education index did not decrease in any country during this period but the increase in the index has been the slowest in the Syrian Arab Republic but the highest in Turkey. Finally, the income index decreased in 19 countries with the decrease in the index being the most marked in the Bolivarian Republic of Venezuela whereas the increase in the index has been the most rapid in China, the most populous country of the world.

Equation (16) permits analysing how the change in the three dimensions of health, education and income that constitute the index  $H$  has contributed to the change in the index  $H$  between 1990 and 2021. Results of the decomposition analysis are presented in table 3 which suggests that the progress in human development during 1990-2021 has largely been driven by the progress in the education dimension of human welfare. For example, in the world, almost 57 per cent of the increase in the index  $H$  between 1990 and 2021 may be attributed to the increase in the education index ( $e$ ) during this period whereas the increase in the health index ( $h$ ) has accounted for an increase of almost 23 per cent in the index  $H$ . This means that the increase in the income index ( $i$ ) between 1990 and 2021 has accounted for only around 20 per cent of the increase in the index  $H$ . In all regions and all groups of countries, progress in education dimension has been the prime driver of human progress. The contribution of the increase in income to the increase in human progress has been substantial in countries having high and medium level of human development. The increase in the health index has not been a dominating contributor in any region or in any group of countries.

The contribution of the change in the three components of human development to the change in the index  $H$  has been different in countries at different level of human development, although the primary contributor has been the change in the education index ( $e$ ). In countries having at very high level of human development in 2021 ( $HDI \geq 0.800$ ), and in countries at low level of human development ( $HDI < 0.550$ ), almost 60 per cent of the increase in the index  $H$  is attributed to the increase in the index ( $e$ ). By contrast, the increase in the income index ( $i$ ) accounts for less than 20 per cent of the increase in the index  $H$  in countries at very high level of human development but only about 10 per cent in country at low level of human development. In countries at high level of human development ( $0.700 \leq HDI < 0.800$ ) and in countries at medium

level of human development ( $0.550 \leq HDI < 0.700$ ), increase in the education index accounts for only about 50 per cent of the increase in the index  $H$ , but the increase in the income index ( $i$ ) accounts for a substantial increase in the index  $H$ . In these countries, the contribution of the increase in the index ( $h$ ) to the increase in the index  $H$  is substantially lower than that in countries at very high or at low level of human development.

Table 3: Decomposition of the change in the index  $H$  between 1990 and 2021 in the world and in different groups of countries and regions.

World/Country groups/Region	Index $H$			Increase in $H$ attributed to		
	1990	2021	Increase	$h$	$e$	$i$
World	0.604	0.733	0.129	0.029	0.074	0.026
Very high human development	0.785	0.896	0.111	0.024	0.066	0.022
High human development	0.561	0.755	0.194	0.033	0.098	0.063
Medium human development	0.457	0.636	0.180	0.038	0.092	0.049
Low human development	0.363	0.520	0.157	0.048	0.093	0.017
Arab States	0.560	0.709	0.148	0.037	0.096	0.015
East Asia and the Pacific	0.511	0.751	0.239	0.036	0.103	0.100
Europe and Central Asia	0.665	0.796	0.131	0.025	0.082	0.024
Latin America and the Caribbean	0.636	0.754	0.118	0.021	0.081	0.017
South Asia	0.446	0.633	0.187	0.039	0.095	0.053
Sub-Saharan Africa	0.410	0.547	0.138	0.048	0.078	0.012

Source: Author

The contribution of the change in the three dimensions of human development to the change in the overall human development as measured in terms of the index  $H$  is different in different regions of the world. In the East Asia and Pacific region, the progress in the education dimension and the progress in the income dimension has accounted for almost 85 per cent of the progress in human development during 1990-2021 whereas the progress in the health dimension has accounted for only about 15 per cent of the progress. On the other hand, in Arab states and in Latin America and the Caribbean, around two-third of the progress in human development is accounted by the progress in the education dimension alone whereas in sub-Saharan Africa, progress in the income dimension has accounted for less than 10 per cent of the progress in human development. There is, however, no group of countries or no region of the world where the progress in the health dimension has been the main contributor to the progress in human development whereas the progress in the education dimension has been the main contributor to the progress in human development in all groups of countries irrespective of the level of human development and in all regions of the world between 1990 and 2021. The relative contribution of the change in indexes  $h$ ,  $e$ , and  $i$  to the change in the index  $H$  during 1990-2021 has also been different in different countries (Table 4). There is no country where the contribution of the increase in the income index ( $i$ ) has been more than 60 per cent of the increase in the index  $H$  whereas, there are only 3 countries where the contribution of the increase in the health index ( $h$ ) to the index  $H$  has been more than 60 per cent. By contrast, there are 78

countries where the contribution of the increase in the education index ( $e$ ) to the increase in the index  $H$  has been more than 60 per cent. The decomposition exercise confirms that, in most of the countries, the progress in human development has been driven primarily by the progress in the education dimension of human development.

Table 4: Decomposition of the increase in the index  $H$  between 1990 and 2021 into the increase attributed to the increase in the health index, education index and income index.

World/Country groups/Region	Index $H$			Increase in $H$ attributed to the increase in		
	1990	2021	Increase	$h$	$e$	$i$
Afghanistan	0.291	0.480	0.190	0.066	0.141	-0.017
Albania	0.649	0.797	0.148	0.015	0.074	0.059
United Arab Emirates	0.737	0.911	0.174	0.034	0.148	-0.008
Argentina	0.724	0.842	0.118	0.018	0.079	0.022
Armenia	0.657	0.760	0.103	0.015	0.038	0.049
Australia	0.865	0.951	0.086	0.038	0.021	0.027
Austria	0.826	0.916	0.090	0.029	0.045	0.015
Burundi	0.295	0.431	0.137	0.067	0.093	-0.023
Belgium	0.817	0.937	0.120	0.029	0.074	0.016
Benin	0.368	0.526	0.158	0.028	0.108	0.022
Bangladesh	0.401	0.662	0.261	0.069	0.126	0.065
Bulgaria	0.686	0.795	0.109	0.002	0.075	0.033
Bahrain	0.747	0.875	0.129	0.030	0.100	-0.002
Belize	0.597	0.684	0.087	-0.001	0.073	0.015
Bolivia (Plurinational State of)	0.550	0.692	0.142	0.037	0.073	0.031
Brazil	0.613	0.754	0.141	0.032	0.093	0.016
Barbados	0.726	0.790	0.064	0.023	0.047	-0.005
Brunei Darussalam	0.775	0.831	0.056	0.015	0.046	-0.004
Botswana	0.587	0.694	0.106	0.003	0.072	0.031
Central African Republic	0.342	0.405	0.063	0.018	0.060	-0.015
Canada	0.860	0.936	0.076	0.026	0.032	0.019
Switzerland	0.853	0.962	0.110	0.033	0.071	0.006
Chile	0.707	0.855	0.148	0.030	0.069	0.049
China	0.489	0.770	0.281	0.043	0.106	0.132
Cote D'Ivoire	0.430	0.551	0.122	0.028	0.065	0.029
Cameroon	0.455	0.577	0.121	0.026	0.091	0.005
Congo (Democratic Republic of the)	0.387	0.481	0.094	0.047	0.071	-0.025
Congo	0.523	0.572	0.049	0.036	0.034	-0.021
Colombia	0.614	0.752	0.139	0.019	0.090	0.029
Costa Rica	0.665	0.809	0.144	0.002	0.105	0.037
Cuba	0.682	0.765	0.083	-0.002	0.062	0.022
Cyprus	0.719	0.896	0.176	0.037	0.119	0.020



World/Country groups/Region	Index $H$			Increase in $H$ attributed to the increase in		
	1990	2021	Increase	$h$	$e$	$i$
Czechia	0.744	0.889	0.146	0.032	0.088	0.026
Germany	0.829	0.942	0.113	0.027	0.066	0.019
Denmark	0.835	0.948	0.113	0.033	0.055	0.025
Dominican Republic	0.580	0.768	0.187	0.026	0.107	0.054
Algeria	0.596	0.747	0.151	0.040	0.099	0.012
Ecuador	0.652	0.740	0.088	0.020	0.053	0.015
Egypt	0.574	0.731	0.157	0.029	0.094	0.034
Spain	0.760	0.905	0.146	0.029	0.099	0.018
Estonia	0.733	0.890	0.158	0.037	0.071	0.050
Finland	0.815	0.940	0.125	0.035	0.072	0.017
Fiji	0.643	0.731	0.088	0.008	0.071	0.008
France	0.793	0.903	0.110	0.027	0.068	0.015
Gabon	0.613	0.706	0.093	0.028	0.075	-0.010
United Kingdom	0.805	0.929	0.123	0.025	0.080	0.019
Ghana	0.461	0.632	0.171	0.038	0.088	0.045
Guinea	0.282	0.468	0.186	0.049	0.112	0.025
Gambia	0.353	0.503	0.150	0.045	0.106	-0.001
Greece	0.762	0.887	0.125	0.013	0.103	0.008
Guatemala	0.492	0.630	0.138	0.029	0.087	0.022
Guyana	0.511	0.715	0.204	0.015	0.070	0.119
Hong Kong, China (SAR)	0.790	0.952	0.163	0.036	0.086	0.040
Honduras	0.521	0.623	0.102	0.021	0.064	0.017
Haiti	0.433	0.536	0.103	0.046	0.068	-0.010
Hungary	0.721	0.846	0.125	0.026	0.071	0.028
Indonesia	0.529	0.705	0.176	0.020	0.106	0.049
India	0.437	0.634	0.197	0.037	0.093	0.066
Ireland	0.740	0.946	0.205	0.035	0.115	0.055
Iran (Islamic Republic of)	0.603	0.774	0.171	0.045	0.106	0.020
Iraq	0.531	0.687	0.156	0.056	0.085	0.015
Iceland	0.812	0.959	0.147	0.022	0.097	0.028
Israel	0.788	0.919	0.131	0.025	0.072	0.035
Italy	0.781	0.895	0.114	0.028	0.078	0.008
Jamaica	0.662	0.709	0.048	-0.008	0.052	0.004
Jordan	0.625	0.721	0.097	0.020	0.063	0.014
Japan	0.846	0.925	0.079	0.028	0.042	0.009
Kazakhstan	0.674	0.811	0.137	0.023	0.087	0.027
Kenya	0.478	0.575	0.097	0.013	0.072	0.013
Kyrgyzstan	0.638	0.693	0.055	0.027	0.034	-0.007
Cambodia	0.382	0.596	0.214	0.058	0.081	0.075
Korea (Republic of)	0.738	0.925	0.187	0.057	0.066	0.064

World/Country groups/Region	Index $H$			Increase in $H$ attributed to the increase in		
	1990	2021	Increase	$h$	$e$	$i$
Kuwait	0.725	0.833	0.108	0.026	0.074	0.008
Lao People's Democratic Republic	0.408	0.610	0.202	0.063	0.073	0.065
Libya	0.668	0.720	0.051	0.012	0.037	0.003
Saint Lucia	0.691	0.716	0.025	0.004	0.014	0.007
Sri Lanka	0.639	0.782	0.144	0.020	0.059	0.064
Lesotho	0.481	0.514	0.033	-0.030	0.056	0.006
Lithuania	0.734	0.875	0.140	0.014	0.082	0.044
Luxembourg	0.791	0.930	0.140	0.035	0.096	0.010
Latvia	0.730	0.863	0.133	0.023	0.080	0.031
Morocco	0.458	0.684	0.227	0.049	0.145	0.033
Moldova (Republic of)	0.656	0.767	0.111	0.004	0.106	0.002
Mexico	0.665	0.758	0.093	0.001	0.082	0.010
Mali	0.256	0.433	0.177	0.048	0.112	0.018
Malta	0.733	0.918	0.185	0.037	0.114	0.034
Myanmar	0.338	0.586	0.248	0.036	0.099	0.112
Mongolia	0.579	0.739	0.160	0.061	0.056	0.044
Mozambique	0.242	0.448	0.207	0.058	0.095	0.054
Mauritania	0.414	0.559	0.145	0.019	0.119	0.006
Mauritius	0.629	0.802	0.173	0.020	0.104	0.049
Malawi	0.304	0.515	0.210	0.086	0.100	0.024
Malaysia	0.644	0.803	0.159	0.017	0.095	0.048
Namibia	0.581	0.615	0.035	-0.016	0.034	0.017
Niger	0.230	0.407	0.177	0.074	0.099	0.004
Nicaragua	0.494	0.669	0.175	0.046	0.097	0.032
Netherlands	0.847	0.941	0.094	0.024	0.049	0.021
Norway	0.838	0.961	0.123	0.033	0.061	0.029
Nepal	0.403	0.603	0.201	0.058	0.096	0.047
New Zealand	0.806	0.937	0.131	0.035	0.066	0.030
Pakistan	0.412	0.548	0.136	0.024	0.089	0.023
Panama	0.671	0.806	0.135	0.024	0.064	0.047
Peru	0.621	0.762	0.141	0.035	0.059	0.047
Philippines	0.599	0.699	0.100	0.016	0.044	0.040
Papua New Guinea	0.383	0.560	0.177	0.022	0.122	0.033
Poland	0.717	0.876	0.160	0.029	0.076	0.055
Portugal	0.706	0.866	0.160	0.032	0.111	0.018
Paraguay	0.599	0.718	0.119	0.011	0.089	0.020
Qatar	0.764	0.857	0.094	0.026	0.058	0.010
Romania	0.704	0.821	0.118	0.022	0.056	0.040
Russian Federation	0.744	0.823	0.079	0.005	0.063	0.011
Rwanda	0.322	0.537	0.214	0.073	0.096	0.045

World/Country groups/Region	Index $H$			Increase in $H$ attributed to the increase in		
	1990	2021	Increase	$h$	$e$	$i$
Saudi Arabia	0.686	0.875	0.189	0.040	0.146	0.003
Sudan	0.348	0.513	0.166	0.064	0.090	0.012
Senegal	0.384	0.517	0.132	0.040	0.078	0.015
Singapore	0.733	0.939	0.206	0.038	0.137	0.031
Sierra Leone	0.317	0.479	0.162	0.070	0.096	-0.004
El Salvador	0.529	0.676	0.147	0.037	0.087	0.023
Sao Tome and Principe	0.488	0.619	0.132	0.027	0.078	0.027
Slovakia	0.694	0.848	0.154	0.020	0.103	0.030
Sweden	0.812	0.947	0.135	0.027	0.088	0.021
Eswatini (Kingdom of)	0.548	0.597	0.049	-0.029	0.062	0.017
Syrian Arab Republic	0.567	0.582	0.015	0.009	0.006	0.000
Togo	0.413	0.540	0.128	0.032	0.085	0.011
Thailand	0.582	0.801	0.219	0.037	0.138	0.045
Tajikistan	0.628	0.686	0.058	0.047	0.019	-0.008
Tonga	0.645	0.746	0.100	0.018	0.060	0.023
Trinidad and Tobago	0.661	0.810	0.149	0.023	0.086	0.039
Tunisia	0.581	0.732	0.151	0.016	0.105	0.030
Turkey	0.606	0.838	0.232	0.040	0.152	0.040
Tuvalu	0.559	0.641	0.082	0.014	0.033	0.036
Tanzania (United Republic of)	0.374	0.551	0.177	0.062	0.079	0.036
Uganda	0.331	0.527	0.196	0.071	0.078	0.047
Ukraine	0.729	0.773	0.043	0.009	0.046	-0.012
Uruguay	0.702	0.809	0.107	0.011	0.062	0.035
United States	0.872	0.921	0.050	0.010	0.016	0.024
Venezuela (Bolivarian Republic of)	0.664	0.693	0.028	-0.005	0.095	-0.062
Viet Nam	0.488	0.704	0.216	0.018	0.110	0.088
Yemen	0.396	0.459	0.063	0.019	0.080	-0.036
South Africa	0.633	0.714	0.080	-0.005	0.077	0.008
Zambia	0.412	0.566	0.153	0.064	0.066	0.023
Zimbabwe	0.510	0.593	0.083	-0.001	0.065	0.019

Source: Author

Table 5 classifies countries according to the contribution of the increase in the health index, education index and income index to the increase in the index  $H$  using the classification and regression tree method (Brieman et al, 1984). The classification exercise suggests that the 142 countries can be grouped into 10 mutually exclusive and exhaustive groups and the increase in the index  $H$  is different in different groups. There are 12 countries where there has been virtually no increase in the index  $H$  between 1990 and 2021. The increase in the index  $H$  in these countries ranges between 0.015 and 0.064 with the average of only  $0.047 \pm 0.015$  in these countries. The contribution

of the increase in the income index to the increase in the index  $H$ , in these countries, has, at best, been marginal whereas the contribution of the increase in the education index has been small. There are 9 countries where the increase in the index  $H$  has been very large, ranging between 0.185 to 0.281 with an average increase  $0.230 \pm 0.029$  in the index  $H$ . The contribution of the increase in all the three indexes to the increase in the index  $H$ , in these countries, has been very substantial. The classification exercise also suggests that the most important dimension in deciding the increase in the index  $H$  is the education dimension whereas the least important one is the income dimension. The importance of the increase in the income index in deciding the increase in the index  $H$  is only around 55 per cent of the importance of the increase in the education index. On the other hand, the importance of the increase in the health index in deciding the increase in the index  $H$  is marginally higher, around 61 per cent of the importance of the increase in the education index. Table 5 also suggests highly uneven progress in human development across different groups of countries.

Table 5: Classification of the countries according to the contribution of the increase in health index, education index and income index to the increase in the index  $H$ .

Group	Increase in index			Increase in index $H$		Countries	
	$h$	$e$	$i$	Mean	SD	N	Name
1	$\leq 0.065$	$\leq 0.008$		0.047	0.015	12	Barbados Brunei Darussalam Central African Republic Congo Jamaica Kyrgyzstan Lesotho Libya Saint Lucia Syrian Arab Republic Tajikistan Ukraine
2	$\leq 0.065$	$> 0.008$ $\leq 0.025$		0.080	0.020	15	Austria Canada Cuba Ecuador Eswatini (Kingdom of) Honduras Japan Jordan Namibia Netherlands Qatar Russian Federation Tonga United States Zimbabwe

Group	Increase in index			Increase in index <i>H</i>		Countries	
	<i>h</i>	<i>e</i>	<i>i</i>	Mean	SD	N	Name
3	≤0.019	>0.065 ≤0.096	≤0.033	0.090	0.026	11	Argentina Belize Botswana Bulgaria Fiji Kenya Mexico Paraguay South Africa Venezuela (Bolivarian Republic of) Yemen
4		≤0.065	>0.025	0.118	0.024	12	Armenia Australia Denmark Mongolia Norway Panama Peru Philippines Romania Sri Lanka Tuvalu Uruguay
5	>0.019	>0.065 ≤0.096	≤0.033	0.129	0.017	33	Belgium Bolivia (Plurinational State of) Brazil Burundi Cote D'Ivoire Cameroon Colombia Congo (Democratic Republic of the) Czechia El Salvador Finland France Gabon Germany Guatemala Haiti Hungary Iraq Italy Kazakhstan Kuwait Latvia Luxembourg

Group	Increase in index			Increase in index <i>H</i>		Countries	
	<i>h</i>	<i>e</i>	<i>i</i>	Mean	SD	N	Name
							New Zealand Pakistan Sao Tome and Principe Senegal Sudan Sweden Switzerland Togo United Kingdom Zambia
6	≤0.033	>0.065 ≤0.096	≤0.033	0.146	0.018	11	Bahrain Benin Greece Iceland Mauritania Moldova (Republic of) Papua New Guinea Portugal Slovakia Spain Tunisia
7	≤0.033	>0.096	>0.033	0.164	0.025	14	Albania Chile Costa Rica Dominican Republic Egypt Guyana Indonesia Israel Lithuania Malaysia Mauritius Poland Trinidad and Tobago Viet Nam
8	>0.033	>0.065 ≤0.096	≤0.033	0.178	0.019	14	Afghanistan Algeria Cyprus Gambia Guinea Iran (Islamic Republic of) Malawi Mali Nicaragua Niger Saudi Arabia

Group	Increase in index			Increase in index $H$		Countries	
	$h$	$e$	$i$	Mean	SD	N	Name
9	>0.033	>0.065 ≤0.096	>0.033	0.183	0.019	11	Sierra Leone
							Singapore
							United Arab Emirates
							Cambodia
							Estonia
							Ghana
							Hong Kong, China (SAR)
							India
							Korea (Republic of)
							Lao People's Democratic Republic
							Mozambique
Nepal							
Tanzania (United Republic of)							
Uganda							
10	>0.033	>0.096	>0.033	0.230	0.029	9	Bangladesh
							China
							Ireland
							Malta
							Morocco
							Myanmar
							Rwanda
							Thailand
							Turkey

Source: Author

## Summary and Conclusions

This paper has proposed an alternative approach of constructing an index of human development based on the concept of human development surface. It is also shown that the alternative index of human development is weighted generalised or power mean of power  $\frac{1}{2}$  of the indexes of health, education, and income. The alternative human development index addresses most of the problems associated with the human development index using either the arithmetic mean or the geometric mean as the aggregation function. An advantage of the alternative human development index is that change in the alternative human development index can be decomposed to the change in the three indexes that reflect the progress in health, education, and income dimensions of human development. This decomposition has relevance to human development policy and human development interventions as it helps in identifying the dimensions of human development in which the progress is lagging. The ranking of countries in human progress based on the alternative human development index is found to be very similar to that obtained using the conventional human development index, although there are important differences.

Application of the alternative human development index to 142 countries for which estimates could be prepared for the year 1990 and for the year 2021 suggests that the progress in human development varies widely across the countries and there are countries where progress in either health or income dimensions of human dimension appears to have reversed between 1990 and 2021. The analysis also suggests that the progress in human development in the world and in its most of the countries between 1990 and 2021 has largely been driven by the progress in the education dimension of human development whereas the contribution of the progress in the dimensions of health and income to the progress in human development has only been secondary which has relevance to human development policy. It is expected that improvement in the education dimension or broadening the opportunities for the people should have resulted in expanding their capacities and in enhancing sustenance. However, the experience of the human development movement in the world during the three decades between 1990 and 2021 suggests that this has not happened in most of the countries. This mismatch between the progress in the education dimension of human development and the health and income dimensions has implications for the efforts directed towards human progress at both international and national levels. There is a need to carry out country level analysis to explore the reasons for this mismatch.

## References

- Anand S (2018) Recasting human development measures. London, London School of Economics and Political Science. International Inequality Institute. Working Paper 23.
- Anand S, Sen AK (1992). *Human development index: Methodology and measurement* (Human Development Report Office Occasional Paper No. 12). New York, NY: United Nations Development Programme.
- Anand S, Sen AK (1995) Gender inequality in human development: theories and measurement. New York, United Nations Development Programme. Occasional Paper 19.
- Anand S, Sen AK (1997) Concept of human development and poverty: a multidimensional perspective. New York, United Nations Development Programme. Human Development Papers 19.
- Brieman L, Friedman J, Stone CJ, Olshen RA (1984) *Classification and Regression Trees*. Chapman and Hall/CRC.
- Chaurasia AR (2013) Social class and residence disparities in human development in Madhya Pradesh. *Indian Journal of Human Development* 7(2): 275-299.
- Davis A, Quinlivan G (2006) A panel data analysis of the impact of trade on human development. *The Journal of Socio-Economics*, 35(5), pp. 868-876.



- Ghislandi S, Sanderson WC, Scherbov S (2019) A simple measure of human development: The human life indicator. *Population and Development Review*, 45(1): 219–233.
- Haq M (1995) *Reflections on human development*. New Delhi: Oxford University Press.
- Kelly AC (1991) The human development index: Handle with care. *Population and Development Review*, 17(2): 315–324.
- Kitagawa EM (1955) Components of a difference between two rates. *Journal of American Statistical Association* 50(272): 1168-1194.
- Klugman J, Rodriguez F, Choi H-J (2011) The HDI 2010: new controversies, old critiques. New York, United Nations Development Program. Human Development Research Paper, 2011/01.
- Kovacevic M (2010) Review of HDI critiques and potential improvements. New York, United Nations Development Programme. Human Development Research Paper No. 2010/33.
- Mishra S, Nathan HSK (2018) A MANUSH or HUMANS characterisation of human development index. *Journal of Human Development and Capabilities* 19(3): 398-415.
- Sagar AD, Najam A (1998) The human development index: A critical review. *Ecological Economics*, 25(3), 249–264.
- United Nations (2010) *Human Development Report 2010. The Real Wealth of Nations. Pathways to Development*. New York, United Nations Development Programme.

