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Progress in Human Development in the World, 1990-2022 Evidence from Surface Measure of Human Development

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Abstract

This paper analyses the progress in human development across countries during the period 1990-2022 based on a surface measure of human development that has been developed for the purpose. The surface measure of human development addresses the problems associated with aggregating the indexes of health, education, and income by either arithmetic mean or geometric mean. The level of human development across countries based on the surface measure of human development index is found to be similar to that obtained by the conventional human development index. The decomposition of the increase in the surface measure of human development during 1990-2021 suggests that progress in the education index has been the main driver of human progress in the world during the last 30 years.

Key Words

Human development, Human development index, Surface measure of human development, HDI construction, Countries, Decomposition

Introduction

The Human Development Index (*HDI*) is the most widely used indicator 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 annually since 1990 for all countries of the world to chart the progress in human well-being across countries. Although the method of construction of *HDI* has evolved over time, yet the basic conceptualization has remained the same since its introduction in 1990 (Kovacevic, 2010; Chaurasia, 2013). The *HDI* has been widely successful in changing the way people think about development. The *HDI* and its three components serve as a report card of human progress. Every year, United Nations rank countries based on *HDI*. A high rank in *HDI* is used as a means of aggrandisement whereas a low rank is used to highlight development insufficiencies. *HDI* has also been used to measure the impact of economic policies on the quality of life (Davis and Quinlivan, 2006). It is now a universal yardstick to measure and monitor 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 and universal use, *HDI* has been criticised 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). One of the major concerns in the construction of *HDI* has been the selection of the aggregation function that combine the three indexes representing the three core dimensions of human development. Initially, the simple arithmetic mean was used the aggregation function to combine the indices of health, education, and income into *HDI* but, since 2010, the geometric mean is used which embodies imperfect substitutability across the three dimensions of *HDI* (United Nations, 2010). However, concerns about the appropriateness of the geometric mean as the aggregation function have been raised in a recent paper and it is recommended that the simple arithmetic mean should be used in place of the geometric mean to construct the *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* which depends upon the aggregation function used (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). The third 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. From the perspective of human development, it may, however, be argued that more importance should be accorded in the construction of *HDI*, to that dimension in which the progress is lagging compared to the dimension in which the progress is advanced.

Many alternatives have been proposed in addition to simple arithmetic mean and geometric mean as the aggregation function for combining the three indexes reflecting the progress in the three dimensions of human development into *HDI*. 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 the construction of *HDI*. In recent years, several other aggregation approaches have been suggested for the construction of *HDI* (Mangaraj and Aparajita, 2020; Natoli et al, 2024; Pinar, 2022; Mariami and Ciommi, 2022). The choice of the aggregation function, however, 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 the simple arithmetic mean is used as the aggregation function but 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.

Alternatively, the three dimensions of human development can be represented on a plain to constitute what may be termed as the human development surface. The level attained in each of the three dimensions of human development may then be connected by straight lines to produce the human development triangle. The surface area of the human development triangle gives a dimensionless, abstract mathematical expression of the progress 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 is an illustration of the progress of human development. Third, the change in human development can be decomposed into the change in its three dimensions while 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 follow the concept of human development surface to construct an alternative measure of human development which we term as the measure of human development surface (*HDS*). This alternative measure of progress in human development is based on the same three core dimensions of human development – health, education, income - which is used for the construction of the conventional *HDI* as developed by the United Nations. We compute the surface measure of human development (*HDS*) for the world, for its different regions and areas and for 193 countries of the world for the period 1990 through 2022 using the same dataset which have been used by the United Nations for the construction of *HDI*. We find that there are countries which have a different rank in *HDS* than the rank in *HDI*, although in majority of the countries, the rank in *HDS* is found to be same as the rank in *HDI*. We also compute for each country and for the world and its different regions and areas, how the progress in health, education, and income dimensions of human development during the period 1990-2022 has contributed to the progress in human development measured in terms of *SDH*. We find that the relative contribution of the progress in the three core dimensions of human development to the progress in human development has been different and there is substantial inter-country variation. At the global level, however, the progress in the education dimension has accounted for more than half of the progress in human development. We also find that the progress in human development in the world reversed during 2019-2021 because of the reversal in the progress in different dimensions of human development during the COVID-19 pandemic. According to the United Nations, the COVID-19 pandemic appears to have been responsible for a decrease of around 1.8 years in the life expectancy at birth in the world during 2019-2021 (United Nations, 2022).

The paper is organised as follows. The next section of the paper outlines the concept of the human development surface and the construction of the surface measure of human development *HDS*. Section three presents estimate of *HDS* along with estimates of *HDI* for the world, for selected regions of the world and for 193 countries for which data used to construct *HDI* are made available by the United Nations. Section four decomposes the change in the index *H* during the period 1990 through 2021 into the change attributed to health, education, and income to explore how progress in the dimensions of 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 *HDS*. 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), in education dimension (e), and in 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 basis for the construction of an alternative index 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 the 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

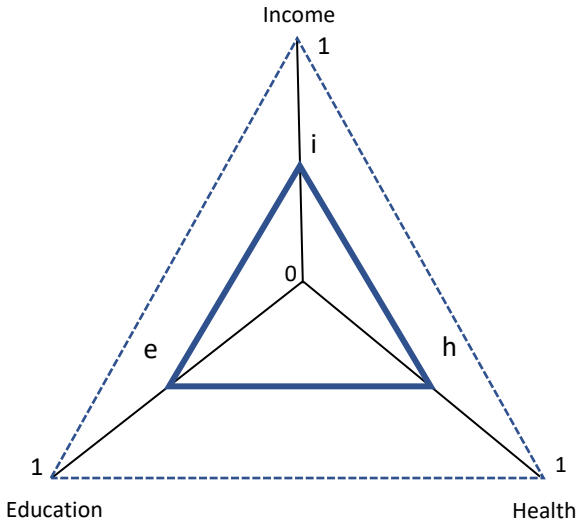

Figure 1: The human development triangle

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

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

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

$$A_{max} = \frac{1*1*\text{Sin}\,(360^o/3)}{2} + \frac{1*1*\text{Sin}\,(360^o/3)}{2} + \frac{1*1*\text{Sin}\,(360^o/3)}{2} = \frac{3}{2}\text{Sin}\,(360^o/3) \quad (3)$$

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

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

A_n can serve as an alternative measure of human development that accounts for the interaction among the three indexes h, e, and i. The problem with using A_n, however, is that the progress in human development based on A_n is 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. The index A_n, therefore, is not the ideal index to measure the progress in human development.

This weakness associated with A_n as a measure of human development may be addressed by using the positive square root of the three indexes *h*, *e,* and *i* to construct the alternative composite index of human development (*HDS*). 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 index of human development (*HDS*) based on the concept of human development surface, may be defined as

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

The *HDS* accounts for the correlation that exists across the different dimensions of human development. This correlation is important as it 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 *HDS* is nothing but the simple arithmetic mean of the three indexes *h*, *e*, and *i*. This means that the ratio or the difference between the simple arithmetic mean of the three index and the *HDS* indicates the inequality in human progress across the three dimensions of human development, the larger this difference the larger the inequality in progress.

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

$$\nabla HDS = HDS_2 - HDS_1 = \frac{\sqrt{h_2*e_2}+\sqrt{e_2*i_2}+\sqrt{i_2*i_2}}{3} - \frac{\sqrt{h_1*e_1}+\sqrt{e_1*i_1}+\sqrt{i_1*i_1}}{3} \tag{6}$$

$$\nabla HDS = \frac{1}{3}\left\{\sqrt{h_2 * e_2} - \sqrt{h_1 * e_1}\right\} + \frac{1}{3}\left\{\sqrt{e_2 * i_2} - \sqrt{e_1 * i_1}\right\} + \frac{1}{3}\left\{\sqrt{i_2 * h_2} - \sqrt{i_1 * h_1}\right\} \tag{7}$$

Now, following Kitagawa (1955)

$$\sqrt{h_2 * e_2} - \sqrt{h_1 * e_1} = \frac{1}{2}\left(\sqrt{h_2} - \sqrt{h_1}\right) * \left(\sqrt{e_2} + \sqrt{e_1}\right) + \frac{1}{2}\left(\sqrt{e_2} - \sqrt{e_1}\right) * \left(\sqrt{h_2} + \sqrt{h_1}\right) \tag{8}$$

$$\sqrt{e_2 * i_2} - \sqrt{e_1 * i_1} = \frac{1}{2}\left(\sqrt{e_2} - \sqrt{e_1}\right) * \left(\sqrt{i_2} + \sqrt{i_1}\right) + \frac{1}{2}\left(\sqrt{i_2} - \sqrt{i_1}\right) * \left(\sqrt{e_2} + \sqrt{e_1}\right) \tag{9}$$

$$\sqrt{i_2 * h_2} - \sqrt{i_1 * h_1} = \frac{1}{2}\left(\sqrt{i_2} - \sqrt{i_1}\right) * \left(\sqrt{h_2} + \sqrt{h_1}\right) + \frac{1}{2}\left(\sqrt{h_2} - \sqrt{h_1}\right) * \left(\sqrt{i_2} + \sqrt{i_1}\right) \tag{10}$$

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

$$\nabla HDS = \frac{1}{6}\left(\sqrt{h_2} - \sqrt{h_1}\right) * \left\{\left(\sqrt{e_1} + \sqrt{e_2}\right) + \left(\sqrt{i_1} + \sqrt{i_2}\right)\right\} + \frac{1}{6}\left(\sqrt{h_2} + \sqrt{h_1}\right) * \left\{\left(\sqrt{e_1} - \sqrt{e_2}\right) + \left(\sqrt{i_1} + \sqrt{i_2}\right)\right\} + \frac{1}{6}\left(\sqrt{h_2} + \sqrt{h_1}\right) * \left\{\left(\sqrt{e_1} + \sqrt{e_2}\right) + \left(\sqrt{i_1} - \sqrt{i_2}\right)\right\} \tag{11}$$

or

$$\nabla HDS = (h_2 - h_i) * v_h + (e_2 - e_1) * v_e + (i_2 - i_1) * v_i \tag{12}$$

where

$$v_h = \frac{1}{6}\left\{\left(\frac{\sqrt{e_1}+\sqrt{e_2}}{\sqrt{h_1}+\sqrt{h_2}}\right) + \left(\frac{\sqrt{i_1}+\sqrt{i_2}}{\sqrt{h_1}+\sqrt{h_2}}\right)\right\} \tag{13}$$

$$v_e = \frac{1}{6}\left\{\left(\frac{\sqrt{h_1}+\sqrt{h_2}}{\sqrt{e_1}+\sqrt{e_2}}\right) + \left(\frac{\sqrt{i_1}+\sqrt{i_2}}{\sqrt{e_1}+\sqrt{e_2}}\right)\right\} \tag{14}$$

$$v_i = \frac{1}{6}\left\{\left(\frac{\sqrt{e_1}+\sqrt{e_2}}{\sqrt{i_1}+\sqrt{i_2}}\right) + \left(\frac{\sqrt{h_1}+\sqrt{h_2}}{\sqrt{i_2}+\sqrt{i_1}}\right)\right\} \tag{15}$$

Equation (15) shows that the difference in *HDS* between two points of time is the weighted sum of the difference in the health index (*h*), in the education index (*e*), and in the income index (*i*). When $h=e=i$, the difference in *HDS* between two points of time is the average of the difference in the three indexes between two points of time.

Progress in Human Development, 1990-2021

We have calculated the index *HDS* 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 *HDS* for the world and for different groups of countries and regions for the year 1990 and 2022 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 *HDS* is higher than *HDI* in the world and in all groups of countries and regions of the world. However, the increase in the index *HDS* between 1990 and 2022 is more sedate than the increase in *HDI*. For example, in the Arab states, the *HDI* increased by 0.154 points between 1990 and 2021, but *HDS* increased by only 0.149 points during the same period. Similarly, in Sub-Saharan Africa, *HDI* increased by 0.145 points, but *HDS* increased by 0.142 points between 1990 and 2022. It is clear that the selection of the aggregation function has an impact not only on the level of human development measured 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, measured in terms of the increase in *HDS* appears to be slower than the progress in human development when the three dimensions of human development are treated independently of each other as measured in terms of the 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 measures of human development, *HDS* and *HDI* are different in different regions of the world or groups of countries.

Table 1: Estimates of *HDS*, and *HDI* for the world, for different groups of countries and for selected regions, 1990 and 2022.

World/Region	*HDS*		*HDI*	
	1990	2022	1990	2022
World	0.604	0.740	0.601	0.739
Countries with very high human development (HDI≥0.800)	0.789	0.902	0.785	0.902
Countries with high human development (0.700≤HDI<0.800)	0.564	0.765	0.560	0.764
Countries with medium human development (0.550≤HDI<0.800)	0.447	0.641	0.443	0.640
Countries with low human development (HDI<0.550)	0.361	0.519	0.354	0.517
Arab states	0.557	0.706	0.550	0.704
East Asia and Pacific	0.511	0.767	0.507	0.766
Europe and Central Asia	0.667	0.802	0.663	0.802
Latin America and the Caribbean	0.639	0.764	0.637	0.763
South Asia	0.448	0.642	0.444	0.641
Sub-Saharan Africa	0.407	0.549	0.404	0.549
Summary measures of inter-country distribution				
Minimum	0.226	0.384	0.212	0.380
Q1	0.482	0.604	0.480	0.602
Median	0.625	0.741	0.622	0.740
Q3	0.732	0.849	0.732	0.847
Maximum	0.875	0.967	0.875	0.967
IQR	0.250	0.246	0.252	0.245
Frequency distribution				
Countries with very high human development (HDI≥0.800)	17	69	17	69
Countries with high human development (0.700≤HDI<0.800)	34	49	32	49
Countries with medium human development (0.550≤HDI<0.800)	42	43	44	42
Countries with low human development (HDI<0.550)	50	32	50	33
N	143	193	143	193

Source: Estimates of *HDI* are from United Nations database. Estimates of *HDS* are author's calculations.

Table 2: Estimates of *HDI* and *HDS* for 193 countries of the world, 1990 and 2022 and the increase in the two indexes between 1990 and 2022.

Country	*HDI*		*HDS*		Increase in	
	1990	2022	1990	2022	*HDI*	*HDS*
Afghanistan	0.284	0.462	0.302	0.465	0.178	0.163
Albania	0.649	0.789	0.651	0.790	0.140	0.139
Algeria	0.593	0.745	0.598	0.746	0.152	0.149
Andorra	na	0.884	na	0.885	na	na
Angola	na	0.591	na	0.591	na	na
Antigua and Barbuda	na	0.826	na	0.827	na	na
Argentina	0.724	0.849	0.725	0.849	0.125	0.124
Armenia	0.658	0.786	0.659	0.786	0.128	0.127
Australia	0.864	0.946	0.864	0.946	0.082	0.082
Austria	0.823	0.926	0.824	0.927	0.103	0.103
Azerbaijan	na	0.760	na	0.760	na	na
Bahamas	0.760	0.820	0.762	0.820	0.060	0.059
Bahrain	0.733	0.888	0.738	0.888	0.155	0.150
Bangladesh	0.399	0.670	0.404	0.672	0.271	0.269
Barbados	0.728	0.809	0.729	0.809	0.081	0.081
Belarus	na	0.801	na	0.801	na	na
Belgium	0.814	0.942	0.815	0.942	0.128	0.126
Belize	0.609	0.700	0.613	0.701	0.091	0.088
Benin	0.350	0.504	0.360	0.506	0.154	0.147
Bhutan	na	0.681	na	0.683	na	na
Bolivia (Plurinational State of)	0.546	0.698	0.546	0.699	0.152	0.152
Bosnia and Herzegovina	na	0.779	na	0.779	na	na
Botswana	0.587	0.708	0.589	0.708	0.121	0.119
Brazil	0.620	0.760	0.622	0.760	0.140	0.138
Brunei Darussalam	0.779	0.823	0.783	0.825	0.044	0.041
Bulgaria	0.698	0.799	0.700	0.799	0.101	0.099
Burkina Faso	na	0.438	na	0.443	na	na
Burundi	0.285	0.420	0.290	0.425	0.135	0.135
Cabo Verde	na	0.661	na	0.664	na	na
Cambodia	0.379	0.600	0.382	0.602	0.221	0.220
Cameroon	0.440	0.587	0.444	0.587	0.147	0.143
Canada	0.861	0.935	0.861	0.935	0.074	0.075
Central African Republic	0.333	0.387	0.338	0.389	0.054	0.051
Chad	na	0.394	na	0.396	na	na
Chile	0.705	0.860	0.706	0.860	0.155	0.154
China	0.482	0.788	0.487	0.790	0.306	0.302
Colombia	0.614	0.758	0.617	0.758	0.144	0.141
Comoros	na	0.586	na	0.587	na	na
Congo	0.541	0.593	0.541	0.594	0.052	0.053
Congo (Democratic Republic of the)	0.377	0.481	0.379	0.484	0.104	0.105
Costa Rica	0.659	0.806	0.664	0.807	0.147	0.143
Côte d'Ivoire	0.425	0.534	0.428	0.536	0.109	0.108
Croatia	na	0.878	na	0.879	na	na
Cuba	0.684	0.764	0.686	0.765	0.080	0.080
Cyprus	0.733	0.907	0.736	0.907	0.174	0.171
Czechia	0.748	0.895	0.749	0.895	0.147	0.145
Denmark	0.839	0.952	0.839	0.952	0.113	0.112
Djibouti	na	0.515	na	0.520	na	na
Dominica	na	0.740	na	0.741	na	na

Country	*HDI*		*HDS*		Increase in	
	1990	2022	1990	2022	*HDI*	*HDS*
Dominican Republic	0.579	0.766	0.582	0.766	0.187	0.184
Ecuador	0.645	0.765	0.646	0.766	0.120	0.120
Egypt	0.567	0.728	0.570	0.728	0.161	0.158
El Salvador	0.519	0.674	0.524	0.675	0.155	0.151
Equatorial Guinea	na	0.650	na	0.650	na	na
Eritrea	na	0.493	na	0.498	na	na
Estonia	0.741	0.899	0.741	0.899	0.158	0.159
Eswatini (Kingdom of)	0.546	0.610	0.549	0.610	0.064	0.061
Ethiopia	na	0.492	na	0.497	na	na
Fiji	0.630	0.729	0.631	0.729	0.099	0.098
Finland	0.811	0.942	0.812	0.942	0.131	0.130
France	0.790	0.910	0.792	0.911	0.120	0.119
Gabon	0.599	0.693	0.603	0.693	0.094	0.090
Gambia	0.323	0.495	0.335	0.498	0.172	0.163
Georgia	na	0.814	na	0.815	na	na
Germany	0.828	0.950	0.828	0.950	0.122	0.121
Ghana	0.445	0.602	0.447	0.603	0.157	0.156
Greece	0.762	0.893	0.765	0.893	0.131	0.129
Grenada	na	0.793	na	0.793	na	na
Guatemala	0.490	0.629	0.498	0.631	0.139	0.134
Guinea	0.270	0.471	0.282	0.473	0.201	0.191
Guinea-Bissau	na	0.483	na	0.485	na	na
Guyana	0.496	0.742	0.499	0.743	0.246	0.245
Haiti	0.441	0.552	0.444	0.553	0.111	0.109
Honduras	0.513	0.624	0.518	0.626	0.111	0.108
Hong Kong, China (SAR)	0.739	0.956	0.744	0.956	0.217	0.212
Hungary	0.721	0.851	0.722	0.851	0.130	0.129
Iceland	0.834	0.959	0.835	0.959	0.125	0.124
India	0.434	0.644	0.438	0.645	0.210	0.207
Indonesia	0.526	0.713	0.530	0.713	0.187	0.183
Iran (Islamic Republic of)	0.613	0.780	0.615	0.781	0.167	0.166
Iraq	0.497	0.673	0.503	0.675	0.176	0.171
Ireland	0.743	0.950	0.746	0.950	0.207	0.204
Israel	0.781	0.915	0.782	0.915	0.134	0.133
Italy	0.780	0.906	0.783	0.907	0.126	0.124
Jamaica	0.664	0.706	0.666	0.707	0.042	0.040
Japan	0.846	0.920	0.846	0.921	0.074	0.075
Jordan	0.622	0.736	0.625	0.737	0.114	0.112
Kazakhstan	0.672	0.802	0.673	0.802	0.130	0.129
Kenya	0.480	0.601	0.484	0.601	0.121	0.117
Kiribati	na	0.628	na	0.629	na	na
Korea (Democratic People's Rep. of)	na	na	na	na	na	na
Korea (Republic of)	0.731	0.929	0.732	0.929	0.198	0.198
Kuwait	0.698	0.847	0.708	0.849	0.149	0.141
Kyrgyzstan	0.637	0.701	0.637	0.703	0.064	0.066
Lao People's Democratic Republic	0.408	0.620	0.411	0.623	0.212	0.212
Latvia	0.732	0.879	0.733	0.879	0.147	0.146
Lebanon	na	0.723	na	0.725	na	na
Lesotho	0.479	0.521	0.481	0.521	0.042	0.040
Liberia	na	0.487	na	0.490	na	na
Libya	0.724	0.746	0.726	0.747	0.022	0.021

Country	*HDI*		*HDS*		Increase in	
	1990	2022	1990	2022	*HDI*	*HDS*
Liechtenstein	na	0.942	na	0.943	na	na
Lithuania	0.740	0.879	0.741	0.879	0.139	0.138
Luxembourg	0.793	0.927	0.798	0.927	0.134	0.129
Madagascar	na	0.487	na	0.491	na	na
Malawi	0.299	0.508	0.301	0.511	0.209	0.210
Malaysia	0.649	0.807	0.652	0.808	0.158	0.156
Maldives	na	0.762	na	0.765	na	na
Mali	0.236	0.410	0.254	0.417	0.174	0.163
Malta	0.726	0.915	0.729	0.915	0.189	0.186
Marshall Islands	na	0.731	na	0.733	na	na
Mauritania	0.397	0.540	0.414	0.545	0.143	0.131
Mauritius	0.620	0.796	0.623	0.797	0.176	0.173
Mexico	0.666	0.781	0.669	0.781	0.115	0.112
Micronesia (Federated States of)	na	0.634	na	0.635	na	na
Moldova (Republic of)	0.688	0.763	0.689	0.763	0.075	0.074
Monaco	na	na	na	na	na	na
Mongolia	0.579	0.741	0.579	0.742	0.162	0.163
Montenegro	na	0.844	na	0.844	na	na
Morocco	0.448	0.698	0.459	0.699	0.250	0.240
Mozambique	0.239	0.461	0.242	0.464	0.222	0.221
Myanmar	0.333	0.608	0.338	0.609	0.275	0.271
Namibia	0.595	0.610	0.596	0.611	0.015	0.015
Nauru	na	0.696	na	0.696	na	na
Nepal	0.395	0.601	0.399	0.604	0.206	0.205
Netherlands	0.847	0.946	0.847	0.946	0.099	0.099
New Zealand	0.812	0.939	0.813	0.940	0.127	0.127
Nicaragua	0.487	0.669	0.491	0.671	0.182	0.180
Niger	0.212	0.394	0.226	0.401	0.182	0.175
Nigeria	na	0.548	na	0.548	na	na
North Macedonia	na	0.765	na	0.766	na	na
Norway	0.845	0.966	0.846	0.966	0.121	0.120
Oman	na	0.819	na	0.820	na	na
Pakistan	0.394	0.540	0.408	0.546	0.146	0.138
Palau	na	0.797	na	0.799	na	na
Palestine, State of	na	0.716	na	0.717	na	na
Panama	0.672	0.820	0.674	0.821	0.148	0.147
Papua New Guinea	0.394	0.568	0.405	0.569	0.174	0.164
Paraguay	0.604	0.731	0.607	0.731	0.127	0.124
Peru	0.620	0.762	0.621	0.762	0.142	0.141
Philippines	0.598	0.710	0.599	0.710	0.112	0.111
Poland	0.715	0.881	0.715	0.881	0.166	0.166
Portugal	0.703	0.874	0.708	0.875	0.171	0.167
Qatar	0.764	0.875	0.770	0.877	0.111	0.107
Romania	0.709	0.827	0.710	0.827	0.118	0.118
Russian Federation	0.741	0.821	0.742	0.821	0.080	0.079
Rwanda	0.320	0.548	0.324	0.551	0.228	0.227
Saint Kitts and Nevis	na	0.838	na	0.838	na	na
Saint Lucia	0.666	0.725	0.667	0.725	0.059	0.058
Saint Vincent and the Grenadines	na	0.772	na	0.772	na	na
Samoa	na	0.702	na	0.703	na	na
San Marino	0.841	0.867	0.844	0.870	0.026	0.026

Country	*HDI*		*HDS*		Increase in	
	1990	2022	1990	2022	*HDI*	*HDS*
Sao Tome and Principe	0.480	0.613	0.483	0.615	0.133	0.131
Saudi Arabia	0.699	0.875	0.705	0.875	0.176	0.170
Senegal	0.371	0.517	0.383	0.523	0.146	0.141
Serbia	na	0.805	na	0.805	na	na
Seychelles	na	0.802	na	0.802	na	na
Sierra Leone	0.314	0.458	0.319	0.461	0.144	0.142
Singapore	0.780	0.949	0.783	0.950	0.169	0.167
Slovakia	na	0.855	na	0.855	na	na
Slovenia	na	0.926	na	0.926	na	na
Solomon Islands	na	0.562	na	0.566	na	na
Somalia	na	0.380	na	0.384	na	na
South Africa	0.635	0.717	0.636	0.718	0.082	0.082
South Sudan	na	0.381	na	0.385	na	na
Spain	0.762	0.911	0.765	0.911	0.149	0.146
Sri Lanka	0.641	0.780	0.643	0.780	0.139	0.137
Sudan	0.322	0.516	0.334	0.521	0.194	0.187
Suriname	na	0.690	na	0.691	na	na
Sweden	0.808	0.952	0.810	0.952	0.144	0.143
Switzerland	0.850	0.967	0.852	0.967	0.117	0.115
Syrian Arab Republic	0.563	0.557	0.567	0.563	-0.006	-0.004
Tajikistan	0.616	0.679	0.617	0.680	0.063	0.064
Tanzania (United Republic of)	0.366	0.532	0.369	0.535	0.166	0.167
Thailand	0.581	0.803	0.588	0.804	0.222	0.216
Timor-Leste	na	0.566	na	0.570	na	na
Togo	0.399	0.547	0.403	0.548	0.148	0.145
Tonga	0.640	0.739	0.641	0.740	0.099	0.100
Trinidad and Tobago	0.656	0.814	0.658	0.814	0.158	0.156
Tunisia	0.566	0.732	0.572	0.733	0.166	0.161
Türkiye	0.598	0.855	0.604	0.855	0.257	0.251
Turkmenistan	na	0.744	na	0.744	na	na
Tuvalu	0.564	0.653	0.564	0.653	0.089	0.089
Uganda	0.329	0.550	0.330	0.551	0.221	0.221
Ukraine	0.731	0.734	0.731	0.734	0.003	0.003
United Arab Emirates	0.717	0.937	0.726	0.937	0.220	0.210
United Kingdom	0.804	0.940	0.805	0.940	0.136	0.135
United States	0.875	0.927	0.875	0.927	0.052	0.052
Uruguay	0.702	0.830	0.703	0.830	0.128	0.127
Uzbekistan	na	0.727	na	0.728	na	na
Vanuatu	na	0.614	na	0.616	na	na
Venezuela (Bolivarian Republic of)	0.657	0.699	0.662	0.699	0.042	0.038
Viet Nam	0.492	0.726	0.499	0.727	0.234	0.229
Yemen	0.357	0.424	0.373	0.430	0.067	0.057
Zambia	0.417	0.569	0.417	0.569	0.152	0.152
Zimbabwe	0.479	0.550	0.480	0.551	0.071	0.071

Source: Estimates of *HDI* are taken from the human development database of the United Nations. Estimates of *HDS* are that of the author based on the values of the indexes *h*, *e*, and *i* from the human development database of the United Nations.
Remarks: na – not available.

In all the 193 countries for which *HDI* as estimated by the United Nations, *HDS* is higher than *HDI* (Table 2) but the difference between the two varies across countries. In 2022, there was virtually no difference between the two indexes in Czechia, whereas the difference was the widest in Mali. In

2022, the ranking of countries in terms of *HDS* is the same as the ranking of countries in terms of *HDI*, in most of the countries. There are, however, 41 countries where the rank in *HDS* in 2022 was not the same as the rank in *HDI*. In 33 of these countries, the rank in *HDS* was better than the rank in *HDI*, but in 8 countries, the rank in *HDS* was poorer than the rank in *HDI*. On the other hand, the progress in human development during 1990-2022 in 143 countries for which data are available for both 1990 and 2022, based on *HDS* is comparatively slower than that based on *HDI* in all but 29 countries. The progress in human development reflected through *HDS* is different from that reflected through *HDI*. The reason is that *HDI* assumes that the variation in indexes *h*, *e*, and *i* across countries is independent of each other whereas *HDS* assumes that the variation in each of the three indexes is also influenced by the variation in the remaining two indexes.

Among the 143 countries, the progress in human development during 1990-2022 has been the most rapid in China where *HDS* increased from 0.487 in 1990 to 0.790 in 2022. On the other hand, Syrian Arab Republic is the only country where *HDS* decreased, instead increased. There are 33 countries where the progress in human development may be classified as slow as the increase in *HDS* during 1990-2022 has been less than 0.100. On the other hand, the progress in human development may be classified as average in 57 countries as the increase in *HDS* in these countries ranged between 0.100 and 0.150. The progress in human development may be classified as rapid in 33 countries in which the increase in *HDS* ranged between 0.150 and 0.200. This leaves only 19 countries where the progress in human development may be classified as very rapid as the increase in *HDS* has been at least 0.200 between 1990 and 2022.

Contributors to the Progress in Human Development

The progress in human development, during 1990-2022, as measured by the increase in *HDS*, is contingent upon the increase in the indexes *h*, *e*, and *i*. We have estimated the contribution of the progress in the health dimension, progress in the education dimensions and progress in the income dimension to the progress in human development in conjunction with equation (12) for the world, for different regions of the world, for different groups of countries and for 143 countries for which estimates of *HDS* could be calculated for both the years 1990 and 2022. In the remaining countries, data are not available to estimate *HDS* for the year 1990. The main contributor to human progress in the world during 1990-2022 has been the progress in education. The *HDS* increased by 0.136 points between 1990 and 2022 and more than half of this increase has been due to the progress in the education dimension of human development. The progress in the health dimension accounted for around 26 per cent of the increase in *HDS* whereas the income dimension accounted for an increase of 20 per cent (Table 3).

Table 3: Decomposition of the change in *HDS* between 1990 and 2021 in the world and in different groups of countries and regions.

World/Country groups/Region	*HDS*			Increase in *HDS* attributed to the increase in		
	1990	2022	Increase	*h*	*e*	*i*
World	0.604	0.740	0.136	0.032	0.076	0.027
Very high human development	0.786	0.902	0.116	0.028	0.065	0.023
High human development	0.564	0.765	0.202	0.036	0.102	0.064
Medium human development	0.447	0.641	0.194	0.043	0.100	0.051
Low human development	0.361	0.519	0.158	0.048	0.092	0.018
Arab States	0.557	0.706	0.149	0.039	0.094	0.017
East Asia and the Pacific	0.511	0.767	0.256	0.039	0.114	0.103
Europe and Central Asia	0.665	0.802	0.137	0.028	0.084	0.025
Latin America and the Caribbean	0.639	0.764	0.124	0.028	0.077	0.019
South Asia	0.448	0.642	0.194	0.042	0.097	0.055
Sub-Saharan Africa	0.407	0.549	0.142	0.050	0.079	0.013

Source: Author's calculations

Table 4: Decomposition of the increase in *HDS* between 1990 and 2022 into the increase attributed to the increase in the health index, education index and income index.

World/Country groups/Region	*HDS*			Increase in *HDS* attributed to the increase in		
	1990	2022	Increase	*h*	*e*	*i*
Afghanistan	0.302	0.465	0.163	0.069	0.132	-0.038
Albania	0.651	0.790	0.139	0.017	0.062	0.060
Algeria	0.598	0.746	0.149	0.044	0.093	0.012
Argentina	0.725	0.849	0.124	0.021	0.079	0.025
Armenia	0.659	0.786	0.127	0.022	0.048	0.058
Australia	0.864	0.946	0.082	0.033	0.022	0.027
Austria	0.824	0.927	0.103	0.033	0.050	0.019
Bahamas	0.762	0.820	0.059	0.021	0.039	-0.002
Bahrain	0.738	0.888	0.150	0.032	0.108	0.010
Bangladesh	0.404	0.672	0.269	0.075	0.128	0.066
Barbados	0.729	0.809	0.081	0.024	0.053	0.004
Belgium	0.815	0.942	0.126	0.031	0.075	0.020
Belize	0.613	0.701	0.088	0.001	0.067	0.019
Benin	0.360	0.506	0.147	0.028	0.096	0.023
Bolivia (Plurinational State of)	0.546	0.699	0.152	0.043	0.076	0.033
Botswana	0.589	0.708	0.119	0.027	0.069	0.024
Brazil	0.622	0.760	0.138	0.035	0.085	0.018
Brunei Darussalam	0.783	0.825	0.041	0.015	0.034	-0.008
Bulgaria	0.700	0.799	0.099	0.001	0.072	0.026
Burundi	0.290	0.425	0.135	0.067	0.092	-0.024
Cambodia	0.382	0.602	0.220	0.059	0.083	0.077
Cameroon	0.444	0.587	0.143	0.028	0.110	0.004
Canada	0.861	0.935	0.075	0.027	0.029	0.019
Central African Republic	0.338	0.389	0.051	0.020	0.052	-0.021
Chile	0.706	0.860	0.154	0.033	0.071	0.050
China	0.487	0.790	0.302	0.044	0.121	0.137
Colombia	0.617	0.758	0.141	0.023	0.088	0.031
Congo	0.541	0.594	0.053	0.035	0.039	-0.021
Congo (Democratic Republic of the)	0.379	0.484	0.105	0.049	0.078	-0.022
Costa Rica	0.664	0.807	0.143	0.003	0.101	0.038
Côte d'Ivoire	0.428	0.536	0.108	0.029	0.050	0.029
Cuba	0.686	0.765	0.080	0.019	0.038	0.023
Cyprus	0.736	0.907	0.171	0.040	0.108	0.023
Czechia	0.749	0.895	0.145	0.034	0.087	0.025
Denmark	0.839	0.952	0.112	0.036	0.052	0.024
Dominican Republic	0.582	0.766	0.184	0.032	0.096	0.056
Ecuador	0.646	0.766	0.120	0.039	0.062	0.019
Egypt	0.570	0.728	0.158	0.028	0.095	0.034
El Salvador	0.524	0.675	0.151	0.040	0.084	0.027
Estonia	0.741	0.899	0.159	0.047	0.072	0.040
Eswatini (Kingdom of)	0.549	0.610	0.061	-0.033	0.071	0.023
Fiji	0.631	0.729	0.098	0.014	0.066	0.018
Finland	0.812	0.942	0.130	0.037	0.072	0.021
France	0.792	0.911	0.119	0.031	0.072	0.016
Gabon	0.603	0.693	0.090	0.027	0.080	-0.017
Gambia	0.335	0.498	0.163	0.047	0.115	0.001
Germany	0.828	0.950	0.121	0.029	0.073	0.019
Ghana	0.447	0.603	0.156	0.038	0.075	0.043

World/Country groups/Region	*HDS*			Increase in *HDS* attributed to the increase in		
	1990	2022	Increase	*h*	*e*	*i*
Greece	0.765	0.893	0.129	0.016	0.101	0.012
Guatemala	0.498	0.631	0.134	0.027	0.083	0.023
Guinea	0.282	0.473	0.191	0.049	0.118	0.024
Guyana	0.499	0.743	0.245	0.017	0.090	0.138
Haiti	0.444	0.553	0.109	0.049	0.073	-0.012
Honduras	0.518	0.626	0.108	0.023	0.067	0.018
Hong Kong, China (SAR)	0.744	0.956	0.212	0.033	0.141	0.039
Hungary	0.722	0.851	0.129	0.028	0.069	0.032
Iceland	0.835	0.959	0.124	0.023	0.075	0.026
India	0.438	0.645	0.207	0.040	0.099	0.069
Indonesia	0.530	0.713	0.183	0.024	0.107	0.052
Iran (Islamic Republic of)	0.615	0.781	0.166	0.049	0.095	0.022
Iraq	0.503	0.675	0.171	0.059	0.101	0.011
Ireland	0.746	0.950	0.204	0.038	0.113	0.053
Israel	0.782	0.915	0.133	0.026	0.072	0.035
Italy	0.783	0.907	0.124	0.034	0.081	0.010
Jamaica	0.666	0.707	0.040	-0.008	0.045	0.003
Japan	0.846	0.921	0.075	0.028	0.033	0.014
Jordan	0.625	0.737	0.112	0.020	0.080	0.012
Kazakhstan	0.673	0.802	0.129	0.024	0.082	0.023
Kenya	0.484	0.601	0.117	0.016	0.086	0.015
Korea (Republic of)	0.732	0.929	0.198	0.059	0.074	0.065
Kuwait	0.708	0.849	0.141	0.033	0.106	0.002
Kyrgyzstan	0.637	0.703	0.066	0.030	0.040	-0.004
Lao People's Democratic Republic	0.411	0.623	0.212	0.067	0.078	0.067
Latvia	0.733	0.879	0.146	0.034	0.085	0.027
Lesotho	0.481	0.521	0.040	-0.030	0.061	0.009
Libya	0.726	0.747	0.021	0.013	0.022	-0.014
Lithuania	0.741	0.879	0.138	0.017	0.084	0.037
Luxembourg	0.798	0.927	0.129	0.035	0.094	0.001
Malawi	0.301	0.511	0.210	0.085	0.101	0.024
Malaysia	0.652	0.808	0.156	0.023	0.085	0.048
Mali	0.254	0.417	0.163	0.048	0.097	0.018
Malta	0.729	0.915	0.186	0.036	0.106	0.043
Mauritania	0.414	0.545	0.131	0.020	0.103	0.008
Mauritius	0.623	0.797	0.173	0.022	0.101	0.051
Mexico	0.669	0.781	0.112	0.023	0.077	0.013
Moldova (Republic of)	0.689	0.763	0.074	0.003	0.075	-0.004
Mongolia	0.579	0.742	0.163	0.068	0.052	0.042
Morocco	0.459	0.699	0.240	0.053	0.154	0.033
Mozambique	0.242	0.464	0.221	0.060	0.104	0.057
Myanmar	0.338	0.609	0.271	0.042	0.114	0.114
Namibia	0.596	0.611	0.015	-0.022	0.020	0.018
Nepal	0.399	0.604	0.205	0.065	0.089	0.051
Netherlands	0.847	0.946	0.099	0.027	0.048	0.023
New Zealand	0.813	0.940	0.127	0.038	0.065	0.024
Nicaragua	0.491	0.671	0.180	0.049	0.100	0.031
Niger	0.226	0.401	0.175	0.075	0.093	0.007
Norway	0.846	0.966	0.120	0.034	0.061	0.025
Pakistan	0.408	0.546	0.138	0.025	0.086	0.027

World/Country groups/Region	*HDS*			Increase in *HDS* attributed to the increase in		
	1990	2022	Increase	*h*	*e*	*i*
Panama	0.674	0.821	0.147	0.027	0.066	0.054
Papua New Guinea	0.405	0.569	0.164	0.025	0.118	0.021
Paraguay	0.607	0.731	0.124	0.012	0.091	0.021
Peru	0.621	0.762	0.141	0.040	0.055	0.046
Philippines	0.599	0.710	0.111	0.029	0.042	0.041
Poland	0.715	0.881	0.166	0.031	0.076	0.058
Portugal	0.708	0.875	0.167	0.037	0.110	0.019
Qatar	0.770	0.877	0.107	0.037	0.064	0.007
Romania	0.710	0.827	0.118	0.022	0.054	0.042
Russian Federation	0.742	0.821	0.079	0.008	0.060	0.011
Rwanda	0.324	0.551	0.227	0.077	0.102	0.048
Saint Lucia	0.667	0.725	0.058	0.005	0.035	0.018
San Marino	0.844	0.870	0.026	0.023	0.001	0.002
Sao Tome and Principe	0.483	0.615	0.131	0.031	0.072	0.028
Saudi Arabia	0.705	0.875	0.170	0.045	0.119	0.006
Senegal	0.383	0.523	0.141	0.043	0.081	0.017
Sierra Leone	0.319	0.461	0.142	0.071	0.075	-0.004
Singapore	0.783	0.950	0.167	0.045	0.090	0.031
South Africa	0.636	0.718	0.082	-0.010	0.079	0.013
Spain	0.765	0.911	0.146	0.033	0.095	0.019
Sri Lanka	0.643	0.780	0.137	0.021	0.057	0.059
Sudan	0.334	0.521	0.187	0.065	0.107	0.015
Sweden	0.810	0.952	0.143	0.029	0.088	0.026
Switzerland	0.852	0.967	0.115	0.034	0.071	0.009
Syrian Arab Republic	0.567	0.563	-0.004	0.010	-0.006	-0.008
Tajikistan	0.617	0.680	0.064	0.045	0.013	0.006
Tanzania (United Republic of)	0.369	0.535	0.167	0.063	0.068	0.036
Thailand	0.588	0.804	0.216	0.041	0.132	0.043
Togo	0.403	0.548	0.145	0.032	0.100	0.013
Tonga	0.641	0.740	0.100	0.019	0.059	0.021
Trinidad and Tobago	0.658	0.814	0.156	0.031	0.089	0.036
Tunisia	0.572	0.733	0.161	0.018	0.111	0.031
Türkiye	0.604	0.855	0.251	0.051	0.157	0.044
Tuvalu	0.564	0.653	0.089	0.015	0.051	0.023
Uganda	0.330	0.551	0.221	0.076	0.095	0.050
Ukraine	0.731	0.734	0.003	-0.006	0.029	-0.019
United Arab Emirates	0.726	0.937	0.210	0.037	0.174	-0.001
United Kingdom	0.805	0.940	0.135	0.032	0.083	0.020
United States	0.875	0.927	0.052	0.015	0.014	0.023
Uruguay	0.703	0.830	0.127	0.023	0.067	0.037
Venezuela (Bolivarian Republic of)	0.662	0.699	0.038	-0.002	0.088	-0.049
Viet Nam	0.499	0.727	0.229	0.022	0.116	0.090
Yemen	0.373	0.430	0.057	0.018	0.077	-0.038
Zambia	0.417	0.569	0.152	0.067	0.065	0.020
Zimbabwe	0.480	0.551	0.071	0.000	0.056	0.015

Source: Author's calculations

The progress has been different in different regions of the world or in different groups of countries. Among different regions of the world, the progress in human development has been the most rapid in East Asia and the Pacific in terms of *HDS* and the progress in the income dimension of human development has largely been responsible for the rapid progress in human development in

the region as it accounted for 40 per cent of the increase in *HDS* which is the highest among all the regions. In the Arab States, and in Europe and Latin America, the progress in human development has been driven primarily by the progress in the education dimension of human development. In all the three regions, the progress in education dimension accounted for more than 60 per cent increase in *HDS*. The slow progress in human development in Sub-Saharan Africa has been mainly because of very slow progress in the income dimension of human development.

The relative contribution of the improvement in the three dimensions of human development to the increase in *HDS* has also been different in different groups of countries classified by the level of *HDI*, although the primary contributor has been the been the progress in the education dimension. In countries having very high level of human development in 1990 ($HDI \geq 0.800$), and in countries at low level of human development ($HDI < 0.550$), almost 60 per cent of the increase in *HDS* is attributed to the progress in the education dimension of human development. By contrast, the progress in the income dimension accounted for less than 20 per cent of the increase in *HDS* in countries at very high level of human development ($HDI \geq 0.800$) but only about 10 per cent in countries at low level of human development ($HDI < 0.550$). In countries at high level of human development ($0.700 \leq HDI < 0.800$) and in countries at medium level of human development ($0.550 \leq HDI < 0.700$), progress in the education dimension has accounted for only about 50 per cent of the increase in *HDS*, but the progress in the income dimension has accounted for a substantial increase in *HDS*. In countries with high level of human development ($0.700 \leq HDI < 0.800$), the contribution of the progress in the health dimension to the increase in *HDS* has been quite low.

The contribution of the progress in the three dimensions of human development to the progress in human development as measured in terms of *HDS* has also been different in different countries (Table 4). There are 8 countries where the progress in the health dimension has been negative during 1990-2022 as the life expectancy at birth decreased, instead increased, in these countries during this period. Similarly, there are 18 countries where the progress in the income dimension has been negative as the index *i* decreased between 1990 and 2022. On the other hand, there is only one country where the progress in the education dimension has been negative. The negative progress in different dimensions of human development contribute to decelerate the progress in human development.

In other countries where the progress in all the three dimensions has contributed to the progress in human development, the relative contribution of the progress in different dimensions to the progress in human development has been different in different countries. The contribution of the improvement in the health dimension to the increase in *HDS* ranged from only 0.85 per cent in Bulgaria to almost 88 per cent in San Marino. On the other hand, the contribution of the improvement in the education dimension ranged from less than 5 per cent in San Marino to almost 79 per cent I Mauritania. The contribution of the improvement in the income dimension, on the other hand, ranged from only 0.7 per cent in Gambia to more than 56 per cent in Guyana. There are only 3 countries, Guyana, Namibia, and Syrian Arab Republic, where the progress in the income dimension accounted for more than 50 per cent of the increase in *HDS*. Similarly, there are only 4 countries, Congo, Libya, San Marino, and Tajikistan, where the progress in the health dimension accounted for more than 50 per cent increase in *HDS* during 1990-2022. By contrast, there are 105 countries where the progress in the education dimension has accounted for more than half of the increase in *HDS*. In most of the countries, the progress in human development has largely been driven by the progress in the education dimension of human development.

It is also obvious from table 4 that the progress in human development in most of the countries has been imbalanced in the sense that above average progress in one or two dimensions of human development has been associated with below average progress in the remaining dimensions of human development. The contribution of the progress in all the three dimensions of human development to the increase in *HDS* has been almost the same in Lao People's Democratic Republic. There are only 44 countries in which the contribution of progress in the three dimensions to the increase in *HDS* during 1990-2022 has nearly been the same. On the other hand, the entire increase in *HDS* during 1990-2022 in Ukraine has been due to the progress in the education

dimension as the progress in the health dimension and the income dimension has been negative in the country during this period. In Venezuela also, the progress in human development, as measured in terms of *HDS* has also been confined to the progress in the education dimension alone as the progress has been negative in both health dimension and the income dimension. There are 7 other countries also where the progress in the three dimensions of human development has been highly unequal. These countries are Central African Republic, Eswatini, Lesotho, Libya, Namibia, Syrian Arba Republic, and Yemen. In all these countries the progress has been negative in either the health or the income dimension of human development. In other countries, although there has been progress in all the three dimensions of human development, yet the contribution of the progress in different dimensions to the increase in *HDS* has not been the same.

Classification of Countries

The progress in the three dimensions of human development during 1990-2022 has been different in different countries. We have, therefore grouped countries by the progress in human development as measured through the increase in *HDS* by taking into consideration the progress in the three dimensions of human development. The classification modeling approach (Han et al. 2012; Tan et al. 2006) has been used for the purpose and the classification and regression tree (CRT) technique (Breiman et al. 1984) is applied. CRT is a nonparametric, recursive partitioning technique that divides countries into mutually exclusive and exhaustive groups in such a way that the within-group homogeneity with respect to the variable of interest or the dependent variable, the increase in *HDS* is maximized. The technique makes no assumption about the data. It can be applied to both quantitative and categorical data as well as the combination of the two. A group, in which the dependent variable is the same for all countries within the group, is termed as "pure." If a group is not pure, then the method provides the measure of impurity within the group and gives the parameters of the distribution of the dependent variable across countries within the group (Chaurasia 2018). If the dependent variable is categorical, the technique generates the classification tree. If the dependent variable is continuous, then the technique generates regression tree. In the present case, the variable of interest is the increase in *SDH* which is a continuous variable so that the classification exercise has generated the regression tree and provided the mean and the standard deviation of the distribution of the increase in *HDS* across countries within each group. All the three explanatory variables - increase in indexes *h*, *e*, and *i* – are also continuous variables.

Table 5 presents results of classification modelling, and the regression tree is depicted in figure 1. The classification exercise has grouped the 143 countries for which the increase in *SDH* during 1990-2022 could be calculated into 10 mutually exclusive and exhaustive groups and, in each group, the average increase in *HDS* has been different. The group where there has been the smallest increase in *HDS*, on average, comprises of 8 countries. The average increase in *HDS* in countries of this group has been 0.028 ± 0.023 with the range 0.004 to 0.058. The countries included in this group are characterised by the lowest increase in the health index *h* ($<=0.054$) and the lowest increase in the education index *e* ($<=0.132$) whereas the increase in the income index *I* varies from -0.058 to 0.071. On the other hand, there are 7 countries where the increase in *HDS* has been the highest, on average, among the 143 countries. The average increase in *HDS* in countries of this group has been 0.232 ± 0.031 with the range 0.221 to 0.302. The countries of this group are characterised by the rapid progress in all the three dimensions of human development as reflected through the increase in the three indexes. In addition, there are 10 countries where the progress in human development has also been quite rapid during the period 1990-2022. The average increase in *HDS* in the countries included in this group has been 0.204 ± 0.023. The progress in the health dimension of human development in the countries of this group has been relatively slow. In majority of the countries, however, *HDS* increased in the between 0.057 to 0.149 with an average increase of 0.114 ± 0.019. In the countries of this group, the increase in the education index *e* ranged between 0.132 and 0.238, whereas the increase in the health index *h* ranged between 0.032 and 0.179. However, the increase in the income index *i* has been less than 0.075 (Figure 2).

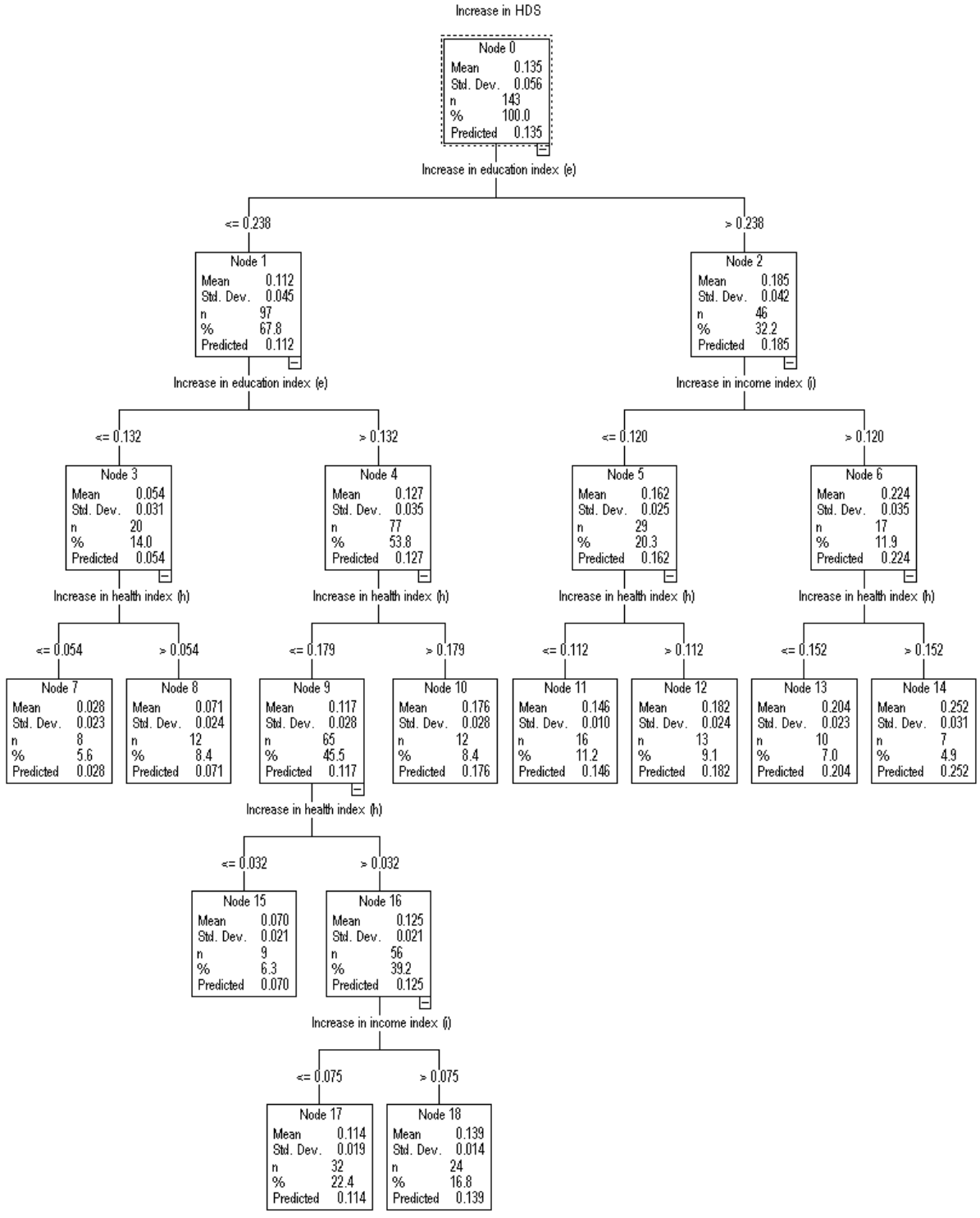

Figure 1: Classification of countries by the increase in *HDS* during 1990-2022.
Source: Author

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 *HDS*.

Node	Number of countries	Increase in *HDS* during 1990-2022		Increase in the index		
		Mean	*SD*	*h*	*e*	*i*
7	8	0.028	0.023	≤0.054	≤0.132	
8	12	0.070	0.024	>0.054	≤0.132	
10	12	0.176	0.028	>0.179	>0.132, ≤0.238	
11	16	0.146	0.010	≤0.112	>0.238	≤0.120
12	13	0.182	0.024	>0.112	>0.238	≤0.120
13	10	0.204	0.023	≤0.152	>0.238	>0.120
14	7	0.252	0.031	>0.152	>0.238	>0.120
15	9	0.070	0.021	≤0.032	>0.132, ≤0.238	
17	32	0.114	0.019	>0.032, ≤0.179	>0.132, ≤0.238	≤0.075
10	24	0.139	0.014	>0.032, ≤0.179	>0.132, ≤0.238	>0.075
All	143	0.135	0.058			

Source: Author

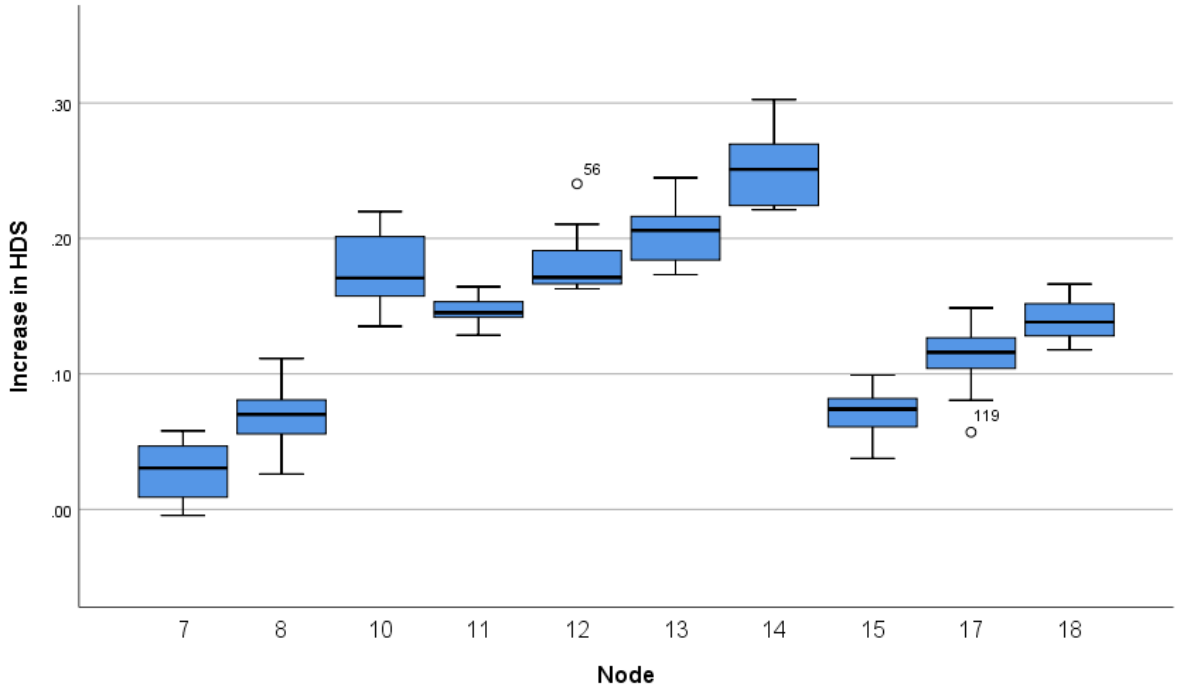

Figure 2: Distribution of countries within different groups of countries (nodes) identified through the classification analysis.
Source: Author

The classification exercise also reveals that the relative importance of the progress in different dimensions of human development in classifying countries in terms of the progress in human development has been different. The progress in the education dimension of human development has been the most important in classifying countries according to the progress in human development, as measured by the increase in *HDS*, closely followed by the progress in the income dimension of human development. By comparison, the importance of the progress in the health dimension of human development in classifying countries according to the progress in human development has been low. Relative to the importance of the education dimension, the importance of the income dimension in classifying countries has been 97 per cent but the importance of the progress in the health dimension in classifying countries in terms of the progress in human development has been only about 43 per cent.

Impact of COVID-19

The COVID-19 pandemic unleashed a human development crisis in the world as *HDS* decreased from 0.740 in 2019 to 0.735 in 2021. This reversal in human progress is attributed to the health effect of the pandemic as the life expectancy at birth in the world decreased from around 73 years in 2019 to around 71.4 years in 2021 so that the health index *h* decreased from 0.816 to 0.790. The education index *e* and the income index *i* increased during the pandemic but the progress in education and income dimensions could not compensate for the reversal in the progress in the health dimension. The decrease in the health index *h* during pandemic accounted for a decrease of 0.0075 in *HDS* whereas the increase in the education index *e* and income index *i* accounted for an increase of 0.0032 in *HDS* so that *HDS* decreased by 0.0043 points during pandemic. It appears that the reversal in the progress in health dimension has also contributed to decelerating the progress in education and income dimensions of human development.

The COVID-19 pandemic has also resulted in a reversal in human progress in all regions of the world except the East Asia and the Pacific region. The impact of the pandemic on human progress has been the most marked in Latin America where *HDS* decreased by 0.014 points between 2019 and 2021. In Europe, *HDS* decreased by 0.010 points between 2019 and 2020 but, between 2020 and 2021, *HDS* increased by 0.005 points. In the East Asia and the Pacific region, on the other hand, *HDS* increased by 0.004 points during the pandemic despite a decrease in the life expectancy at birth in from 76.0 years in 2019 to 75.6 years in 2021 which accounted for a decrease of 0.002 points in *HDS*. However, the negative contribution of the reversal in progress in the health dimension in the region has been more than compensated but progress in education and health dimensions which accounted for an increase of 0.0065 in *HDS*.

Among the 192 countries for which estimates of *HDS* are available for the years 2019 and 2021, the progress in human development reversed in 145 countries during the pandemic years whereas 47 countries recorded progress in human development even during the pandemic. The most rapid progress in human development during the pandemic has been recorded in Bangladesh where *HDS* increased by 0.016 points – from 0.648 in 2019 to 0.664 in 2021. The health index *h* in Bangladesh decreased by 0.006 points but the education index *e* increased by 0.035 points and the income index *i* increased by 0.013 points so that the reversal in progress in the health dimension has been more than compensated by the progress in the education and income dimensions in the country. On the other hand, the reversal in human progress during the pandemic has been the most rapid in Timor-Leste where *HDS* decreased by more than 0.051 points between 2019 and 2021 because of the decrease of 0.008 points in the health index *h* and a very rapid decrease of 0.139 points in the income index *i*, although the education index *e* increased by 0.007 points even during the pandemic.

In many countries, the COVID-19 pandemic has hit the progress in education and income dimensions also. In 20 countries, the progress during pandemic reversed in all the three dimensions of human development whereas in 17 countries, progress reversed in health and education dimensions but not in income dimension. In 47 countries, progress reversed in the health dimension, but these countries recorded progress during pandemic in the other two dimensions and, in 17 countries, progress in education and income dimensions more than compensated the reversal in progress in health dimension. On the other hand, there are only 11 countries which recorded progress in all the three dimensions of human development even during the pandemic whereas, in 17 countries, the progress reversed in the income dimension only and the progress in human development reversed in 8 of these 17 countries. This leaves only 4 countries which recorded progress in health dimension even during the pandemic but in 2 of these 4 countries progress reversed in both education and income dimension while, in 2 countries, the progress reversed in education dimension only. However, in all these 4 countries, the progress reversed in human development during the pandemic. Table 6 gives the distribution of countries by the progress in the three dimensions of human development and the progress in human development during the COVID-19 pandemic.

Table 6: Distribution of 192 countries by the progress in human development during the COVID-19 pandemic.

Progress during COVID-19 pandemic in the dimension of			Progress during COVID-19 pandemic in human development	
Health	Education	Income	Reversed	Not reversed
Reversed	Reversed	Reversed	Brunei Darussalam, Cabo Verde, Cuba, Lebanon, Libya, Madagascar, Malaysia, Mali, Mauritania, Mauritius, Mexico, Micronesia, Mongolia, Nepal, North Macedonia, Palestine State of, Philippines, Thailand, Ukraine, Venezuela	
Reversed	Reversed	Not reversed	Venezuela, Albania, Azerbaijan, Belarus, Belize, Benin, Bulgaria, Dominica, Guatemala, Kenya, Lao People Democratic Republic, New Zealand, Oman, Paraguay, Serbia, Tanzania, United States, Uzbekistan	
Reversed	Not reversed	Reversed	Afghanistan, Algeria, Andorra, Angola, Antigua, Argentina, Armenia, Bahrain, Bolivia, Botswana, Burundi, Cambodia, Cameroon, Central Africa Republic, Chad, Chile, Dominica, Ecuador, Equatorial Gini, Fiji, Gabon, Gambia, Germany, Greece, Guinea, Guinea-Bissau, Haiti, Honduras, India, Iraq, Jamaica, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lesotho, Liberia, Malawi, Maldives, Montenegro, Mozambique, Myanmar, Namibia, Netherlands, Niger, Panama, Peru, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Sierra Leone, Solomon Islands, South Africa, South Sudan, Spain, Sudan, Suriname, Timor-Leste, Trinidad, Tunisia, United Arab Emirates, United Kingdom, Uruguay, Yemen, Zambia, Zimbabwe	Austria, Comoros, Cyprus, France, Italy, Morocco, Nigeria, Papua New Gini, Portugal, Saudi Arabia
Reversed	Not reversed	Not reversed	Bosnia and Herzegovina, Brazil, Burkina Faso, Colombia, Congo (Democratic Republic of the), Costa Rica, Czechia, El Salvador, Estonia, Eswatini, Georgia, Hungary, Indonesia, Iran (Islamic Republic of), Latvia, Liechtenstein, Lithuania, Moldova, Pakistan, Poland, Qatar, Romania, Russian, San Marino, Sao Tome and Principe, Senegal, Singapore, Slovakia, Slovenia, Türkiye	Bangladesh, Côte d'Ivoire, Croatia, Denmark, Djibouti, Egypt, Eritrea, Ethiopia, Ghana, Guyana, Ireland, Israel, Nicaragua, Rwanda, Sweden, Uganda, Viet Nam
Not reversed	Reversed	Reversed	Samoa, Syrian Arab Republic	
Not reversed	Reversed	Not reversed	Luxembourg, Tajikistan	
Not reversed	Not reversed	Reversed	Bahamas, Barbados, Grenada, Iceland, Kiribati, Saint Kitts and Nevis, Tonga, Tuvalu	Belgium, Bhutan, Canada, Congo, Japan, Marshall, Sri Lanka, Turkmenistan, Vanuatu
Not reversed	Not reversed	Not reversed		Australia, China, Finland, Hong Kong, Korea (Republic of), Malta, Nauru, Norway, Palau, Switzerland, Togo

Source: Author

Summary and Conclusions

In this paper, we have used an alternative measure of human development (*HDS*) to chart the progress in human development in the world, in its different regions and countries during the 30 years period 1990-2020. This alternative measure is based on the same indexes of health, education and income that are used by the United Nations to construct the human development index (*HDI*) but uses a different aggregation function to combine the indexes of health, education and income that is based on the concept of human development surface. The advantage of this alternative measure of human development is that it addresses most of the problems associated with aggregating the three indexes related to health, education, and income dimensions of human development through either the arithmetic mean or the geometric mean. Another advantage of the alternative measure of human development used in this analysis is that it accounts for the interaction between the three dimensions of human development.

Application of the alternative measure of human development to 143 countries for which estimates indexes of health, education and income have been made available by the United Nations for the period 1990 through 2022 reveals that the progress in human development has varied widely across countries and there are countries where progress in either health or income dimensions of human dimension has reversed between 1990 and 2022. The analysis also suggests that the progress in human development in the world and in its most of the countries 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 has only been secondary which has relevance to human development policy and efforts directed towards balanced human progress. It is expected that improvement in the education dimension of human development or in terms of broadening the opportunities for the people should have resulted in expanding their capacities and in enhancing their sustenance. However, the experience of the human development movement in the world during the three decades between 1990 and 2021, as revealed through the present analysis, indicates that this has not happened in most of the countries. This mismatch in the progress in different dimension of human development has implications for the efforts directed towards hastening the pace of human progress at both international and national levels.

The present analysis also reveals that the COVID-19 pandemic, 2019-2021 has moved back the global human development movement by at least three years and the impact of the pandemic has not been confined to the progress in the health dimension of human development only, although in most of the countries, the pandemic has reversed the progress in the health dimension of human development. There are many countries in which the pandemic has also reversed the progress in the education and the income dimension of human development in many countries. There is, however, only a small proportion of countries in which the COVID-19 pandemic has impacted the progress in all the three dimensions of human development. Similarly, there is only a small number of countries which recorded progress in all the three dimensions of human development even during the pandemic.

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