Inequality-adjusted Human Development Index for India's States

2011

M.H. Suryanarayana, Ankush Agrawal and K. Seeta Prabhu

United Nations Development Programme
55, Lodi Estate
New Delhi - 110003
India

© UNDP India 2011

Disclaimer: The views in the publication are those of the authors' and do not necessarily reflect those of the United Nations Development Programme.

Copyright © UNDP India 2011. All rights reserved. Manufactured in India

Acknowledgements

The ranking of countries on human development indices presented in Global Human Development Reports annually since 1990 has captured the imagination of policy makers, development practitioners and civil society alike. Progress on the Human Development Index (HDI) is often cited in national and international debates as a benchmark of a country's progress on key development indicators.

The 20th anniversary edition of the Global Human Development Report released in 2010 *The Real Wealth of Nations: Pathways to Human Development* introduced three new measures of human development in response to the demand that distributional concerns be integrated into measuring human development outcomes. The Inequality adjusted Human Development Index (IHDI) represents one such index which explicitly accounts for inequalities.

This discussion paper provides for the first time, IHDI estimates for Indian states following the methodology proposed in the 2010 Human Development Report. The IHDI is particularly critical in the Indian context because average indicators mask inequalities in human development attainments across India's states.

The task of calculating IHDI at the state level has been a challenging one. On behalf of the authors, we would like to thank Tushar Agrawal for arriving at estimates of average years of schooling and inequality in education and S. Chandrasekhar for estimates of school life expectancy. Many thanks to P. Arokiasamy, Ashwini Deshpande, Deepa Sankar and to the UNDP India team, in particular, Meenakshi Kathel and Ritu Mathur for their insights and comments and to Meenaz Munshi for editorial support.

We would like to take this opportunity to thank the lead authors of this paper. M.H. Suryanarayana, Professor of Economics at Indira Gandhi Institute of Development Studies, Mumbai, Ankush Agrawal, Assistant Professor at the Institute of Economic Growth, New Delhi and K. Seeta Prabhu, Senior Advisor at UNDP India for their important contribution in developing the state level inequality adjusted human development indices for India.

Caitlin Wiesen
Country Director,
UNDP India

Patrice Coeur-Bizot
United Nations Resident Coordinator &
UNDP Resident Representative, India

Abstract

The 2010 UNDP Global Human Development Report *The Real Wealth of Nations: Pathways to Human Development* introduced a new index, the Inequality-adjusted HDI aimed at capturing the distributional dimensions of human development. Three dimensions of HDI i.e. income, education and health are adjusted for inequalities in attainments across people. Globally, India is ranked 119 out of 169 countries but loses 32 percent of its value when adjusted for inequalities.

Amidst growing concern over these persistent inequalities, and in light of government emphasis on inclusive growth, this paper calculates the HDI and Inequality-adjusted HDI for states in India. The methodology adopted is similar to the approach of the HDR 2010 and data utilized from different rounds of the National Sample Survey on appropriate variables. To facilitate a cross-country comparison, the indices are normalized with reference to the goalposts outlined in the HDR 2010.

When ranked according to global goalposts, Kerala's rank is 99 (between Philippines and the Republic of Moldova) whereas Orissa is ranked 133 (between Myanmar and Yemen). Amongst India's states, Madhya Pradesh suffers the greatest loss of HDI due to inequality with 35.74 percent. Variations in IHDIs across states and a comparative analysis with global averages reveal that inequality in the distribution of human development is distinctly more pronounced in India than elsewhere.

Further, loss resulting from inequality varies across dimensions and is highest in education (43 percent), followed by health and income. Loss resulting from inequality in education is much higher than the global average of 28 percent and loss due to inequality in health is 34 percent, compared to the global average of 21 percent.

The findings of this paper suggest that human development outcomes alone, without measurement of inequalities, may significantly mask the performance of individual states.

Introduction

The 2010 UNDP HDR entitled *The Real Wealth of Nations: Pathways to Human Development* focuses specifically on inequalities in human development attainments across countries. To quantify the potential loss because of such inequalities, the Report introduces three new indices, viz., Inequality-adjusted Human Development Index (IHDI), Gender Inequality Index and Multi-dimensional Poverty Index.

The Government of India (GoI) has been concerned about rising inequalities and uneven distribution of the benefits of growth. Accordingly, the thrust of the 11th Five-Year Plan (2007-12) was on inclusive growth. The forthcoming 12th Five-Year Plan is expected to deepen and sharpen the focus on inequalities.

In view of the above, this paper presents a methodology and provides estimates for the Inequality-adjusted HDI for Indian states. The paper is organized as follows: The first section focuses on the methodology adopted to arrive at these estimates and data sources utilized. The second section outlines the IHDI estimates for India's states and findings from the analysis. The paper concludes by highlighting key areas for further research and policy interventions.

Methodology

HDIs based on international goalposts

Given the current Indian policy goals for globalization and the MDG emphasis on development partnerships for supporting countries and regions lagging behind, it is important to examine the relative standing of different Indian states in the international context. Hence, this paper estimates global HDIs across Indian states with reference to the same goalposts as the international ones. The methodology followed is the same as outlined in the HDR 2010 (UNDP 2010).[1]

[1] For further details on methodology, see Alkire and Foster (2010) and Kovacevic (2010).

Table 1: Goalposts for the Human Development Index: HDR 2010		
Dimension	**Observed maximum**	**Minimum**
Life expectancy	83.2 (Japan, 2010)	20.0
Mean years of schooling	13.2 (United States, 2000)	0
Expected years of schooling	20.6 (Australia, 2002)	0
Combined education index	0.951 (New Zealand, 2010)	0
Per capita income (PPP $)	108,211 (United Arab Emirates, 1980)	163 (Zimbabwe, 2008)

Source: UNDP (2010; p. 216)

Given this framework (UNDP 2010), the sub-indices for the three different dimensions are worked out as follows:

$$I_X = Dimension\ index\ of\ 'X' = \frac{Actual\ value - Minimum\ value}{Maximum\ value - Minimum\ value}$$

An aggregate of these sub-indices (HDI) is obtained in terms of their geometric mean as follows:

$$HDI = \sqrt[3]{I_{Life} * I_{Education} * I_{Income}}$$

Inequality-adjusted estimates corresponding to the three dimensions are obtained using the following estimator:

$$I_{I_X} = (1 - A_X) * I_X$$

Where I_{IX} is the inequality-adjusted dimension index, I_X is the dimension index and A_X is the Atkinson inequality measure for `x'th dimension. The *Human Development Report 2010*

assumes value of the aversion parameter, ε, to be 1 so that the Atkinson inequality measure becomes

$$A_X = 1 - \frac{g_X}{\mu_X} = 1 - \frac{\sqrt[n]{X_1 * X_2 * \ldots \quad * X_n}}{\bar{X}}$$

Where $\{X_{1\ldots} X_n\}$ denotes the underlying distribution of dimension X, and $\bar{X}$ its arithmetic mean.

Finally, the inequality-adjusted HDI is obtained as the geometric mean of the three-dimension indices adjusted for inequality.

$$IHDI = \sqrt[3]{I_{I_{Life}} * I_{I_{Education}} * I_{I_{Income}}}$$

Data Sources

Income

This paper uses the estimate of Gross National Income per capita (PPP US$) for India from the HDR 2010. Per capita income estimates for states are computed using the National Sample Survey (NSS) estimates of per capita personal consumer expenditure for the year 2004-05 (GoI, 2006a) assuming that size distribution of income distribution across states is the same as that of NSS consumer expenditure distribution.[2]

Taking a similar approach, we have used estimates of Atkinson measure of inequality based on the NSS unit record data on per capita consumer expenditure distribution for the year 2004-05 as proxy for corresponding inequality estimate of income. We have computed consumption inequality measures, as per UNDP (2010), after truncating the top 0.5 percentile group of the distribution, and replacing zero expenditure with minimum value of expenditure of the bottom 0.5-percentile group.

Education

The mean years of schooling of the adult population (aged 25 years and above) are estimated using the NSS data on educational status and training in India (GoI, 2006b). The same data

[2] One could have used estimates of state specific domestic product for this purpose but not followed since (i) the latter do not include inter-state remittances; and (ii) some components are based on intra/extrapolations.

source is used to obtain estimate of Atkinson inequality in levels of education. Estimates of school life expectancy[3] are made based on the NSS unit record data on education in India (GoI, 2010).

Health

The estimates of life expectancy for 16 major states are obtained from *SRS Based Abridged Life Tables 2002-2006* (GoI, 2008). The estimates of inequality have also been derived from the *SRS Based Abridged Life Tables,* which also provides a profile of mortality across age-intervals for the Indian states.

The information on life expectancy is not available for three states formed in recent years, namely, Chhattisgarh, Jharkhand, and Uttarakhand. For these states, life expectancy as well health inequality estimates corresponding to their parent states, viz., Madhya Pradesh, Bihar, and Uttar Pradesh are used.

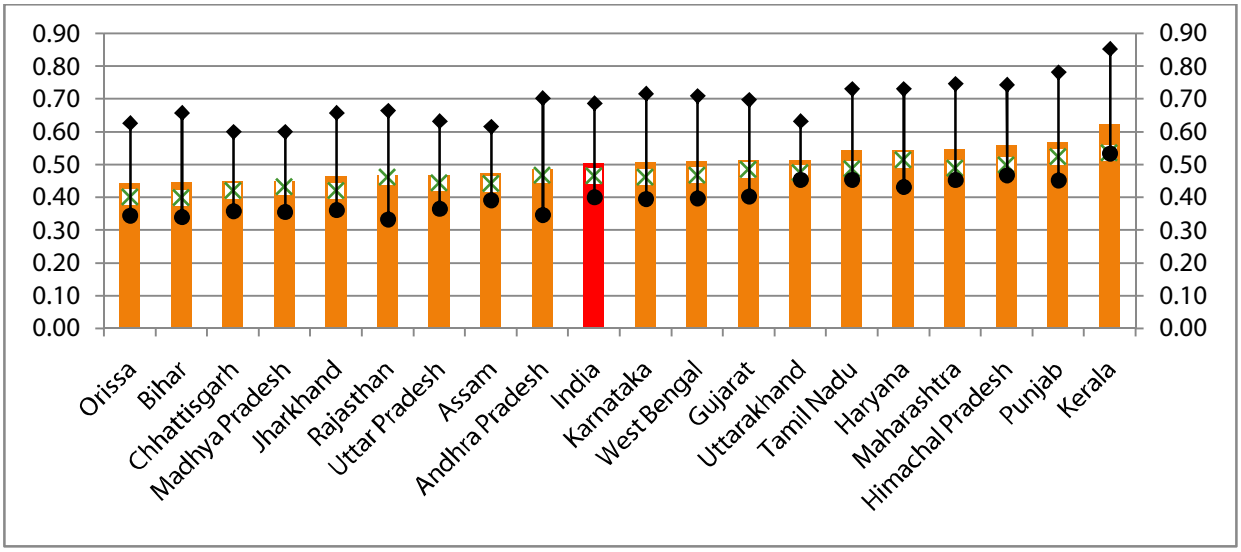
Estimates and Findings

The Human Development Index (HDI) achievements of states in India both at the aggregate and disaggregate levels are shown in Figure 1. India has a HDI value (using international goalposts) of 0.504 (Table 3). The HDI is the highest for Kerala (0.625) followed by Punjab (0.569) and the lowest for Orissa (0.442), Bihar (0.447) and Chhattisgarh (0.449).

As the graph reveals, while the HDI scores across states show little variation and range between 0.442 (Orissa) and 0.625 (Kerala), the variation in the sub-indices for education and health show a greater degree of variation. The income index shows the least degree of variation.

[3] School Life Expectancy (or Expected years of schooling) is defined as the number of years of schooling that a child of school entrance age can expect to receive if prevailing patterns of age-specific enrollment rates were to stay the same throughout the child's life (UNDP 2010). Estimates for states in India are made taking into account age-specific enrollment rates for the age group six to 18 years (both inclusive).

Figure 1: HDI and its dimensions: Indian states



Notes: Vertical bars (orange color for states and red for India) indicate the HDI; dark black circles (inside the bars) indicate the education dimension index; cross within white squares, the income dimension index; and dark black diamonds (outside the bars), the health dimension index; and the states are arranged in ascending order of their HDIs.

Inequality Adjusted Human Development Index

Tables 1 to 8 and Figures 2 and 3 provide relevant information on estimates of sub-indices and the inequality-adjustment factors for the three different human development dimensions across states.[4] The average loss due to inequality is 32 percent at the All-India level. It is the highest for Madhya Pradesh (36 percent) and Chhattisgarh (35 percent) and the lowest for Kerala (17 percent). The loss due to inequality is higher than the national level in the states of Bihar, Uttarakhand, Orissa, Jharkhand, Rajasthan, Uttar Pradesh, Chhattisgarh and Madhya Pradesh.

[4]Annexure I provides an illustration to the methodology discussed in Section 2 for the state of Andhra Pradesh.

Assam, Bihar, Gujarat, Jharkhand, Karnataka, Orissa, Rajasthan, Tamil Nadu and West Bengal improve their ranking after adjustment for inequality while Andhra Pradesh, Chhattisgarh, Haryana, Madhya Pradesh, Uttarakhand and Uttar Pradesh lose their ranks. (Table 3)

The country's achievement in terms of the normalized indices, both pre- and post-inequality adjustment, is better with respect to health dimension than for the HDI as a whole (Figure 2). The loss due to inequality is the highest with respect to education dimension (43 percent), followed by health (34 percent) and income (16 percent). In other words, the potential loss due to inequality is the highest in the education sector. The situation is similar across states.

Income Dimension

Income indicates the monetary dimension of human well-being. As many as 10 out of the 19 major states fare as good as or better than the nation as a whole in terms of the sub-index for the income dimension (0.465) (Table 4). The average loss due to inequality in income is 16 percent at the All-India level; it is highest for Maharashtra (19 percent) followed by Tamil Nadu (17 percent) and lowest for Bihar and Assam (9 percent).

Education Dimension

All states with the exception of economically poorer states of Bihar, Madhya Pradesh, Rajasthan, Orissa and Uttar Pradesh (including the newly formed states of Chhattisgarh, Jharkhand, and Uttarakhand) and Assam fare as good as or better than the nation as a whole in the sub-index of the education dimension (Table 5). Inequality in education has cost, on an average, a loss of 43 percent in the education component of HDI. The loss is the highest in Uttar Pradesh, Rajasthan, and Jharkhand (46 percent) and lowest in Kerala (23 percent) and Assam (34 percent).

The loss due to inequality is more than that at the national level in Karnataka, Haryana, Chhattisgarh, Uttarakhand, Andhra Pradesh, Bihar, Madhya Pradesh, Jharkhand, Rajasthan and Uttar Pradesh. Kerala emerges as an outlier after adjustment for inequality in education (Figure 2). This would mean that from a distributional perspective, Kerala has done exceptionally well on education in comparison with remaining states.

Health Dimension

Kerala (0.854) ranks first, followed by Punjab (0.782), Madhya Pradesh, and Chhattisgarh (0.601) in the sub-index for health (Table 6). The average loss due to inequality in health is 34 percent. It is the highest in Chhattisgarh and Madhya Pradesh (43 percent) and the lowest in Kerala (11 percent).

The loss due to inequality is higher than that at the national level in nine of the major states being analyzed. Similar to the inequality-adjusted education sub-index, Kerala emerges as an outlier (Figure 2).

The correlation between ranks based on different pairs of HDI with its sub-indices is the highest for income, followed by education and health (Table 8). The rank correlations of different pairs of normalized indices are positive and significant implying that achievement/deprivation in different dimensions co-varies across states. The same holds good for the profile based on inequality-adjusted indices.

An International Perspective

India, with a global HDI value of 0.504, falls in the category of countries with 'Medium Human Development'. It falls short of the world average, which is 0.624 (UNDP, 2010; p. 155). The loss in global HDI due to inequality is much higher in India (32 percent) than in the world as a whole (22 percent) (UNDP, 2010; p. 155).

The major states are distributed between the categories of countries with 'Medium' and 'Low Human Development' as per the HDR 2010 classification (Table 7). Kerala, with a global HDI of 0.625, is in the 'Medium HDI' category. Other major states in this group are Punjab, Himachal Pradesh, Haryana, Maharashtra, Tamil Nadu, Karnataka, Gujarat, West Bengal and Uttarakhand. Nine other states, namely Andhra Pradesh, Assam, Uttar Pradesh, Rajasthan, Jharkhand, Madhya Pradesh, Chhattisgarh, Bihar and Orissa fall in the 'Low HDI' category.
While India is ranked 119 out of 169 countries in the Global HDI, our estimates for different states range from 99 for the state of Kerala (whose Global HDI estimate places it between Philippines and the Republic of Moldova) to 133 for Orissa (whose Global HDI estimate places it between Myanmar and Yemen).

The box plot profiles for global HDI and IHDI for the Indian states, *vis-a-vis,* countries across the world highlights one major contrast. While the upper quartile for IHDI is about the median for HDI across countries, even the upper extreme value for IHDI is just above the median HDI

across the Indian states. In other words, inequality in the distribution of human development is distinctly pronounced in India in comparison with the world scenario (Figures 2 & 3).

While the plots for normalized indices across dimensions point to a progressive increase in the median from income to education to health across countries, the order is from education to income, and finally to health across the Indian states (Figure 2). In other words, education is one major human development dimension, which calls for serious policy attention to reduce disparities in attainment. Further, whereas for income, health and the HDI (and their inequality-adjusted indices), India lies in the inter-quartile range of cross-country distribution, the same is not the case with education, where the country is in the bottom quartile group (Figure 3).

The adjustment for inequality made little difference to the distributional profile of normalized indices for education across countries; but the same brought about a radical downward shift of the box plot for the Indian states (Figures 2 & 3)**.** Accordingly, the loss due to inequality for the world as a whole was 28 percent in education, while for India, it's a much higher 43 percent and the loss due to inequality in health in India is 34 percent as compared to the world average of 21 (Tables 5 & 6; UNDP, 2010; p. 155).

A striking feature of the box plot profiles is that while the distribution of HDI as well as IHDI is negatively skewed across countries, it is positively skewed across states in India (Figures 2 & 3). This would mean that the relatively better-off top half of the states are spread out over a larger interval than the bottom half calling for significant policy efforts and focus to shift the deepening inequalities.

In conclusion

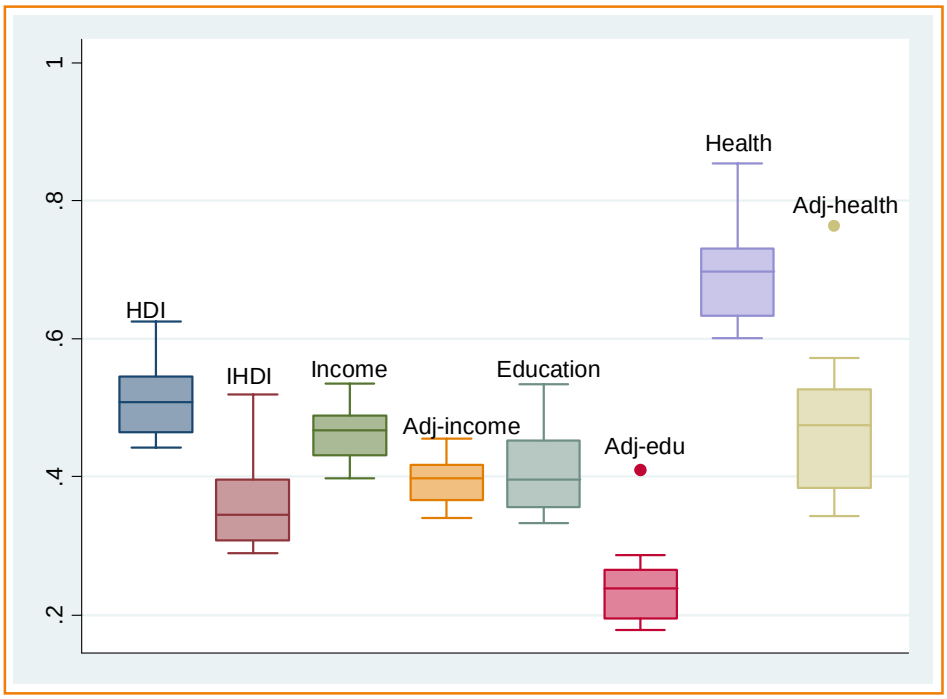
The inequality-adjusted HDI estimates for Indian states facilitate quantification of the potential loss due to inequality with respect to access to education and health. The paper briefly reviews the impact of inequalities within the states on human development outcomes of individual states. Inter-regional inequalities are likely to add another level of complexity to this scenario, but are beyond the scope of this paper and need to be explored separately.

The HDI computed using the global goalposts, classifies ten states as medium human development states, while nine are low human development states. The medium human development states show an average loss of 28 percent as a result of inequalities, while low human development states show 33 precent loss due to inequalities on an average. This indicates that the human development outcomes alone sans inequalities measurement, may mask the performance of states in a significant manner.

An analysis of the impact of inequalities at a disaggregated level reveals that inequalities in the education dimension are the highest, which is in consonance with the findings of the HDR 2010. It calls for a special focus on areas and social groups that continue to face constraints in accessing education. Similarly, the inequalities are also high in the case of health. Many studies have pointed out marked differences in access to healthcare and its utilization. In both education and health, not only is the attainment of people low, but the extent of inequality remains high.

Further research is required to explore the inter-linkages between inequalities across various dimensions and to examine the factors behind these inequalities.

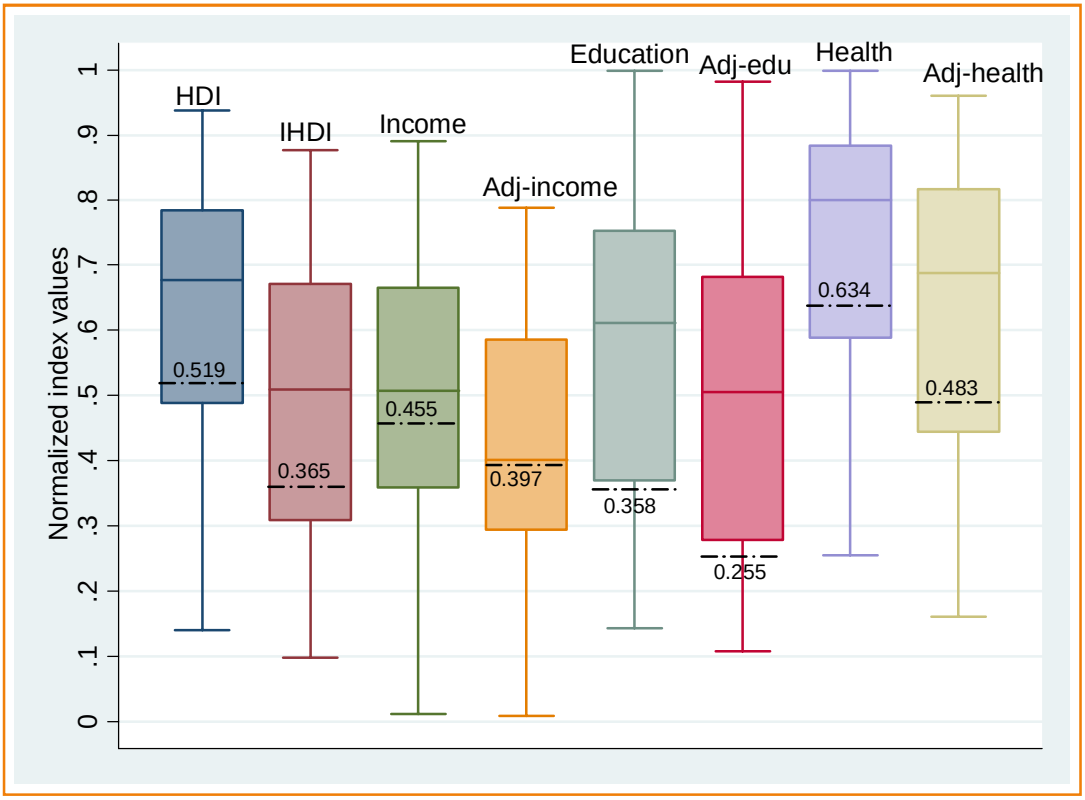
Figure 2: Box plot of HDI and its dimensions for Indian states



Source: Authors' estimates.

Notes: The dotted observation in cases of inequality-adjusted sub-indices for education and health represents Kerala, which is an outlier among the major Indian states.

Figure 3: Box plot of HDI and its dimensions for countries



Source: Based on estimates from UNDP (2010)

Note: The dashed lines and the values indicated for each plot correspond to the value of index for India.

Table 1: Key indicators: States and All-India

State	PPP Income per capita (PPP 2008 $)	Life expectancy at birth (years) (2002-2006)	Mean years of schooling (years) (2004/05)	School life expectancy (years) (2007/08)
Andhra Pradesh	3398.76	64.4	3.06	9.66
Assam	2883.44	58.9	3.96	9.54
Bihar	2161.80	61.6	2.97	9.58
Chhattisgarh	2497.00	58.0	3.39	9.31
Gujarat	3782.87	64.1	4.54	8.79
Haryana	4574.51	66.2	4.74	9.68
Himachal Pradesh	4168.39	67.0	4.88	11.05
Jharkhand	2516.41	58.0	3.32	9.68
Karnataka	3269.76	65.3	3.95	9.75
Kerala	5262.89	74.0	6.19	11.33
Madhya Pradesh	2673.76	58.0	3.47	8.95
Maharashtra	3913.14	67.2	5.12	9.86
Orissa	2185.84	59.6	3.34	8.74
Punjab	4885.12	69.4	5.12	9.80
Rajasthan	3289.27	62.0	2.96	9.19
Tamil Nadu	3835.05	66.2	4.79	10.57
Uttar Pradesh	2910.58	60.0	3.56	9.19
Uttarakhand	3536.13	60.0	4.97	10.23
West Bengal	3414.08	64.9	4.36	8.87
India	**3337.33**	**63.5**	**4.10**	**9.62**

Source: NSS data on educational status and training in India (GoI, 2006b). The same data source is used to obtain estimate of Atkinson inequality in levels of education. Estimates of School Life Expectancy are made based on the NSS unit record data on Education in India (GoI, 2010).

Table 2: Estimates of sub-indices by dimension, with and without adjustment for inequality

State	Income (x)		Education (y)		Health (z)	
	I_x	I_{Ix}	I_y	I_{Iy}	I_z	I_{Iz}
Andhra Pradesh	0.467	0.397	0.347	0.192	0.703	0.479
Assam	0.442	0.404	0.392	0.258	0.616	0.379
Bihar	0.398	0.364	0.34	0.187	0.658	0.411
Chhattisgarh	0.420	0.356	0.358	0.202	0.601	0.343
Gujarat	0.484	0.413	0.403	0.243	0.698	0.475
Haryana	0.513	0.445	0.432	0.244	0.731	0.485
Himachal Pradesh	0.499	0.433	0.468	0.287	0.744	0.527
Jharkhand	0.421	0.363	0.361	0.196	0.658	0.411
Karnataka	0.461	0.387	0.396	0.226	0.717	0.503
Kerala	0.535	0.449	0.534	0.410	0.854	0.764
Madhya Pradesh	0.431	0.366	0.355	0.194	0.601	0.343
Maharashtra	0.489	0.398	0.453	0.279	0.747	0.562
Orissa	0.400	0.341	0.345	0.199	0.627	0.380
Punjab	0.523	0.455	0.452	0.265	0.782	0.572
Rajasthan	0.462	0.409	0.333	0.179	0.665	0.400
Tamil Nadu	0.486	0.405	0.454	0.278	0.731	0.550
Uttar Pradesh	0.444	0.384	0.365	0.195	0.633	0.384
Uttarakhand	0.474	0.417	0.454	0.256	0.633	0.384
West Bengal	0.468	0.396	0.397	0.238	0.71	0.494
India	**0.465**	**0.389**	**0.400**	**0.229**	**0.688**	**0.452**

Notes:

i. The three dimensions, *viz*., income, education, and health are denoted by x, y, and z respectively; and

ii. The symbol I_j denotes the dimension index for *j*th dimension and I_{Ij}, the corresponding inequality-adjusted index.

Table 3: HDI and IHDI estimates across Indian states

State	HDI	IHDI	Ratio	Loss (%)	Rank HDI	Rank IHDI	Difference
Andhra Pradesh	0.485	0.332	0.685	31.55	11	12	-1
Assam	0.474	0.341	0.718	28.17	12	11	1
Bihar	0.447	0.303	0.679	32.06	18	16	2
Chhattisgarh	0.449	0.291	0.649	35.14	17	18	-1
Gujarat	0.514	0.363	0.705	29.50	8	7	1
Haryana	0.545	0.375	0.688	31.18	5	6	-1
Himachal Pradesh	0.558	0.403	0.722	27.81	3	3	0
Jharkhand	0.464	0.308	0.663	33.67	15	14	1
Karnataka	0.508	0.353	0.696	30.44	10	9	1
Kerala	0.625	0.520	0.832	16.78	1	1	0
Madhya Pradesh	0.451	0.290	0.643	35.74	16	19	-3
Maharashtra	0.549	0.397	0.722	27.75	4	4	0
Orissa	0.442	0.296	0.669	33.11	19	17	2
Punjab	0.569	0.410	0.720	28.04	2	2	0
Rajasthan	0.468	0.308	0.660	34.02	14	13	1
Tamil Nadu	0.544	0.396	0.727	27.28	6	5	1
Uttar Pradesh	0.468	0.307	0.655	34.47	13	15	-2
Uttarakhand	0.515	0.345	0.670	33.03	7	10	-3
West Bengal	0.509	0.360	0.707	29.30	9	8	1
India	**0.504**	**0.343**	**0.680**	**32.00**			

Note: 'Difference' denotes the difference between the 'Rank HDI' and 'Rank IHDI' above, and therefore denotes the gain/loss in ranking due to inequality-adjustment.

Table 4: Income dimension sub-index, with and without adjustment for inequality for Indian states

State	I_x	I_{Ix}	Ratio	Loss (%)
Andhra Pradesh	0.467	0.397	0.85	15.16
Assam	0.442	0.404	0.91	8.58
Bihar	0.398	0.364	0.92	8.50
Chhattisgarh	0.420	0.356	0.85	15.33
Gujarat	0.484	0.413	0.85	14.64
Haryana	0.513	0.445	0.87	13.25
Himachal Pradesh	0.499	0.433	0.87	13.22
Jharkhand	0.421	0.363	0.86	13.72
Karnataka	0.461	0.387	0.84	16.17
Kerala	0.535	0.449	0.84	16.07
Madhya Pradesh	0.431	0.366	0.85	15.10
Maharashtra	0.489	0.398	0.81	18.69
Orissa	0.400	0.341	0.85	14.71
Punjab	0.523	0.455	0.87	13.05
Rajasthan	0.462	0.409	0.88	11.53
Tamil Nadu	0.486	0.405	0.83	16.72
Uttar Pradesh	0.444	0.384	0.87	13.35
Uttarakhand	0.474	0.417	0.88	12.03
West Bengal	0.468	0.396	0.85	15.44
India	**0.465**	**0.389**	**0.84**	**16.37**

Note: The symbol I_x denotes the dimension index for *income* dimension and I_{Ix}, the corresponding inequality-adjusted index.

Table 5: Education dimension sub-index, with and without adjustment for inequality

State	I_y	I_{Iy}	Ratio	Loss (%)
Andhra Pradesh	0.347	0.192	0.55	44.60
Assam	0.392	0.258	0.66	34.21
Bihar	0.340	0.187	0.55	45.03
Chhattisgarh	0.358	0.202	0.56	43.56
Gujarat	0.403	0.243	0.60	39.70
Haryana	0.432	0.244	0.57	43.39
Himachal Pradesh	0.468	0.287	0.61	38.80
Jharkhand	0.361	0.196	0.54	45.75
Karnataka	0.396	0.226	0.57	42.85
Kerala	0.534	0.410	0.77	23.25
Madhya Pradesh	0.355	0.194	0.55	45.24
Maharashtra	0.453	0.279	0.62	38.38
Orissa	0.345	0.199	0.58	42.18
Punjab	0.452	0.265	0.59	41.40
Rajasthan	0.333	0.179	0.54	46.07
Tamil Nadu	0.454	0.278	0.61	38.66
Uttar Pradesh	0.365	0.195	0.54	46.48
Uttarakhand	0.454	0.256	0.56	43.71
West Bengal	0.397	0.238	0.60	39.89
India	**0.400**	**0.229**	**0.57**	**42.80**

Note: The symbol I_y denotes the dimension index for education dimension and I_{Iy}, the corresponding inequality-adjusted index.

Table 6: Estimates of health dimension sub-index, with and without adjustment for inequality

State	I_z	I_{Iz}	Ratio	Loss (%)
Andhra Pradesh	0.703	0.479	0.682	31.75
Assam	0.616	0.379	0.616	38.39
Bihar	0.658	0.411	0.624	37.63
Chhattisgarh	0.601	0.343	0.571	42.91
Gujarat	0.698	0.475	0.681	31.91
Haryana	0.731	0.485	0.664	33.63
Himachal Pradesh	0.744	0.527	0.708	29.17
Jharkhand	0.658	0.411	0.624	37.63
Karnataka	0.717	0.503	0.702	29.76
Kerala	0.854	0.764	0.895	10.54
Madhya Pradesh	0.601	0.343	0.571	42.91
Maharashtra	0.747	0.562	0.753	24.73
Orissa	0.627	0.380	0.607	39.31
Punjab	0.782	0.572	0.731	26.86
Rajasthan	0.665	0.400	0.602	39.79
Tamil Nadu	0.731	0.550	0.753	24.70
Uttar Pradesh	0.633	0.384	0.607	39.34
Uttarakhand	0.633	0.384	0.607	39.34
West Bengal	0.710	0.494	0.695	30.48
India	**0.688**	**0.452**	**0.657**	**34.26**

Note: The symbol I_z denotes the dimension index for health dimension and I_{Iz}, the corresponding inequality-adjusted index.

Table 7: Comparison of Indian states with other countries

HDI Rank	Country	HDI Value	IHDI Value	Loss
1 to 42	***Countries with Very High HDI***	***0.788-0.938***	***0.700-0.876***	***6.1-16.7***
43 to 85	***Countries with High HDI***	***0.677-0.784***	***0.492-0.693***	***8.1-30.7***
86 to 127	***Countries with Medium HDI***	***0.488-0.669***	***0.320-0.546***	***13.5-44.3***
86	Fiji	0.669	..	..
87	Turkmenistan	0.669	0.493	26.4
88	Dominican Republic	0.663	0.499	24.8
89	China	0.663	0.511	23.0
90	El Salvador	0.659	0.477	27.6
91	Sri Lanka	0.658	0.546	17.1
92	Thailand	0.654	0.516	21.2
93	Gabon	0.648	0.512	21.0
94	Suriname	0.646	0.489	24.3
95	Bolivia (Plurinational State of Bolivia)	0.643	0.398	38.0
96	Paraguay	0.640	0.482	24.7
97	Philippines	0.638	0.518	18.9
98	Botswana	0.633	..	..
	Kerala	0.625	0.520	16.78
99	Moldova (Republic of Moldova)	0.623	0.539	13.5
100	Mongolia	0.622	0.527	15.2
101	Egypt	0.620	0.449	27.5
102	Uzbekistan	0.617	0.521	15.7
103	Micronesia (Federated States of Micronesia)	0.614	0.375	39.0
104	Guyana	0.611	0.497	18.6
105	Namibia	0.606	0.338	44.3
106	Honduras	0.604	0.419	30.6
107	Maldives	0.602	0.508	15.6
108	Indonesia	0.600	0.494	17.7
109	Kyrgyzstan	0.598	0.508	15.1
110	South Africa	0.597	0.411	31.2
111	Syrian Arab Republic	0.589	0.467	20.8
112	Tajikistan	0.580	0.469	19.1
113	Viet Nam	0.572	0.478	16.4
	Punjab	0.569	0.410	28.03
114	Morocco	0.567	0.407	28.1
115	Nicaragua	0.565	0.426	24.6
116	Guatemala	0.560	0.372	33.6
	Himachal Pradesh	0.558	0.403	27.81
	Maharashtra	0.549	0.397	27.75
	Haryana	0.545	0.375	31.18
	Tamil Nadu	0.544	0.396	27.27
117	Equatorial Guinea	0.538	..	..
118	Cape Verde	0.534	..	..
119	India	0.519	0.365	29.6
	Uttarakhand	0.515	0.345	33.03
	Gujarat	0.514	0.363	29.50

	West Bengal	0.509	0.360	29.30
	Karnataka	0.508	0.353	30.44
	INDIA	0.504	0.343	32.02
120	Timor-Leste	0.502	0.334	33.3
121	Swaziland	0.498	0.320	35.7
122	Lao People's Democratic Republic	0.497	0.374	24.8
123	Solomon Islands	0.494	..	..
124	Cambodia	0.494	0.351	28.8
125	Pakistan	0.490	0.336	31.5
126	Congo	0.489	0.334	31.8
127	Sao Tome and Principe	0.488	..	..
128 to 169	***Countries with Low HDI***	***0.140-0.470***	***0.098-0.383***	***19.32-45.30***
	Andhra Pradesh	0.485	0.332	31.55
	Assam	0.474	0.341	28.17
128	Kenya	0.470	0.320	31.9
129	Bangladesh	0.469	0.331	29.4
	Uttar Pradesh	0.468	0.307	34.47
	Rajasthan	0.468	0.308	34.02
130	Ghana	0.467	0.349	25.4
	Jharkhand	0.464	0.308	33.66
131	Cameroon	0.460	0.304	33.9
	Madhya Pradesh	0.451	0.290	35.73
132	Myanmar	0.451	..	..
	Chhattisgarh	0.449	0.291	35.14
	Bihar	0.447	0.303	32.05
	Orissa	0.442	0.296	33.11
133	Yemen	0.439	0.289	34.2
134	Benin	0.435	0.282	35.2
135	Madagascar	0.435	0.308	29.2
136	Mauritania	0.433	0.281	35.1
137	Papua New Guinea	0.431	..	..
138	Nepal	0.428	0.292	31.9
139	Togo	0.428	0.287	32.9
140	Comoros	0.428	0.240	43.9
141	Lesotho	0.427	0.282	34.0
142	Nigeria	0.423	0.246	41.7
143	Uganda	0.422	0.286	32.1
169	Zimbabwe	0.140	0.098	29.9

Notes:

i. The UNDP (2010) classifies countries into four ordinal groups with reference to HDI values. Since none of the Indian states has an HDI value within the limits of the first two groups, the details of these countries are not shown.

ii. The estimates in the rows, which are shaded and not numbered, are from this paper and the rest from UNDP (2010).

iii. For the four country groups, corresponding columns show the range (i.e., minimum and maximum values in each group) of HDI, IHDI and the loss.

Table 8: Correlation between ranks based on different pairs of HDI and its sub-indices

	HDI	IHDI	I_x	I_{Ix}	I_y	I_{Iy}	I_z	I_{Iz}
HDI	1							
IHDI	0.9662*	1						
I_x	0.9759*	0.9276*	1					
I_{Ix}	0.8820*	0.8284*	0.9070*	1				
I_y	0.8973*	0.8613*	0.8267*	0.7082*	1			
I_{Iy}	0.8302*	0.8398*	0.7456*	0.6421*	0.9311*	1		
I_z	0.8567*	0.9103*	0.8480*	0.6837*	0.6620*	0.6151*	1	
I_{Iz}	0.8238*	0.8941*	0.7923*	0.6052*	0.6656*	0.6166*	0.9846*	1

Notes: Please see notes to Table 2.

References

Alkire, Sabina and Foster, James (2010): "Designing the Inequality-Adjusted Human Development Index (HDI)" *OPHI Working Paper No 37*, Oxford Poverty & Human Development Initiative, Oxford.

Government of India (2006a): *Level and Pattern of Consumer Expenditure, 2004-05, NSS 61st Round (July 2004 - June 2005),* Report No. 508(61/1.0/1), National Sample Survey Organization, Ministry of Statistics and Programme Implementation, New Delhi.

Government of India (2006b): *Status of Education and Vocational Training in India 2004-05*, Report No. 517 (61/10/3), National Sample Survey Organization, Ministry of Statistics and Programme Implementation, New Delhi.

Government of India (2008): *SRS Based Abridged Life Tables 2002-2006*, Office of the Registrar General, Ministry of Home Affairs, Government of India: New Delhi.

Government of India (2010): *Education in India: 2007-08 Participation and Expenditure*, Report No. 532 (64/25.2/1), National Sample Survey Organization, Ministry of Statistics and Programme Implementation, New Delhi.

Kovacevic, Milorad (2010): *Measurement of Inequality in Human Development – A Review*, Human Development Research Paper 2010/35, UNDP, New York.

UNDP (2010): *Human Development Report 2010 The Real Wealth of Nations: Pathways to Human Development,* New York.

Annexure I
Calculating the HDI and IHDI for Indian states: An illustration

This Annexure illustrates the methodology used in the paper in the computation of Human Development Index (HDI) and Inequality-adjusted Human Development Index (IHDI) for the Indian states using the international goalposts.

1. HDI

To begin with, estimate the sub-index for each of the three dimensions as follows:

$$I_X = Dimension\ index\ of\ 'X' = \frac{Actual\ value - Minimum\ value}{Maximum\ value - Minimum\ value}$$

The goalposts used are the same as in HDR 2010 (see Section 2.1). Following *HDR 2010*, natural logarithm of income is used for the sub-index for income. It may be noted that the dimension index for education is based on two components, *viz.*, (i) mean years of schooling; and (ii) expected years of schooling (or school life expectancy), which are aggregated by their geometric mean.

An illustration is provided below with reference to the computations for the state of Andhra Pradesh as an example. The basic information for Andhra Pradesh is as follows:

Indicator	Value
Life expectancy at birth (years)	64.4
Mean years of schooling (years)	3.06
Expected years of schooling (years)	9.662
Gross State Income per capita	8.131

The computation of the Dimension Indices using the goalposts discussed in HDR 2010 is illustrated on the next page.

Income Index $= \frac{8.131-5.094}{11.592-5.094} = 0.467$

Mean Years of Schooling Index $= \frac{3.06-0}{13.2-0} = 0.232$

Expected Years of Schooling Index $= \frac{9.66-0}{20.6-0} = 0.469$

Education Index $= \frac{\sqrt{0.232*0.469}-0}{0.951-0} = 0.347$

Life Expectancy Index $= \frac{64.4-20}{83.2-20} = 0.703$

The HDI is geometric mean of the Dimension Indices of income, education and health.

HDI $= \sqrt[3]{0.467 * 0.347 * 0.703} = 0.485$

2. IHDI

Each of the Dimension Indices is adjusted for inequality using the methodology discussed in Section 2.1. To continue with our previous example of Andhra Pradesh, the values of Atkinson's inequality index (with ε = 1; the HDR 2010 assumes value of ε to be equal to one) for income, education and health are 0.152, 0.446 and 0.123 respectively (see section 2.2). The computation of the Inequality-adjusted Dimension Indices is illustrated below.

Inequality-adjusted Income Index $= 0.467 * (1 - 0.152) = 0.396$

Inequality-adjusted Education Index $= 0.347 * (1 - 0.446) = 0.192$

Inequality-adjusted Health Index $= 0.703 * (1 - 0.123) = 0.480$

The Inequality-adjusted HDI is geometric mean of the Inequality-adjusted Dimension Indices of income, education and health.

IHDI $= \sqrt[3]{0.396 * 0.192 * 0.480} = 0.332$

For queries, please email: info.in@undp.org
or contact:
United Nations Development Programme
55, Lodi Estate, P.O. Box 3059
New Delhi 110003, India
Tel: + 91-11-4653 2333
Fax: + 91-11-2462 7612