A state level analysis of the status of social sector in India

Nayak, Purusottam and Mishra, SK

North-Eastern Hill University, Shillong (India)

27 August 2014

A State Level Analysis of the Status of Social Sector in India

Purusottam Nayak & Sudhanshu K Mishra
Dept. of Economics, North-Eastern Hill Uiversity, Shillong (India)

1. Introduction: It is theoretically expected that a self-organizing market-based economy would satisfy the welfare needs of the society as much as it would be able to optimally allocate the resources and generate correct prices for the same. However, a real-world economy is much more complex and imperfect. Also, it is not well understood whether such self-organization is quick (within a short period of, say, a year) or time-taking (spanning over decades or more). It is required, therefore, that the extra-market forces in general and public efforts in particular should correct the unsolicited outcome of the market-based forces. Social sector or the realm of activities that are not based on profit motive but have an alternative motive of welfare or correction of the said unsolicited imbalance have an important role to play to maintain the health of the economy and society. That is why the social sector has emerged as a significant sector and it claims a sizeable proportion of the public expenditure on regular basis. Of late, with an ever increasing concern of the government and policy makers with human development that incorporates health and education as very important components of it, development of infrastructure and services in the social sector is considered extremely important. This sector of development, therefore, claims a large public expenditure. This work is concerned with the growth of public expenditure on, and status of, social sector in India. The analysis is carried out at the state level (including the Union Territories).

2. Magnitude and Growth of Public Expenditure on the Social Sector: Public expenditure on social sector (SSE) exceeds Rs. 7 thousand billions (in 2012-13, Revised Budget Estimates). In Table-1(a) and Table-1(b) a scenario of increase in public expenditure on social sector is presented. The index values are computed considering 2012-13 expenditure on social sector (in the State) as 100. Data for Union Territories are not available (NA). In case of the states that were created after 1991, the data are available from the year of creation/afterward. In such cases, NA means non-applicability. In Table-2 we have presented the average (estimated) growth rate of the SSE index for different states. These growth rates (β) are estimated by fitting the regression equation $\log_{10}(SSE\_Index) = \alpha + \beta t + \varepsilon$, where t varies from the initial year to the terminal year for the state concerned. In most of the states, the initial year (under consideration) is 1990-91. However, for newly created states such as Chhattisgarh and Uttarkhand, the initial year is 2000-01 and for Jharkhand it is 2001-02. For all states the terminal year is 2012-13. A perusal of Table-2 suggests that the states such as Uttarakhand, Chhattisgarh, Bihar, Madhya Pradesh, Delhi, Punjab, Jharkhand and Odisha have $0.937 < \beta \leq 0.98$. The states such as Haryana, West Bengal, Uttar Pradesh, Arunachal Pradesh, Kerala, Meghalaya, Gujarat, Tripura, Nagaland, Tamil Nadu and Assam have $0.98 < \beta \leq 0.99$. Other

States, viz. Manipur, Karnataka, Mizoram, Andhra Pradesh, Goa, Himachal Pradesh, Maharashtra, Rajasthan, Sikkim and Jammu & Kashmir have $0.99 < \beta < 0.999$. Puducherry is the only state that exhibited decrease in public expenditure in 2012-13 over two previous years, 2010-2012.

TABLE-1(a): A SCENARIO OF INCREASING PUBLIC EXPENDITURE ON SOCIAL SECTOR 1990-91 to 1999-2000

State/Year	SSE*	Index values considering 2012-13 SSE as 100									
	2012-13	1990 - 91	1991 - 92	1992 - 93	1993 - 94	1994 - 95	1995 - 96	1996 - 97	1997 - 98	1998 - 99	1999 - 2000
A&N Islands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Andhra Pr.	561.7	4.88	5.55	6.52	6.98	7.60	9.81	11.18	12.03	15.90	15.72
Arunachal Pr.	23.4	5.56	5.98	7.26	8.55	9.40	11.11	13.68	14.10	14.10	15.81
Assam	171.3	5.43	6.48	6.65	8.17	8.99	10.62	9.98	11.03	12.55	15.41
Bihar	387.5	6.14	7.92	8.10	8.85	9.08	9.81	10.35	11.28	13.81	21.52
Chandigarh	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chhattisgarh	201.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D&N Haveli	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Daman & Diu	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Delhi	155.7	0.00	0.00	0.00	2.50	7.45	8.80	10.98	13.10	14.39	15.80
Goa	31.4	5.10	5.73	6.05	7.01	7.01	8.28	9.24	11.15	13.06	14.97
Gujarat	392.4	5.07	5.96	6.27	7.24	8.33	9.35	10.37	12.61	16.85	19.29
Haryana	194.9	4.00	4.00	4.93	5.59	6.67	8.72	8.36	9.39	12.67	13.19
Himachal Pr.	73.5	5.99	6.67	7.89	8.44	9.93	11.97	13.47	16.87	21.09	23.13
J&Kashmir	90.7	6.62	8.05	9.81	9.92	11.58	13.45	15.33	17.86	16.54	19.07
Jharkhand	166.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Karnataka	427.5	4.30	5.38	5.99	7.16	8.07	9.36	10.60	11.44	13.68	15.91
Kerala	217.0	6.82	7.33	8.25	9.49	11.01	12.40	14.79	19.54	21.47	25.02
Lakshadweep	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Madhya Pr.	358.2	6.81	7.43	8.43	9.80	10.75	12.34	14.71	15.69	19.24	20.71
Maharashtra	738.2	5.13	6.23	7.53	8.40	9.10	11.32	12.46	14.37	15.46	17.39
Manipur	24.8	6.05	7.26	8.06	8.47	9.68	12.50	15.32	16.94	15.73	24.60
Meghalaya	31.4	5.10	6.05	6.37	7.64	7.01	9.24	9.87	10.83	12.42	15.92
Mizoram	22.9	6.55	7.42	8.73	9.17	10.48	12.66	14.85	13.97	16.59	22.27
Nagaland	22.8	7.89	7.89	9.65	11.84	13.16	15.79	15.35	16.23	18.42	21.05
Odisha	215.1	5.16	6.09	6.93	8.14	8.65	10.18	11.48	12.27	15.11	22.73
Puducherry	15.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Punjab	168.7	5.69	6.52	6.28	7.88	9.31	10.49	7.29	13.28	18.08	16.12
Rajasthan	365.0	5.12	5.59	6.55	7.62	9.01	10.71	11.84	12.88	16.30	17.48
Sikkim	18.3	3.28	3.83	4.37	4.92	5.46	8.20	9.29	10.38	13.66	13.11
Tamil Nadu	511.2	5.83	6.71	7.69	8.31	8.90	10.05	12.15	13.01	15.94	17.33
Tripura	36.6	7.10	7.92	7.10	8.74	10.38	11.75	14.21	16.12	18.31	21.31
Uttar Pradesh	752.1	6.26	5.90	7.41	6.93	8.02	8.60	10.22	12.07	13.93	15.52
Uttarakhand	92.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
W. Bengal	430.0	6.56	6.33	6.40	7.72	8.91	9.53	11.60	12.05	15.42	21.72

*Note: SSE = Social Sector Expenditure 2012-13 (Revised Estimates) in Rs. Billion.
Source: Reserve Bank of India: http://rbi.org.in/Scripts/PublicationsView.aspx?Id=15605

.

TABLE-1(b): A SCENARIO OF INCREASING PUBLIC EXPENDITURE ON SOCIAL SECTOR 2000-20011 to 2012-2013

State/Year	Index values considering 2012-13 SSE as 100												
	2000-01	2001 - 02	2002 - 03	2003 - 04	2004 - 05	2005 - 06	2006 - 07	2007 - 08	2008 - 09	2009 - 10	2010 11	2011 12	2012 -13
A&N Islands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Andhra Pr.	17.82	19.37	19.90	23.80	24.60	26.53	33.20	43.56	55.97	53.91	69.66	80.83	100
Arunachal Pr.	13.68	19.23	17.95	26.50	27.78	31.62	35.90	40.60	54.70	75.64	67.09	92.31	100

Assam	17.98	17.75	18.86	21.66	27.90	25.98	30.47	35.38	39.46	53.47	59.78	65.32	100
Bihar	19.12	14.92	16.70	18.12	15.79	22.35	28.72	35.66	42.17	46.12	49.99	62.06	100
Chandigarh	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chhattisgarh	4.81	12.05	13.99	16.07	18.01	21.33	28.32	34.47	44.00	57.94	58.63	73.46	100
D&N Haveli	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Daman & Diu	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Delhi	19.27	19.20	22.41	22.22	27.42	29.35	33.01	47.21	57.29	67.50	69.43	84.84	100
Goa	16.56	17.20	20.06	21.97	25.48	28.03	32.17	35.67	46.50	57.01	66.56	73.25	100
Gujarat	24.67	23.01	20.85	22.91	25.82	28.01	33.38	37.95	46.33	59.05	72.86	77.34	100
Haryana	17.39	18.88	14.42	14.47	17.96	24.32	28.73	37.66	50.33	68.55	69.98	83.48	100
Himachal Pr.	26.67	25.99	26.80	31.97	31.70	38.10	45.31	50.88	62.18	66.80	81.90	81.63	100
J&Kashmir	22.49	25.58	27.78	27.45	34.18	44.43	47.96	56.34	61.85	76.07	81.92	96.36	100
Jharkhand	0.00	22.36	29.38	25.90	30.76	36.93	44.30	47.84	59.17	60.19	73.74	64.27	100
Karnataka	17.64	17.87	17.71	19.46	22.83	27.32	33.71	41.26	47.81	58.71	67.11	75.72	100
Kerala	24.15	22.72	29.22	27.28	33.82	34.65	33.13	41.52	50.05	55.44	62.76	86.36	100
Lakshadweep	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Madhya Pr.	19.96	16.78	19.99	18.96	20.30	26.33	29.76	35.18	41.01	49.22	65.47	75.74	100
Maharashtra	20.90	20.93	21.27	25.58	27.68	32.88	38.31	40.26	49.44	64.16	72.92	82.81	100
Manipur	18.15	22.18	22.58	24.19	35.08	37.90	41.94	47.58	58.47	62.10	77.82	81.45	100
Meghalaya	18.47	17.83	18.15	20.38	23.57	24.52	27.71	33.12	38.85	44.59	55.73	74.52	100
Mizoram	22.27	23.58	24.45	28.38	28.38	31.44	34.93	41.05	50.22	64.19	69.87	71.62	100
Nagaland	25.88	23.68	25.00	28.07	27.63	35.09	39.91	46.05	49.12	51.32	69.30	70.61	100
Odisha	18.87	19.15	19.57	20.27	21.39	25.06	28.50	38.12	51.56	58.21	70.85	83.91	100
Puducherry	NA	NA	NA	NA	NA	53.33	55.33	62.00	70.67	91.33	104.00	114.67	100
Punjab	23.06	22.11	17.72	20.92	22.23	24.01	27.92	29.58	40.66	42.15	49.50	59.10	100
Rajasthan	19.78	21.18	22.00	25.29	26.96	29.92	34.47	40.22	53.23	59.12	62.44	76.30	100
Sikkim	14.21	16.94	19.13	22.40	26.23	27.32	30.05	36.07	44.81	55.19	57.92	79.23	100
Tamil Nadu	18.82	17.98	18.90	22.67	26.64	27.97	33.10	39.10	52.60	57.41	71.38	81.96	100
Tripura	24.59	26.50	26.50	26.23	30.60	30.60	33.06	38.25	45.90	59.56	59.02	73.50	100
Uttar Pr.	16.13	16.33	17.42	17.28	22.51	26.78	31.95	39.90	52.53	62.82	67.37	79.40	100
Uttarakhand	3.79	14.29	18.51	21.97	25.22	30.09	34.96	40.37	45.35	60.82	64.39	79.87	100
W. Bengal	22.37	22.28	19.67	20.95	22.63	26.60	30.56	37.65	45.28	64.42	71.07	82.81	100
Based on the data available at Reserve Bank of India: http://rbi.org.in/Scripts/PublicationsView.aspx?Id=15605													

.

TABLE-2 : GROWTH RATE OF INDEX OF PUBLIC EXPENDITURE IN SOCIAL SECTOR IN DIFFERENT STATES									
State/UT	**β**	**State/UT**	**β**	**State/UT**	**β**	**State/UT**	**β**	**State/UT**	**β**
A&N Islands	-	D&N Haveli	-	J&Kashmir	0.996	Manipur	0.991	Rajasthan	0.995
Andhra Pr.	0.993	Daman & Diu	-	Jharkhand	0.977	Meghalaya	0.987	Sikkim	0.995
Arunachal Pr.	0.986	Delhi	0.969	Karnataka	0.992	Mizoram	0.992	Tamil Nadu	0.989
Assam	0.990	Goa	0.994	Kerala	0.986	Nagaland	0.989	Tripura	0.988
Bihar	0.960	Gujarat	0.988	Lakshadweep	-	Odisha	0.980	Uttar Pradesh	0.982
Chandigarh	-	Haryana	0.981	Madhya Pr.	0.966	Puducherry	0.948	Uttarakhand	0.937
Chhattisgarh	0.951	Himachal Pr.	0.994	Maharashtra	0.995	Punjab	0.969	W. Bengal	0.981
Beta (β) may be considered a sort of growth rate of the SSE_Index in the relationship $Log_{10}(SEE\_Index) = \alpha + \beta t + \varepsilon$									

.

3. Assessment of the Status of Social Sector at the State/Union Territory level: To gauze into the status of social sector in India, we have selected some indicator variables (at the state/union territory level) that represent the one or the other aspect of the social sector (Table-3). Six indicators are concerned with health. Those are: (i) Population served per Allopathic Doctor, (ii) Govt. Hospital Beds per Lakh Population, (iii) Per Capita Expenditure on Health, (iv) Infant Mortality Rate, (v) Birth Rate, and (vi) Death Rate. Together, they represent the health infrastructure, health services, resource allocation on public health and their

outcome in terms of improving the health status of the people. Likewise, six indicators are related to education: (i) Literacy, (ii) Women Enrollment in Higher Education; (iii) Men Enrollment in Higher Education,; (iv) No. of Primary Schools per 1000 Population, (v) No. of Upper Primary Schools per 1000 Population and (vi) No. of Secondary Schools per 1000 Population. Lastly, Per Capita Expenditure (Rs.) on Social Sector has been used as an omnibus measure of infrastructure, services, allocation of resources, etc.

TABLE-3: INDICATORS OF THE STATUS OF SOCIAL SECTOR

State	PDOCT	PCBED	PCEH	IMR	BR	DR	LIT	WENHE	MENHE	PRIMSCH	UPSCH	SSCH	PCESOC*
A&N Islands	3455	233	1347	25	15.1	4.6	86.27	18.30	18.47	54	15	12	8858
Andhra Pr.	11421	43	410	46	17.5	7.5	67.66	6.43	12.98	72	18	15	5362
Arunachal Pr.	3365	188	771	31	19.8	5.8	66.95	6.39	9.59	97	26	10	15618
Assam	7854	11	471	58	22.8	8.0	73.18	3.22	6.52	100	26	12	3706
Bihar	23174	24	173	48	27.7	6.7	63.82	3.03	7.21	44	11	3	2608
Chandigarh	11692	225	798	22	15.0	4.1	86.43	23.43	22.30	2	1	5	8157
Chhattisgarh	19585	41	378	51	24.9	7.9	71.04	6.60	7.32	105	27	5	6457
D&N Haveli	4831	87	430	38	26.1	4.6	77.65	2.35	3.12	37	25	4	3902
Daman & Diu	6231	105	405	23	18.4	4.9	87.07	1.79	2.24	21	10	8	4412
Delhi	3933	141	840	30	17.5	4.3	86.34	16.16	31.82	15	5	3	9255
Goa	4673	178	1149	10	13.3	6.7	87.40	10.88	10.59	71	5	24	15775
Gujarat	25168	53	270	44	21.3	6.7	79.31	6.39	9.70	13	53	8	5284
Haryana	9173	32	280	48	21.8	6.5	76.64	9.09	13.50	38	9	21	6417
Himachal Pr.	1394	123	884	40	16.5	6.7	83.78	10.55	9.86	159	28	19	8751
J&Kashmir	5152	36	845	43	17.8	5.5	68.74	9.47	12.00	93	35	13	7764
Jharkhand	17487	18	328	42	25.0	6.9	67.63	4.01	8.88	57	14	4	3603
Karnataka	11933	86	419	38	18.8	7.1	75.60	6.73	9.12	45	40	13	5504
Kerala	6289	82	454	13	15.2	7.0	93.91	6.86	5.60	20	9	4	5612
Lakshadweep	2560	274	1315	25	14.7	6.4	92.28	3.78	2.06	6	31	11	7912
Madhya Pr.	17811	29	235	62	26.9	8.2	70.63	5.23	7.26	74	38	6	3737
Maharashtra	24540	28	278	28	16.7	6.3	82.91	11.11	18.47	37	23	12	5501
Manipur	3812	94	695	14	14.4	4.1	79.85	6.49	8.60	94	29	20	7421
Meghalaya	4567	106	690	55	24.1	7.8	75.48	9.84	9.09	196	36	17	7894
Mizoram	2485	128	1611	37	16.6	4.4	91.58	13.10	15.28	115	78	31	15032
Nagaland	6798	85	794	23	16.1	3.3	80.11	6.71	8.44	61	21	12	7242
Odisha	10695	37	263	61	20.1	8.5	73.45	2.38	7.88	87	28	15	4303
Puducherry	3534	284	1333	22	16.1	7.2	86.55	17.88	16.72	26	11	10	13826
Punjab	7256	40	360	34	16.2	6.8	76.68	6.33	6.36	52	10	9	3875
Rajasthan	8717	51	287	55	26.2	6.7	67.06	3.89	6.35	48	34	8	4058
Sikkim	1622	173	1446	30	17.6	5.6	82.20	11.56	16.92	82	22	15	23966
Tamil Nadu	25042	72	410	24	15.9	7.4	80.33	8.37	10.69	50	10	6	6252
Tripura	4439	66	740	27	14.3	5.0	87.75	5.57	7.84	56	12	11	7327
Uttar Pradesh	19409	18	293	61	27.8	7.9	69.72	4.57	7.59	58	15	2	3027
Uttarakhand	8742	84	630	38	18.9	6.2	79.63	8.73	8.29	142	35	8	7530
W. Bengal	8416	58	262	31	16.3	6.2	77.08	5.41	8.20	55	2	5	3898

PDOCT=Population served per Allopathic Doctor; PCBED=Govt. Hospital Beds per Lakh Population; PCEH=Per Capita Expenditure on Health; IMR=Infant Mortality Rate; BR=Birth Rate; DR=Death Rate; LIT=Literacy; WENHE=Women Enrollment in Higher Education; MENHE= Men Enrollment in Higher Education; PRIMSCH=No. of Primary Schools per 1000 Population; UPSCH= No. of Upper Primary Schools per 1000 Population; SSCH= No. of Secondary Schools per 1000 Population; PCESOC=Per Capita Expenditure (Rs.) on Social Sector. Note: PCESOC data for all Union Territories are estimated by Iterated Least Absolute Deviation Estimator.

Thus, in all, we have selected thirteen indicators (variables over states and union territories). The statistics on those indicator variables are not consistently available for any recent year. In view of this, the indicators selected by us pertain to the period 2008-2011, but not consistently for any particular year in this period.

4. Construction of Composite Indices: A composite index is almost always obtained as a weighted mean of the indicator variables or a suitable order-preserving function of the latter. Therefore, it is a matter of utmost importance to discuss as to the assignment of weights, the choice of suitability of the function that transforms the original indicator variables into their images and the choice of norm that is used for computing the mean. It may be noted that various types of mean (such as the arithmetic mean, the geometric mean, the harmonic mean, etc.) are only the special cases of the generalized mean (Hölder mean) for different values of the exponent, p, in the general formula $\bar{x}_p = \left(\sum_{i=1}^{n} w_i x^p\right)^{1/p}$; $\sum_{i=1}^{n} w_i = 1$; $-\infty < p < \infty$. In particular, $\bar{x}_{-1}$, $\bar{x}_0$ and $\bar{x}_1$ are harmonic, geometric and arithmetic means, respectively. As to transformation of the original variables, there could be many possible choices. Using the variables in their original form may be considered as an identity transformation where $x = x = I(x)$. However, if some indicator variables are increasing exponentially (or say, logarithmically) vis-à-vis increase in other variables, it may be advisable to transform them suitably. Alternatively, the variables may be transformed to their ranking scores that preserves the order but ignores the magnitude of increase (or decrease). As to assignment of weights, there are several alternatives. In an extreme case, weights may be assigned subjectively, possibly based on the judgment of the analyst, which may rely on experience, purpose of analysis, or, the opinion of experts. Alternatively, quantity of a surrogate measure may be used for the assignment of weights to the indicator variables. For example, in constructing the consumers' price index, proportions of expenditure are used as weights to the prices of different consumption items. On the other extreme, weights are computed from the dataset (indicator variables or their images) itself and no subjective judgment or extraneous information is used. These weights are proportional to the measure of concordance between the composite index and the indicator variables. For computation of weights from the dataset itself, the technique of Principal Component Analysis is used quite frequently. Of late, Pena's method of construction of composite index is gaining popularity. Pena's method obtains intrinsic weights (derived from the dataset itself) by applying multiple regression method on data repeatedly.

The conventional Principal Component Analysis (PCA) constructs the composite index (z) from the indicator variables such that $\sum_{j=1}^{m} r^2(z, x_j)$; $z_i = \sum_{j=1}^{m} w_j x_{ij}$ is maximized. The weights (w_j) are determined to this effect and the squared Pearsonian coefficient of correlation ($r^2(z, x_j)$)

between z and the j^{th} indicator variable, x_j, is used as the measure of concordance. An issue remains, however, as to the choice of the measure of correlation as well as the choice of exponent (i.e. whether absolute or squared coefficient of correlation should be the measure of concordance and whether the Pearsonian coefficient of correlation should be used). This amounts to obtaining the composite index (z) by maximization of $\sum_{j=1}^{m}\left|\rho(z,x_j)\right|^p$, where ρ is a measure of any non-Pearsonian correlation and p is the exponent relating to norm (Mishra, 2009a; 2009b). Such an index may be solicited mainly because it is well known that the Pearsonian coefficient of correlation is a measure of linear dependence and it is prone to be pulled by extreme values (and outliers) in the dataset. Further, it is a measure that fits well only to the Euclidean space. Squaring of such a measure to obtain weights further aggravates its sensitivity to nonlinearity and extreme values. Therefore, other measures of correlation such as signum correlation, rank correlation, Kendall's tau, absolute correlation (Bradley, 1985), Shevlyakov's correlation (Shevlyakov, 1997), Brownian correlation (Székely and Rizzo, 2009), etc. might be considered for measuring the degree of concordance between the composite index and the indicator variables.

5. Composite Indices of the Status of Social Sector: In this study, we do not have any strong basis to obtain weights (for different indicator variables) subjectively. Nor are we equipped with enough information so as to obtain weights by using some extraneous criterion. Therefore, we must derive weights intrinsically. We have experimented with a number of variants of the PCA that use different measures of correlation. Optimization has been done with the Host-Parasite Co-Evolutionary Algorithm (Mishra, 2013). We also have used the Pena's method. We have compared the composite indices obtained by different methods and finally chosen one of them on the basis of judgment and provided the reasons behind such a choice.

As presented in Table-4 CPCA Index is based on the conventional principal component analysis that maximizes the sum of squared coefficients of Pearsonian correlation between itself and the indicator variables. According to this index, Mizoram is on the top while Bihar is at the bottom. The next composite index (Brown) is derived so as to maximize the sum of squared Brownian coefficients of correlation (Székely and Rizzo, 2009) between itself and the indicator variables (Mishra, 2014). It may be pertinent to note here that unlike other measures of correlation lying between -1 and 1, where zero implies (and is also implied by) linear independence, the Brownian coefficient of correlation lies between zero and unity, where zero implies (and also is implied by) complete independence between two variables while unity implies (and is also implied by) perfect dependence. According to this index, Chandigarh is at the top and Bihar is at the bottom.

The third composite index (Bradley) maximizes the sum of squared Bradley's absolute coefficients of correlation between itself and the indicator variables. Bradley's absolute correlation is a member of the family where median is the measure of central tendency. Like

median, it is not pulled by extreme values or outliers in the dataset. According to this composite index, Mizoram tops the list while West Bengal is at the bottom. The fourth composite index (Campbell) is based on moderation of the impact of outliers (if any) in the dataset using Mahalanobis distance as a criterion of detection of outliers. It maximizes the sum of squared Campbell coefficients of correlation between itself and the indicator variables. According to this composite index, Goa is at the apex and Bihar is at the base.

TABLE-4: COMPOSITE INDICES OF THE STATUS OF SOCIAL SECTOR OBTAINED BY DIFFERENT METHODS

State/UT	CPCA	Brown	Bradley	Campbell	Shevlyakov	Kendall	Rank	Signum	Pena
A&N Islands	0.99623	0.92864	0.50694	0.86938	0.60872	0.97059	0.97059	0.34778	0.43578
Andhra Pr.	0.32701	0.30089	0.26963	0.26034	0.21604	0.29412	0.29412	0.13417	0.27298
Arunachal Pr.	0.61187	0.52707	0.58864	0.46682	0.62647	0.67647	0.64706	0.57815	0.42733
Assam	0.17191	0.12626	0.40991	0.18666	0.07154	0.17647	0.17647	0.07945	0.29942
Bihar	0.00000	0.00000	0.26340	0.00000	0.06729	0.00000	0.00000	0.00000	0.02241
Chandigarh	0.94388	1.00000	0.30672	0.79556	0.60622	0.82353	0.85294	0.31657	0.26493
Chhattisgarh	0.14141	0.13230	0.54396	0.12913	0.14701	0.20588	0.20588	0.19150	0.34779
D&N Haveli	0.31664	0.26192	0.27384	0.35699	0.28483	0.41176	0.26471	0.10067	0.03498
Daman & Diu	0.49601	0.41125	0.00734	0.58422	0.37829	0.50000	0.47059	0.15382	0.00000
Delhi	0.87085	0.84701	0.31064	0.80515	0.60327	0.79412	0.82353	0.36900	0.24275
Goa	0.95783	0.71111	0.42390	1.00000	0.68951	0.88235	0.94118	0.65524	0.56841
Gujarat	0.25125	0.24637	0.39733	0.29844	0.29209	0.23529	0.23529	0.16767	0.31626
Haryana	0.40047	0.34020	0.29226	0.41012	0.28053	0.35294	0.38235	0.21021	0.30374
Himachal Pr.	0.66634	0.57897	0.63247	0.59097	0.40985	0.76471	0.76471	0.33273	0.60893
J&Kashmir	0.49567	0.43390	0.42966	0.38638	0.45718	0.58824	0.58824	0.24447	0.36673
Jharkhand	0.12919	0.08960	0.26520	0.15632	0.11829	0.14706	0.08824	0.05715	0.08467
Karnataka	0.38789	0.34432	0.36429	0.39563	0.25648	0.38235	0.41176	0.16453	0.31826
Kerala	0.58531	0.48058	0.00247	0.77336	0.30309	0.52941	0.61765	0.23063	0.09051
Lakshadweep	0.80266	0.66504	0.34058	0.84126	0.46876	0.85294	0.73529	0.32385	0.30104
Madhya Pr.	0.03177	0.05468	0.53750	0.03974	0.01719	0.05882	0.05882	0.07087	0.30758
Maharashtra	0.46447	0.42147	0.22924	0.51262	0.36897	0.44118	0.50000	0.19090	0.30329
Manipur	0.71423	0.56154	0.26484	0.69270	0.58701	0.73529	0.79412	0.26253	0.31767
Meghalaya	0.39575	0.34231	0.90355	0.30431	0.19348	0.61765	0.52941	0.26639	0.68586
Mizoram	1.00000	0.75515	1.00000	0.96322	0.88304	1.00000	1.00000	0.63781	1.00000
Nagaland	0.65936	0.55862	0.18720	0.61163	0.63391	0.70588	0.70588	0.25725	0.18330
Odisha	0.17319	0.16879	0.36765	0.15524	0.08480	0.08824	0.11765	0.10505	0.33364
Puducherry	0.98992	0.88693	0.58992	0.94053	0.55199	0.91176	0.91176	0.56605	0.52185
Punjab	0.38661	0.35769	0.05590	0.40247	0.22917	0.26471	0.35294	0.09804	0.09705
Rajasthan	0.14130	0.13849	0.40465	0.11997	0.12634	0.11765	0.14706	0.07336	0.17731
Sikkim	0.97810	0.76377	0.75506	0.90877	1.00000	0.94118	0.88235	1.00000	0.73368
Tamil Nadu	0.40934	0.36672	0.17102	0.45283	0.30309	0.47059	0.44118	0.21402	0.21693
Tripura	0.64403	0.53869	0.09804	0.67832	0.53266	0.64706	0.67647	0.28695	0.18803
Uttar Pradesh	0.00323	0.02437	0.38265	0.01916	0.00000	0.02941	0.02941	0.03837	0.14443
Uttarakhand	0.47380	0.43865	0.55028	0.41565	0.37940	0.55882	0.55882	0.26558	0.43923
W. Bengal	0.39348	0.38952	0.00000	0.38773	0.26383	0.32353	0.32353	0.09962	0.01600

The fifth composite index (Shevlyakov) maximizes the sum of squared coefficients of Shevlyakov correlation between itself and the indicator variables. The Shevlyakov correlation moderates the impact of outliers in the dataset using median as the central tendency and the median of absolute deviations (from median) as a measure of scale (Hampel et al., 1986). According to this composite index, Sikkim is at the top and Uttar Pradesh is at the bottom. The sixth composite index (Kendall) maximizes the sum of squared coefficients of concordance (Tau) between itself and the indicator variables. The Kendall's tau is the most powerful (more robust

as well as more efficient) non-parametric measures of association between two variables (Croux and Dehon, 2010). According to this index, Mizoram tops the list and Bihar is at the base. The seventh composite index (Rank) is based on maximization of the coefficients of rank correlation (Spearman) between itself and the index variables. It is fairly robust and efficient measure of association between two variables. According to this index, Mizoram is at the top while Bihar is at the bottom. The eighth composite index (Signum) maximizes the sum of squared coefficient of signum correlation (Blomqvist, 1950) between itself and the indicator variables. Signum correlation is a fairly robust measure of correlation, although slightly weaker than the rank correlation of Spearman (Croux and Dehon, 2010). According to this composite index, Sikkim tops the list while Bihar is at the bottom.

Unlike the composite indices discussed so far which are based on the one or the other measure of correlation and maximization of the sum of squared coefficients of that kind of correlation between the composite index and the indicator variables, the last composite index (Pena) is based on Pena's measure of distance (Somarriba and Pena, 2009; Nayak and Mishra, 2012) defined as:

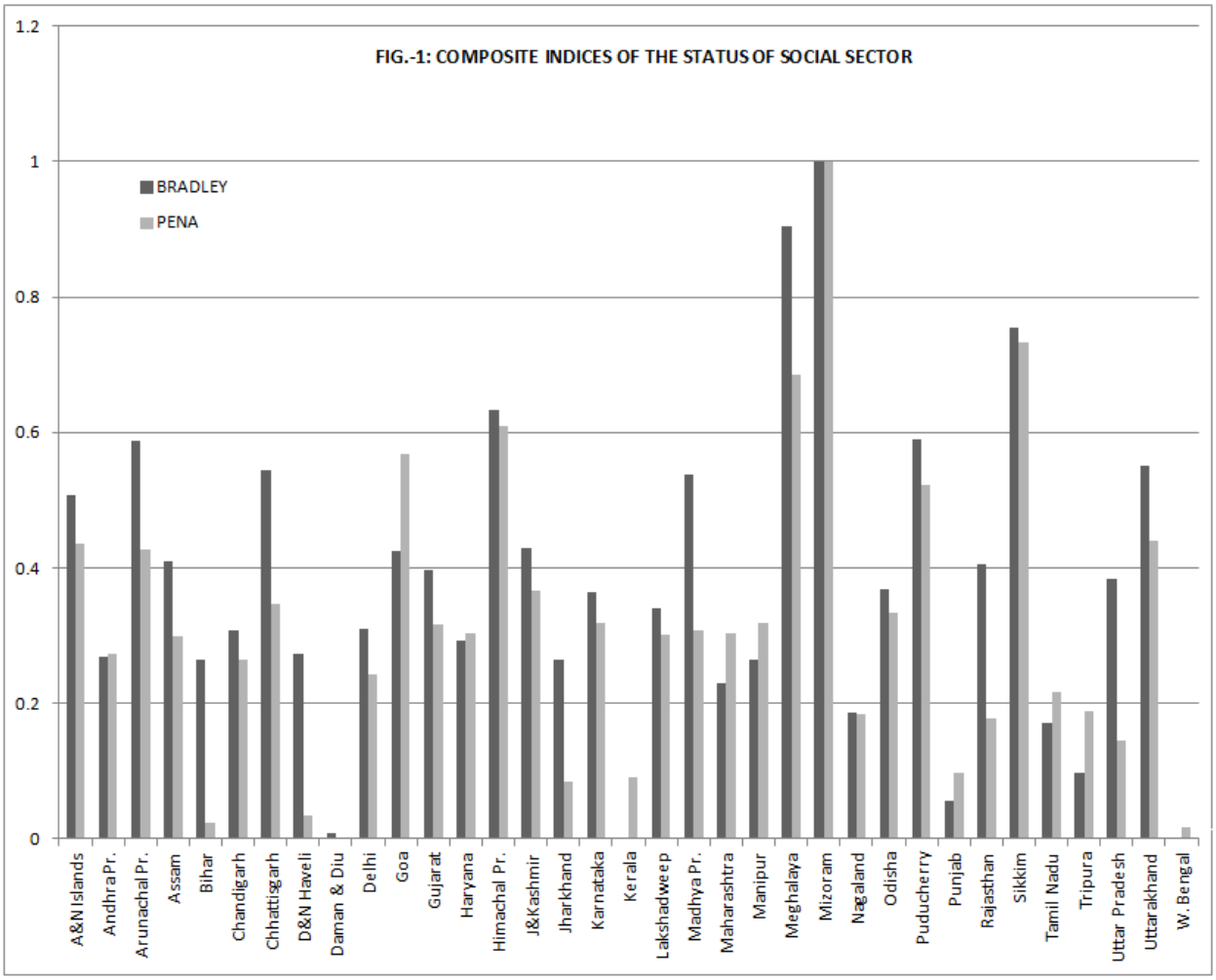
$$D_i = \sum_{j=1}^{m}\left[\left(\frac{d_{ij}}{\sigma_j}\right)\left(1-R^2_{j,j-1,\ldots,1}\right)\right]; i = 1,2,\ldots,n$$

where $d_{ij} = \left|x_{ij} - x_{rj}\right|; i = 1,2,..,n;\ j = 1,2,\ldots,m$; r is the reference case; σ_j is the standard deviation of variable j; $R^2_{j,j-1,\ldots,1}$; $j > 1$ is the coefficient of determination in the regression of x_j over $x_{j-1,}x_{j-2},\ldots,x_1$. Moreover, $R^2_1 = 0$. It is important to note that the value of an indicator variable is transformed to d_{ij}, which is an absolute deviation from a reference case (r, which could refer to the minimal value of an indicator variable) rescaled by the standard deviation (σ_j). It may also be noted that the first variable obtains an absolute weight of unity (1- R^2_1). The subsequent variable $j = 2$ obtains a weight (1- $R^2_{2,1}$) and in general, the j^{th} variable obtains a weight of (1- $R^2_{j,j-1,\ldots,1}$). Thus, weighs are proportionate to the explanatory power a variable has exhibited. It goes without saying that in this method weights are prone to pull by extreme values and effects of nonlinearity. According to this composite index, Mizoram is at the top and Daman & Diu is at the bottom. Of course, Bihar is the second from the bottom.

6. Concordance among Different Composite Indices: In table-5 we have presented the Pearsonian correlation among different composite indices as well as the expected growth rate of the index of public expenditure on social sector during 1990-2013. It is observed that Pena is rather poorly correlated with Campbell and Brown and strongly correlated with Bradley and Signum. CPCA, Rank, Brown, Campbell, Kendall and Shevlyakov are very strongly correlated, suggesting that the dataset conforms to linearity and does not contain any significant outliers. It appears, therefore, that the composite indices pertaining to the dataset at hand may be grouped into two groups: the one containing Pena, Bradley and Signum and the other containing CPCA, Rank, Brown, Campbell, Kendall and Shevlyakov.

TABLE-5. PEARSONIAN CORRELATION AMONG DIFFERENT TYPES OF COMPOSITE INDICES AND EXPECTED GROWTH RATE OF INDEX OF PUBLIC EXPENDITURE ON SOCIAL SECTOR (SSE β)										
	CPCA	**Brown**	**Bradley**	**Campbell**	**Shevlyakov**	**Kendall**	**Rank**	**Signum**	**Pena**	**SSE β**
CPCA	1.00000	0.98069	0.23732	0.97546	0.92145	0.97332	0.98294	0.80955	0.52586	0.05698
Brown	0.98069	1.00000	0.19233	0.93840	0.87169	0.94289	0.95652	0.73676	0.45564	0.01516
Bradley	0.23732	0.19233	1.00000	0.12248	0.29604	0.33768	0.28730	0.53743	0.88834	0.30152
Campbell	0.97546	0.93840	0.12248	1.00000	0.88549	0.93709	0.95269	0.77011	0.44582	0.05471
Shevlyakov	0.92145	0.87169	0.29604	0.88549	1.00000	0.91286	0.91232	0.88161	0.55705	0.08901
Kendall	0.97332	0.94289	0.33768	0.93709	0.91286	1.00000	0.98628	0.81063	0.58820	0.10423
Rank	0.98294	0.95652	0.28730	0.95269	0.91232	0.98628	1.00000	0.79791	0.57576	0.10975
Signum	0.80955	0.73676	0.53743	0.77011	0.88161	0.81063	0.79791	1.00000	0.73783	0.14905
Pena	0.52586	0.45564	0.88834	0.44582	0.55705	0.58820	0.57576	0.73783	1.00000	0.28013
SSE β	0.05698	0.01516	0.30152	0.05471	0.08901	0.10423	0.10975	0.14905	0.28013	1.00000

.



From Table-5 it is also evident that the correlation between SSE β and Bradley composite index is largest (r = 0.30152) followed by Pena composite index (r = 0.28013), Signum (r = 0.14905), Rank (r = 0.10975) and Kendall (r = 0.10423). We expect a strong correlation between the composite index of the status of social sector (z) and SSE β. In absence of strong correlation, it

may be justifiable to choose that composite index (z) which has the highest empirically observed correlation. On this ground, Bradley or Pena composite index is a better choice.

7. Rank Scores of States/UTs according to the Composite Indices of Status of Social Sector: According to Bradley composite index, the seven states in the top quintile (5-quantile) are: Mizorm, Meghalaya, Sikkim, Himachal Pradesh, Puducherry, Arunachal Pradesh and Uttarakhand. However, according to Pena composite index, the seven states in the top quintile are: Mizoram, Sikkim, Meghalaya, Himachal Pradesh, Goa, Puducherry and Uttarakhand. Notably, Arunachal Pradesh and Goa are uncommon states in the top quintile of these two composite indices.

On the other hand, according to Bradley composite index the seven states/UTs in the bottom quintile are: Nagaland, Tamil Nadu, Tripura, Punjab, Daman & Diu, Kerala and W. Bengal. However, according to Pena composite index, the states/UTs in the bottom quintile are: Punjab, Kerala, Jharkhand, D&N Haveli, Bihar, W. Bengal and Daman & Diu. Interestingly, Nagaland, Tamil Nadu and Tripura, which are in the bottom quintile according to the Bradley composite index, are not included in the bottom quintile by Pena index. Jharkhand, D&N Haveli and Bihar are in the bottom quintile of Pena, which are not there in the bottom quintile of Bradley.

TABLE-6: RANK SCORES OF STATES/UT ACCORDING TO BRADLEY AND PENA COMPOSITE INDICES

SL#	STATE/UT	BRADLEY	$\Re(B)$	PENA	$\Re(P)$		SL#	STATE/UT	BRADLEY	$\Re(B)$	PENA	$\Re(P)$
1	A&N Islands	0.50694	10	0.43578	8		19	Lakshadweep	0.34058	19	0.30104	19
2	Andhra Pr.	0.26963	24	0.27298	21		20	Madhya Pr.	0.53750	9	0.30758	16
3	Arunachal Pr.	0.58864	6	0.42733	9		21	Maharashtra	0.22924	28	0.30329	18
4	Assam	0.40991	13	0.29942	20		22	Manipur	0.26484	26	0.31767	14
5	Bihar	0.26340	27	0.02241	33		23	Meghalaya	0.90355	2	0.68586	3
6	Chandigarh	0.30672	21	0.26493	22		24	Mizoram	1.00000	1	1.00000	1
7	Chhattisgarh	0.54396	8	0.34779	11		25	Nagaland	0.18720	29	0.18330	26
8	D&N Haveli	0.27384	23	0.03498	32		26	Odisha	0.36765	17	0.33364	12
9	Daman & Diu	0.00734	33	0.00000	35		27	Puducherry	0.58992	5	0.52185	6
10	Delhi	0.31064	20	0.24275	23		28	Punjab	0.05590	32	0.09705	29
11	Goa	0.42390	12	0.56841	5		29	Rajasthan	0.40465	14	0.17731	27
12	Gujarat	0.39733	15	0.31626	15		30	Sikkim	0.75506	3	0.73368	2
13	Haryana	0.29226	22	0.30374	17		31	Tamil Nadu	0.17102	30	0.21693	24
14	Himachal Pr.	0.63247	4	0.60893	4		32	Tripura	0.09804	31	0.18803	25
15	J&Kashmir	0.42966	11	0.36673	10		33	Uttar Pradesh	0.38265	16	0.14443	28
16	Jharkhand	0.26520	25	0.08467	31		34	Uttarakhand	0.55028	7	0.43923	7
17	Karnataka	0.36429	18	0.31826	13		35	W. Bengal	0.00000	35	0.01600	34
18	Kerala	0.00247	34	0.09051	30		$\Re(B)$ = Bradley Rank Score; $\Re(P)$ = Pena Rank Score					

Our general impression, however, would favor the classification provided by Pena index. Goa, not Arunachal Pradesh, is more likely to be in the top quintile. Similarly, Jharkhand, D&N Haveli and Bihar, and not Nagaland, Tamil Nadu and Tripura, are more likely to fall in the bottom quintile.

In the mid quintile Bradley has Gujarat, Uttar Pradesh, Odisha, Karnataka, Lakshadweep, Delhi and Chandigarh. But Pena has Gujarat, Madhya Pradesh, Haryana, Maharashtra, Lakshadweep, Assam and Andhra Pradesh. Once again, by our impression, Pena's grouping appears to be more reliable. We conclude, therefore, that Pena composite index is more reliable and strikes a better balance between unaided impressionism and unaided empiricism.

8. Concluding Remarks: The importance of social sector in correcting the imbalances in the economy and society is now well recognized and it has drawn the attention of policy makers and the government. In India, especially after the year 2000-01, the allocation of resources or the public expenditure on the social sector has gained momentum. Growth rate of public expenditure in the last two decades fairly explains the status of the social sector attained by different states in India. However, the efficiency and efficacy of investment in social sector depends on the size of population as well as fiscal and financial governance. It has been seen, therefore, that population-wise smaller states with more development-oriented attitude have achieved a better status of social sector. States such as Mizoram, Sikkim, Meghalaya, Himachal Pradesh, Goa, Puducherry and Uttarakhand have scored very high on this account. On the other hand, states such as Punjab, Kerala, Jharkhand, Bihar, W. Bengal, Nagaland, Tamil Nadu and Tripura are at the lower end. Gujarat, Madhya Pradesh, Haryana, Maharashtra, Assam and Andhra Pradesh have shown average status. To further improve the status of social sector in different states/UTs it is important that the public expenditure on this sector keeps its pace undaunted, but, perhaps, it is more important that fiscal and financial management is streamlined and its governance is improved to achieve better results.

References

Blomqvist, N. (1950). On a measure of dependence between two random variables. *Annals of Mathematical Statistics* 21(4): 593-600.

Bradley, C. (1985). The Absolute Correlation. *The Mathematical Gazette* 69(447):12-17.

Croux, C. and Dehon, C. (2010). Influence functions of the Spearman and Kendall correlation measures. *Statistical Methods and Applications* 19(4):497-515.

Hampel, F. R., Ronchetti, E.M., Rousseeuw, P.J. and W. A. Stahel, W.A. (1986). *Robust Statistics: The Approach Based on Influence Functions*, Wiley, New York.

Mishra, S.K. (2009a). A note on positive semi-definiteness of some non-Pearsonian correlation matrices. SSRN: http://ssrn.com/abstract=1419362.

Mishra, S.K. (2009b). On construction of robust composite indices by linear aggregation. *IUP Journal of Computational Mathematics* 2(3):24-44. Pre-print copy available at MPRA: http://mpra.ub.uni-muenchen.de/9232/1/MPRA_paper_9232.pdf.

Mishra, S.K. (2013). Global optimization of some difficult benchmark functions by host-parasite coevolutionary algorithm. *Economics Bulletin* 33(1):1-18.

Mishra, S.K. (2014). What happens if in the principal component analysis the Pearsonian is replaced by the Brownian coefficient of correlation? SSRN: http://ssrn.com/abstract=2443362.

Nayak, P. and Mishra, S.K. (2012). Efficiency of Pena's P2 distance in construction of human development indices. SSRN: http://ssrn.com/abstract=2066567.

Shevlyakov, G.L. (1997). On robust estimation of a correlation coefficient. *Journal of Mathematical Sciences* 83(3):434-438.

Somarriba, N. and Pena, B. (2009). Synthetic indicators of quality of life in Europe. *Social Indicators Research* 94(1):115–133.

Székely, G.J. and Rizzo, M.L. (2009). Brownian distance covariance. *The Annals of Applied Statistics* 3(4):1236-1265.