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An Alternative Approach to Measure Human Development of Haryana: Principal Component Analysis

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ABSTRACT

Human Development Index (HDI) is a compendious measure used around the world that indicates whether a country is developed, still developing, or undeveloped. HDI comprises the main elements of human life such as health, education and income. The analysis so far has been based on some popular indicators of human development. In this study effort has been made to measure human development through alternative measure like Composite index (Principal Component Analysis). Attempt has also been made to compare the positions of districts with respect to human development. Composite Index of human development has been developed by using 12 socio-economic and demographic indicators. Specifically analysis has been carried out at one point of time. The study has carried out on the data of 2009-10.

INTRODUCTION

The Human Development Index constitute a suitable kinship between economic valuation of a development viewed in terms of per capita income or consumption expenditure on one hand and social valuation as viewed in terms of health status measured through life expectancy, Infant Mortality Rate (IMR), birth rate and death rate and educational status measured through literacy combined with intensity of formal education on the other hand.

Human Development Index (HDI) is a compendious measure used around the world that indicates whether a country is developed, still developing, or undeveloped. HDI comprises the main elements of human life such as health, education and income. The analysis so far has been based on some popular indicators of human development. However, we have seen in that conventional indicators can hide many things. There are many indicators like Combined School Enrolment Ratio, Adult Literacy Rate, Infant Mortality Rate, Urbanization, Pupil-Teacher Ratio, Birth Rate, Metalled (Pucca) Road, Death Rate, Per Capita Electricity Consumption, Sex-Ratio etc., which are integral parts of human development, but rarely enter into quantification and indexing of human development progress.

Although, UNDP is regularly publishing data relating to some indicators belonging to these categories, they are not integrated with the conventional indicators (per capita income, life expectancy and education attainment) so that finer picture of the overall human development position can be received. The author is making here a modest attempt to bring a few such non-conventional indicators into the inter-district human development structure. We are here analyzing, without resorting to any complex indexing technique. Instead, we follow the simple factor analysis technique (principal component analysis).

RESEARCH METHODOLOGY

In this study effort has been made to measure human development through alternative measure like Composite index (Principal Component Analysis). Attempt has also been made to compare the positions of districts with respect to human development. Composite index of human development has been developed by using 12 socio-economic and demographic indicators. Specifically analysis has been carried out at one point of time. The study has carried out on the data of 2009-10. The statistical technique employed to develop the weighted composite index consists in finding out the principle component of the groups consisting of various variables and drive implicit weights based thereon. Technique applied here is known as "Principal Component Analysis" popularly known as factor analysis which is branch of well known multivariate analysis (Adelmon and Morris, 1967, Harman, 1967). The composite index is then constructed by combining various indicators whose implicit weights will be determined.

The Principal Component Analysis Method has been used to analyze the data because it gives mathematical weightage in a purely objective manner and provides solution to the problem of multi collinearity and assesses the relative levels of development. The data regarding all the selected indicators is subjected to this method to derive composite scores of individual districts in terms of the levels of development. The technique involves transformation of the original data set into a new set consisting of general components, the number of which equals to the number of variables in the original data set. It is generally seen that the first few components explain a greater part of the total variance in the original data set. Further, the correlation coefficient of each of the component with the variables in the original data set, i.e., the component loadings can be meaningfully interpreted only in the case of first few components. The loadings of the selected components (correlation coefficient between the component and the original values and interpreted very much in a similar way) are used as weights of the standardized values of the given variables for working out component scores corresponding to each of the observation.

"PCA describes the variation of a set of *correlated* multivariate data (X's) in terms of a set of *uncorrelated* variables (Y's), known as principal components. Each Y is a linear combination of the original variables X.

$$\text{Yij} = \sum_{j=1}^{m} \text{X i j f i j}$$

Where, Yij is the standardized values of observation 'i' on the variable 'j'; Fij is the loading of variable 'j' on the component 'J'; Yij is the score of observation 'i' on component j; and summation is overall 'm' variables. The Yij's (between -1 to 1) are the weights of each X variable contributing to the new Yi". (Y H Chan, Principal component and factor analysis). To calculate the overall score we convert the raw score to a Z-score. SPSS will do this by using Analyze - Descriptive - Descriptive Statistics - Save Standardized Values. Then we do the sum of Z-score and found the component scores for the variables. (Jeromy Anglin:- Psychology and Statistics "Calculating Composite Scores of Ability and Other Tests in SPSS"). A high and positive score indicate that a particular district is more developed than others with lower scores.

The composite indices of development will be obtained for different districts of Haryana for calculation of human development. The districts will be ranked on the basis of developmental indices. As human development depends upon many factors; therefore, a single indicator cannot be used to measure human development. Human development can only be explained by number of economic, social and demographic indicators. In this study attempt has been made to measure human development which is representative of broad spectra of indicators (12). The selection of these indicators may be arbitrary, but the author feels that it is justifiable, as the purpose is to demonstrate the need and viability of integrating such indicators into the study of human development. The following 12 indicators have been taken into study to measure human development of different districts of the Haryana.

(i) $\mathbf{X_1}$ = Per Capita Income
(ii) $\mathbf{X_2}$= Life Expectancy at Birth
(iii) $\mathbf{X_3}$= Combined School Enrolment Ratio
(iv) $\mathbf{X_4}$= Adult Literacy Rate

(v) $\mathbf{X_{5=}}$ Infant Mortality Rate
(vi) $\mathbf{X_{6=}}$ Urban Population as Percentage of Total Population
(vii) $\mathbf{X_{7=}}$ Pupil-Teacher Ratio
(viii) $\mathbf{X_{8=}}$ Crude Birth Rate
(ix) $\mathbf{X_{9=}}$ Metalled (Pucca) Road Length
(x) $\mathbf{X_{10=}}$ Crude Death Rate
(xi) $\mathbf{X_{11=}}$ Per Capita Electricity Connection
(xii) $\mathbf{X_{12=}}$ Females per Thousand Male (Sex-Ratio)

In this study the ranking of districts are according to composite index. Analysis of the ranks on the basis of composite index based on different socio-economic and demographic indicators shows that composite index definitely has an edge in explaining the human development of different districts. The main reason for this is the broad-based nature of the composite index which covers many aspects of human development.

Table- 1: Indicators of Development for 2000-01

Districts	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	Total Composite Score	Ranking Status of districts
Sonipat	0.5844	-0.3906	-0.5428	-0.3672	0.8793	0.3214	0.2634	0.1969	1.6057	-0.9098	-0.1112	0.3565	0.1283	8
Rohtak	0.4779	-0.0674	-0.3765	0.2214	2.4327	0.1254	1.3959	1.1420	-0.98	-2.4999	0.2303	0.4593	2.6967	7
Panipat	0.47769	0.31347	1.41834	1.65119	1.9042	1.0324	0.4866	-1.378	0.59	-0.0218	0.6158	0.1795	5.7652	4
Rewari	-0.6967	-0.6848	1.6958	2.4928	0.2646	-0.4567	-0.4798	1.4840	0.7628	0.9592	0.8250	1.2412	3.0726	6
Mahendragarh	-1.0172	-0.74276	-0.5425	-0.53564	0.1093	0.1326	0.9676	-0.6213	0.8757	1.1783	-0.3398	0.5126	-2.721	17
Kurukshetra	0.1576	-0.1853	-0.27064	-0.4553	0.7481	-10.012	2.3879	-8.6289	-6.8957	2.6817	-3.7625	-7.2608	-0.0013	10
Yamunanagar	1.9258	0.5489	-0.7162	-0.6195	3.2356	1.0154	0.8499	-0.0826	0.1801	0.1125	1.4960	-1.2840	4.4206	5
Karnal	-0.4831	0.0207	0.0381	-0.0309	1.3014	-0.0754	0.4166	-1.1722	09775	0.1729	0.4494	-0.3969	0.8594	9
Jhajjar	-0.1628	-0.3026	-0.7797	-0.7036	0.9658	-1.1698	-0.1575	1.0098	-0.97	-0.3117	-0.0827	-0.0409	-0.9801	12
Kaithal	-0.8034	-0.0097	-0.7562	-0.7086	1.4921	-0.9590	-0.3564	-0.5725	0.5010	-0.9239	0.0376	-1.7205	-0.8047	11
Ambala	1.4769	1.9551	0.6538	1.30545	1.6659	0.7413	1.6278	0.0169	-0.4483	0.9515	0.3409	0.3387	7.0549	2
Gurgaon	2.8268	3.1878	0.1482	0.03099	1.8377	0.8162	-	0.21658	0.5538	2.4737	0.3818	-	8.0316	1

							2.3935					0.3309		
Panchkula	-0.1698	0.04941	2.6751	2.1584	1.3184	1.1029	1.0096	1.15	-1.31	1.44	-0.07	-0.82	6.0334	3
Jind	-0.5909	-0.68408	-0.70156	-0.70386	0.2429	-0.8869	-0.1257	-1.2276	0.6903	-0.2508	-1.3292	0.8416	-2.5363	16
Bhiwani	-0.6967	-0.56672	-0.71891	-0.70386	0.1806	-0.4629	-0.0956	1.0156	1.2019	-0.7928	-0.3258	-0.1004	-2.4195	15
Fatehabad	-1.1238	-0.5084	1.1585	-0.0309	0.3625	-1.1908	-0.6224	1.5812	0.9790	-1.2793	0.0119	-0.4783	-5.7398	18
Sirsa	-0.3763	-0.5906	-0.4933	-0.5364	0.19564	-1.2857	-0.5280	-1.2489	0.7541	0.2364	-0.6002	-0.4882	-5.8100	19
Faridabad	-0.3763	-0.6848	-0.7688	-0.7086	0.1651	-0.6339	-0.0557	-0.2109	-1.4528	-0.9821	0.4716	0.4619	-2.379	14
Hisar	-0.4831	-0.6574	-0.5136	-0.7086	0.1285	2.4649	-1.8734	-0.0404	0.1917	-0.9001	-1.9900	-0.3628	-2.2374	13

Source: Calculated by Author

These overall scores have been classified into four categories as given in table:

Category (Overall Score)	No. of Districts	Name of Districts
High(Above 5)	2	Panchkula, Gurgaon.
Moderate(0 to 5)	8	Panipat, Kurukshetra, Sonipat, Yamunanagar, Karnal, Ambala, Faridabad, Rewari.
Low(-5 to 0)	6	Jhajjar, Sirsa, Bhiwani, Hisar, Rohtak, Kaithal.
Very Low(below -5)	3	Jind, Fatehabad, Mahendragarh.

Accordingly the state has been regionalized into four regions:

(1) Areas having high level of development. (above 5)
(2) Areas having moderate level of development. (0 to 5)
(3) Areas having low level of development. (0 to -5)
(4) Areas having high level of development. (below -5)

The discussion is based on the data given in table for the time 2009-10.

(1) Areas having high level of development. (Above 5): After looking at all the socio-economic indicators, we come to know only two districts are highly developed. Two districts namely Gurgaon, Panchkula have been included in this region. The overall score value under this category is above 5. Almost all the indicators are favourable and responsible for high level of development in this region. In this regard Gurgaon is the most developed district followed by district Panchkula in 2009-10. Position of Gurgaon and Panchkula has remained top in both the years. Highly developed region Gurgaon is near national capital and Panchkula is near state capital Chandigarh. Both the districts are highly urbanized, literate and economically strong districts.

(2) Areas having moderate level of development. (0 to 5): Moderately developed region of the state is comprised of eight districts i.e. Panipat, Kurukshetra, Sonipat, Yamunanagar, Karnal, Ambala, Faridabad, Rewari. District Rewari has recruitment centre for armed forces. A large male folk is employed in these services which ultimately increases awareness among people. District Karnal is agriculturally developed district and have vast potential of agro-based industries. All these things ultimately results in overall development of these regions.
(3) Areas having low level of development. (0 to -5): Jhajjar, Sirsa, Bhiwani, Hisar, Rohtak, Kaithal are the six districts having low level of development.
(4) Areas having high level of development. (Below -5): Jind, Fatehabad, Mahendragarh is included in this category. The overall score value under this category is below 5. Regarding infrastructural development also, this region is most deficient part of the state. District Sirsa is the least developed district.

CONCLUSION AND RESULT

The overall results represent that Mahendragarh district in the extreme southern west part of the state is least developed. It occupies the 19th position in 2009-10. North-eastern Haryana, southern east part of the state and Sirsa district have low level of development. Rewari, Yamunanagar, Sonipat, Karnal are moderately developed districts. There seems to be improvement in the position of Faridabad, Kurukshetra, Rohtak, Kaithal, Jhajjar and western Haryana are moderately developed in this regard. Fatehabad is the least developed district. It reveals that Gurgaon and Panchkula districts are highly developed in this regard. Four districts namely Kurukshetra, Rewari, Bhiwani and Jhajjar are moderately developed. Fatehabad, Rohtak, Hisar and Panipat are the four districts falling in category of very low (below 5). Low grade facility is available in all rest of the ten districts.

This study throws light on Principle Component Analysis approach for calculation of HDI in Haryana with inter-district variations in 2009-10. However, in all, Jhajjar, Fatehabad, Rewari, Panchkula and Hisar are well performers in achieving development level, as their HDI level is not only higher than other districts. Thus, in spite of less development, they are performing well in providing opportunities of education and health facilities.

For 2009-10, For instance, Rewari, Jhajjar, Jind have performed very well in terms of human development and have been able to occupy higher ranks in this respect in 2000-10 by UNDP Approach, but not in attaining same level of development by PCA method also as Rewari occupy 9th, Jhajjar 16th and Jind 18th rank in terms of HDI. As all the basic amenities are increased in all the districts in a decade

So far as human development is concerned, it is more a matter of more socio- economic variable availability needed to improve the level of human development of any economy. An increase in literacy, work participation rate and engagement in economic activities/economic growth measured by per-capita income index have not translated effectively in terms of providing a high level of human development status in the society.

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Appendix

Raw Data of all the indicators selected for the year 2009-10

District	Per Capita Income	Sex Ratio	Crude Death rate	Metalled Road Length	Crude Birth rate	Life Expectancy at Birth	Combined School Enrolment Ratio	Adult Literacy Rate	Infant Mortality Rate	Urbanisation	Pupil-Teacher Ratio	Electricity Connections
Ambala	54460	121	0.299	1274	0.840	61.1	64.4	81.75	8.307	44.38	26	343837
Panchkula	62483	112	0.123	601	0.510	65.5	64.5	81.88	4.324	54.87	27	342203
Yamuna Nagar	40961	120	0.295	1177	0.887	57.6	70.9	77.99	10.171	38.94	29	345102
Kurukshetra	37735	134	0.213	1177	0.845	61.7	87.1	76.31	8.070	28.93	29	213408
Kaithal	30942	124	0.248	1822	0.877	63.3	104.4	69.15	5.081	21.97	29	191599
Karnal	42888	125	0.342	1603	1.228	59.6	87.7	74.73	8.894	30.27	34	319290
Panipat	81203	120	0.221	898	1.070	67.7	59.1	75.94	2.467	45.97	28	217704
Sonipat	41420	124	0.331	1431	1.152	63.1	110.6	79.12	5.374	30.52	35	299767
Rohtak	35733	122	0.478	1035	1.028	55.5	69.2	80.22	20.099	42.02	8	243845
Jhajjar	38519	128	0.207	1329	0.577	64.1	94.2	80.65	5.188	25.39	26	182079
Faridabad	67137	114	0.286	533	1.515	65.1	119.7	81.7	5.178	79.44	66	533816
Gurgaon	230489	115	0.257	832	1.214	68.0	102.2	84.7	2.663	68.82	36	425508
Rewari	53753	119	0.196	720	0.774	66.8	79	80.99	3.923	25.82	26	299342
Mahendra Garh	26253	109	0.194	948	0.660	59.1	109.8	77.72	8.953	14.43	27	363560
Bhiwani	30893	128	0.343	1018	1.263	57.2	102.2	75.21	9.990	19.80	35	292186
Jind	31429	130	0.305	1032	1.035	61.9	102.8	71.44	7.767	22.82	31	261565
Hisar	40349	118	0.456	2429	1.518	57.0	69.2	72.89	12.726	31.73	16	492271
Fatehabad	37338	121	0.205	1129	0.905	62.4	71.4	67.92	6.754	19.04	35	271002
Sirsa	39537	122	0.271	2213	1.021	62.8	77.6	68.82	6.180	34.79	39	271128