Human Development and Regional Disparities in India*

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Abstract

There is enough evidence to suggest that regional disparities within most developing countries are alarmingly high and probably increasing. This paper analyses regional disparities amongst major states in India to find out if they are on a convergence or further divergence course. It compares human development and poverty indices for various states in India and investigates if there has been any reduction in disparities over a decade. The analysis is extended to the evolution of disparities amongst the states with respect to a larger set of socio-economic indicators. A number of regional composite indices are constructed from the selected indicators and tested for their *validity.* The paper then suggests and applies a method for computing targets aiming at reducing regional disparities systematically. Finally a number of inequality and polarisation measures are employed to see the change in inequality and polarisation over the decade and whether the suggested method results in a reduction in both these phenomena.

Keywords: Regional disparities, spatial inequality, inequality, regional polarisation, India, human development.

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1. Introduction

Regional inequality is a major concern in a large number of developing countries. Growth pole dynamics and inverted-U hypothesis sustain that regional inequalities within developing countries will be eventually reduced through factor mobility. Neoclassical growth theory highlights the mobility of supply side factors, in particular capital stock, technical change and labour, as the reason for the eventual reduction of such disparities. On the other hand the opposing theories, in particular dependency and structural change theories, postulate that regional inequality is an inevitable outcome of capital accumulation and profit maximisation.

The proposition of convergence in recent growth literature has been of much appeal to the analysis of disparities amongst developed countries. Would it be equally applicable to the analysis of regional disparities within a developing country?[1] Following Barro and Sala-i-Martin (1995) in the context of regions there are two views on how the process of catching up and convergence can take place: β-convergence , where poor regions will tend to grow faster than the more developed regions (as the diminishing marginal returns to capital prevails in the latter regions) and σ-convergence concerning cross-regional dispersion (inequalities) which would tend to decrease over time. These authors give examples of both types of convergence having taken place amongst different states in the USA, various prefectures in Japan and different regions within Germany, United Kingdom, France, Italy and Spain. Coulombe (2003) suggests that since 1950 relative per capita income and human capital in 10 Canadian provinces did generally converge to a long-run steady state, though of different forms.

While this may have been the case in advanced countries other studies show the opposite in the case of developing countries.

Fedorov (2002) highlights the growing regional inequalities in Russia in the1990s. Referring to recent studies on regional disparities in Russia he states that "Virtually

[1] For a good review of classical theories and convergence theory in the context of regional inequality and "New Europe" see Dunford and Smith (2000).

all authors agree that the transition period has been characterised by rapidly growing economic inequality among Russia's regions…" (page 444). This study shows that regional inequality and polarisation during the transitional period in Russia have increased significantly.

Vanderpnye-Orgle (2002) after citing a number of studies on the growing regional disparities in Ghana, discusses the growing trends in spatial inequalities and polarisation in Ghana during the period of stabilisation and structural adjustment programmes – late 1980s to late 1990s. This study concludes that regional inequality increased during the first stages of reform period, followed by a short period of decline before resuming its increasing trend for the rest of the period to 1999.[2]

The Human Development Report for Zimbabwe reports striking differences in the constituent indicators of human poverty index across its provinces ranging from 33% to just over 6% for illiteracy and from just above 28% to less than 1% for no access to clean water (UNDP et al.1998).

Wei and Kim (2002) report that the increasing regional inequality is widely considered to be the reason for the existing regional problems in China and an obstacle to its stability and development. In this study of inter-county inequality in Jiangsu province of China they conclude that for the period of 1950-95 neither β-convergence nor σ-convergence took place in these counties.

Riskin (1988) observes that substantial disparities between Chinese provinces in the 1950s became much more serious with industrialisation. He states that the leadership opted for the diversion of investment resources to the more backward provinces and consequently "…relative convergence of provincial industrialisation occurred from the start of the First Five Year Plan [1953-57] with less industrialised provinces growing at higher proportional rates than more industrialised ones." (Page 227). Nevertheless, he argues that the regional disparities in terms of rural poverty remained high.

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[2] The reader may be interested to note that Ghana is often quoted as the success story of reform programmes by the World Bank and IMF.

Wei (1999 and 2000) considers the policy of the reduction of regional inequality as one of the major components of the above plan and subsequent policies in China, though he states that researchers are not in agreement over the success or failure of such policies. He maintains that regional inequality has remained a major concern of the Chinese government in post-Mao China.

The Philippine Human Development Report 1997 reports changes in the Human Development Index (HDI) across various provinces in Philippines for 1990 to 1994 ranging from an increase of nearly 25% to a decrease of nearly 4%. It states that human development across its provinces is influenced by the past biases: "…absolute standouts are few and far between, and geographical concentration of development is still evident." (HDNUNDP, 1997, page 31).

The Human Development Report of the I. R. of Iran 1999 (PBOUN, 1999) observes wide regional disparities within 26 provinces of Iran in terms of HDI and its gender adjusted indices and the human poverty index. Such disparities have been growing at an alarming rate leading to serious problems including migration with its associated problems from backward provinces to the more developed provinces. After dividing provinces into higher, medium and lower groups according to the value of their HDI the report highlights the extent of regional disparities and the need to deal with them: "The level of deprivation seen in the third group [lower group in terms of HDI] and the vast areas covered by the provinces in the second [medium] group suggest that special disparity-reducing measures need to be taken." (Page 20, terms in brackets are added). The report concludes the analysis of regional disparities in human development by stating that "An improvement in human development in the I.R. of Iran as a whole requires not only a higher rate of economic growth but also a more equitable distribution of health and education facilities." (Page 23).

Dreze and Sen (1995) find the diversities in economic and social development amongst the Indian states remarkable. Ravallion and Datt (2002) in a cross-state study of poverty in 15 major states in India conclude that various states have different capacities for poverty reduction for a variety of reasons. They argue that a substantial difference of the elasticity of poverty index to non-farm output between the state with the lowest elasticity, Bihar, and the state of Kerala is due to the difference in literacy rates between these states. In a previous study Datt and Ravallion (1998) referring to major states in India - after controlling for a number of socio-economic conditions, which in turn explains why some states in India did better in reducing poverty than others – conclude that "Starting endowment of physical infrastructure and human resources appear to have played a major role in explaining the trend in poverty reduction;" (page 34). The same authors (1993) observe "Disparities in living standards among regions and between urban and rural sectors have long raised concern in India." (page 91).

The evidence points to the case of regional divergence rather then convergence within developing countries.

The rest of this study analyses regional disparities amongst various states in India to find out if they are on a convergence course or further divergence. Section 2 compares human development and poverty indices for various states in India and investigates if there has been any reduction in disparities over a decade. It then extends the analysis to the evolution of disparities amongst the states with respect to a larger set of socio-economic indicators. Section 3 discusses the construction of a composite regional index with a broader base. Section 4 computes a set of weighted composite indices and tests the validity of the suggested composite indices by relating them to the indicators of poverty. Section 5 suggests and applies a method for reducing the regional disparities systematically. Section 6 employs a set of inequality and polarisation measures to see what has been the extent of inequality and polarisation over the decade and whether the suggested method results in a reduction in both these phenomena. Section 7 concludes.

2. Regional disparities in India

The National Human Development Report 2001 for India (2002) reveals vast differences in human development and poverty between the States of India in 1981. The report notes that "At the state level, there are wide disparities in the level of human development." (NHDR 2002, page 4). The report also notes that disparities amongst the States with respect to human poverty are quite striking.

It is more alarming to note that over a decade there has been no reduction of such disparities. The report notes that while there have been improvements in the human development index and human poverty index during the 1980s, the inter-state disparities have persisted through the decade. Table 1 compares the position of sixteen major states in India in 1981 and 1991 with respect to human development and poverty indices[3].

Table 1. Human Development and Poverty Indices

State	HDI81	HDI91	HPI81	HPI91
Kerala	0.500	0.591	32.10	19.93
Delhi	0.495	0.624	19.27	17.01
Punjab	0.411	0.475	33.00	25.06
Himachal Pradesh	0.398	0.469	34.05	26.21
Maharashtra	0.363	0.452	38.63	29.25
Gujarat	0.360	0.431	37.31	29.46
Haryana	0.360	0.443	38.97	28.55
Karnataka	0.346	0.412	43.96	32.70
Tamil Nadu	0.343	0.466	42.05	29.28
West Bengal	0.305	0.404	47.64	40.48
Andhra Pradesh	0.298	0.377	50.09	39.78
Orissa	0.267	0.345	59.34	49.85
Rajasthan	0.256	0.347	54.16	46.67
Uttar Pradesh	0.255	0.314	54.84	48.27
Madhya Pradesh	0.245	0.328	52.15	43.47
Bihar	0.237	0.308	57.57	52.34
INDIA	***0.302***	***0.381***	***47.33***	***39.36***

HDI81 (HDI91): Human Development Index 1981 (1991), the higher the more developed.
HPI81 (HPI91): Human Poverty Index 1981 (1991), the higher the poorer.
Source: Compiled from the National Human Development Report 2001 (2002).

In Table 1 all states are ranked according to the value of HDI81. The value of HDI81 in the bottom five states is around half of the same value for Kerala, which has the highest value. While there has been some improvement in indices over the decade the disparities have not been reduced significantly. In 1991 the value of HDI for the bottom five states is around half of that for the top State, Delhi. This is more or less the same situation as a decade ago. The HPI is revealing an even more alarming picture. The HPI for Bihar in 1981 is nearly three folds of that for Delhi. After a decade the relative position of Bihar has worsened.

[3] All states with a population of above 5 million in 1991 have been selected though Assam and Jammu & Kashmir had to be excluded due to the lack of data for the subsequent analyses in the paper.

The HDI and HPI are composite indices based on only a few indicators. To investigate further the extent of disparities amongst the states we have selected fifteen socio-economic indicators for which the data is available for the early 1980s and 1990s. We intend to find out if there has been any reduction in regional inequalities over the decade.

The selected indicators reflect various economic aspects: education and its quality, shelter and its quality, gender, health and poverty in the early 1980s (in the case of one indicator in the late 1970s) and in the early 1990s. Ideally we should have more indicators though this is limited by the availability of data. The list of the selected indicators is in Appendix A. Tables B1 and B2 in Appendix B provide the data for the early 1980s and 1990s.

The preliminary inspection of data in Appendix B gives more cause for concern. In the 1980s the per capita net state domestic product for Bihar was less than 22% of that of Delhi. A decade later the difference was markedly worsened; the same for Bihar was less than 19% of the figure for Delhi. Inflation and income adjusted per capita consumption for Bihar has worsened from just less than 49% of that of Delhi to just above 42% of the same in the 1990s. The percentage of people below the poverty line in 1980s in Bihar was nearly four folds higher than in the top State, Punjab. This has increased to nearly five folds in 1990s. The percentages of houses having access to electricity in the state of Bihar in the 1980s was just above 9% as compared to nearly 74% in Delhi. A decade later this figure is less than 13% for Bihar as compared to 87% for Himachal Pradesh. In 1980s only 28% of adults in Rajasthan were literate as compared to 78% in Kerala. Adult female literacy disparities are even more pronounced ranging from 12% in Rajasthan and Bihar to 70% in Kerala, while in 1990s there has been some improvement in this indicator, the disparities have widened.

Furthermore, we employ two kinds of measures to analyse the changes in regional inequality between the early 1980s and early 1990s. The measures appearing in Table 2 give an account of the relative dispersion between the States.

Table 2. Measures of inequality (dispersion) for the selected indicators in the early 1980s and early 1990s

Indicators	CV80s	CV90s	GiniC80s	GiniC90s
NSDPP	0.4284	0.4608	0.1980	0.2329
IIAPC	0.2108	0.2372	0.1050	0.1075
ROADsk	1.7908	1.9157	0.5590	0.6204
HPUCCA	0.4404	0.3463	0.2140	0.1901
HSDW	0.5248	0.2821	0.2720	0.1531
HELEC	0.5364	0.4274	0.2840	0.2451
ADLIT	0.2992	0.2613	0.1500	0.1402
ER1114	0.1059	0.0931	0.0560	0.0504
IFEA	0.3325	0.2559	0.1720	0.1470
TPRS	0.1527	0.3176	0.0800	0.1727
ADFLIT	0.5091	0.4363	0.2470	0.2304
FER1114	0.1539	0.1213	0.0820	0.0673
IFEAF	0.5204	0.3630	0.2640	0.2065
U5SR	0.0363	0.0275	0.0190	0.0151
PPaPL	0.2441	0.1647	0.2060	0.2002

The first two columns in Table 2 show the coefficients of variation (CV) for all indicators[4]. Over a decade this measure has worsened for the first two indicators of income and consumption, NSDPP and IIAPC. It also show a decline in the roads, ROADsk and also for teachers/pupil ratio, TPRS, with a considerable improvement for houses with safe drinking water, HSDW. All other indicators show some improvement which, given the length of the period - a decade - is trivial.

The GiniC coefficient has worsened for the first three indicators and also for the quality of education as represented by TPRS[5]. For all other indicators some improvement is observable which is again trivial for a decade perhaps once again with the exception of HSDW - a pattern similar to CV.[6]

[4] Coefficient of variation is the ratio of the standard deviation to the mean of the distribution.

[5] The GiniC coefficient has been computed as follows:

$$GiniC = \frac{2\text{cov}(y, r_y)}{N\bar{y}}$$

where $\text{cov}(y, r_y)$ is the covariance of indicator y and ranks of all states according to y and $\bar{y}$ is the mean of y (see Pyatt et al., 1980). It must be pointed out that this in fact is a measure of the concentration of indicator y, hence we called it GiniC in order to distinguish it with the population-weighted Gini coefficient which we will employ later in the paper.

[6] Milnovic (1997) demonstrates that the Gini coefficient is approximately equal to the product of three elements: a constant, the coefficient of variation (CV) and the correlation coefficient between the attribute and its rank.

The above measures do not take into account the population share of each state despite the fact that they are either in per capita form or ratios. Below we employ a set of measures, which take into account the population share of each state. These measures are the Lorenz-consistent Gini coefficient (Gini) and the Generalized Entropy (GE) set of measures which are also Lorenz-consistent (Cowell, 1995, Shorroks 1980, 1984 and Fedorov 2002). The first one measuring inequality amongst the states can be presented as:

$$Gini = \frac{1}{m}\sum_{i=1}^{R}\sum_{j=1}^{R} f(y_i) f(y_j) \left| y_i - y_j \right| \qquad (1)$$

where y_i is the value of the indicator in state i, $f(y_i)$ is the population share of state i in total population and m is the *country* mean value for indicator under consideration.

The GE set of measures are sensitive to various parts of the distribution.

$$GE = \begin{cases} \sum_{i=1}^{R} f(y_i)\left[\left(\frac{y_i}{m}\right)^c - 1\right], c \neq 0,1 \\ \sum_{i=1}^{R} f(y_i)(\frac{y_i}{m})\log(\frac{y_i}{m}), c = 1 \\ \sum_{i=1}^{R} f(y_i)\log(\frac{m}{y_i}), c = 0 \end{cases} \qquad (2)$$

where all variables are as defined above. For c=0 we will have the mean logarithm deviation which is more sensitive to lower values of the index i.e. the bottom part of the distribution. For c=1 this measure (the Theil Entropy measure) is sensitive to all parts of the distribution and setting $c \neq 0,1$ makes the measure sensitive to the middle part of the distribution. Table 3 presents the results for these measures for the selected indicators.

Table 3. Measures of inequality for the selected indicators in the early 1980s and early 1990s

Indicators	Gini80	Gini90	GE80(c=0)	GE90(c=0)	GE80(c=1)	GE90(c=1)	GE80(c=2)	GE90(c=2)
NSDPP	0.2713	0.3241	0.1943	0.2194	0.0859	0.0738	0.1752	0.1535
IIAPC	0.1305	0.1297	0.1111	0.1017	0.0821	0.0724	0.1651	0.1448
ROADsk	0.3589	0.3667	0.8293	0.9099	0.0975	0.0583	0.0422	0.0012
HPUCCA	0.2750	0.2670	0.2098	0.1598	0.0924	0.0689	0.1922	0.1446
HSDW	0.4043	0.2109	0.2125	0.0703	0.0221	0.0105	0.0546	0.0284
HELEC	0.4340	0.4310	0.4305	0.3429	0.1083	0.0737	0.2645	0.1919
ADLIT	0.2691	0.2396	0.1222	0.1147	0.0440	0.0504	0.0886	0.1017
ER1114	0.1064	0.0957	0.0488	0.0489	0.0370	0.0381	0.0743	0.0766
IFEA	0.2737	0.2481	0.1516	0.1436	0.0644	0.0708	0.1320	0.1471
TPRS	0.1423	0.3595	0.0515	0.1346	0.0302	0.0095	0.0602	0.0197
ADFLIT	0.4306	0.3883	0.2689	0.2338	0.0350	0.0487	0.0778	0.1047
FER1114	0.1452	0.1205	0.0715	0.0628	0.0488	0.0462	0.0984	0.0930
IFEAF	0.4301	0.3465	0.2950	0.2298	0.0562	0.0784	0.1263	0.1726
U5SR	0.0381	0.0323	0.0124	0.0075	0.0110	0.0065	0.0220	0.0131
PPaPL	0.2182	0.1649	0.1203	0.0789	0.0665	0.0489	0.1369	0.0997

The first two column of Table 3 show the results for Gini coefficient (for early 80s and early 90s) which takes into account the population share of each state. The distribution in the 1990s as compared to the 1980s has become worse for NSDPP, ROADsk, and TPRS. The improvement for HSDW is notable while the improvement in other indicators is practically trivial.

GE, for c=0, shows that once we take into account the population shares in each state the situation has worsened with respect to NSDPP, ROADsk and TPRS. Improvements in HSDW, U5SR, U5SR and PPaPL are notable while all other indicators register small improvements after a decade. It should be reiterated that this measure is sensitive to the bottom part of the distribution.

GE, for c=1(Theil index), shows that the distribution overall as we compare early 80s with early 90s has worsened for ADLIT, ER1114, IFEA, ADFLIT and IFEAF. There seems to be notable improvements in ROADsk, HSDW, TPRS and U5SR while the remaining indicators register trivial changes. It should be noted that the Theil measure is sensitive to the entire range of distribution.

For GE with $c \neq 0,1$, sensitive to the middle part of distribution, we used c=2. For this value ADLIT, ER1114, IFEA, ADFLITand IFEAF show that the distribution has worsened in the 1990s. Notable improvements are found for HSDW, ROADsk, TPRS and U5SR with the rest of the indicators having minor improvements.

The results in tables 2 and 3, given the length of the period, are not very encouraging. It seems that there has been little progress in reducing disparities amongst the states over a decade. While the situation seems to have worsened with respect to some indicators any improvement that have been made for other indicators, considering the length of the period involved, may be regarded as insignificant.

3. A composite index

So far we have investigated the extent of disparities for individual indicators. The interesting question is how these States compare with each other, in terms of the selected indicators, collectively? We attempt to answer this question by constructing a composite index. However as our focus is on disparities amongst the states the adopted method would need to satisfy certain criteria. We follow the method proposed by Noorbakhsh (1998 and 2002). The adopted method is different to that of HDI in a number of ways, which are appropriate to our study.

To start with instead of measuring the distance for each state from a *fixed* minimum – as is most recently the case with HDI – the adopted method measures how far is a state from the maximum value observed amongst all states. This is specifically more suitable to our objective of measuring disparities amongst states. In other words as disparity is a relative phenomenon the comparison of states with the best one is a more sensible approach for our purpose.

We also diverge from the indexation method adopted in HDI.[7] We prefer to use standardisation for indexation in order to avoid the possible criticism that the value of

[7] In the methodology of HDI indexation is done by dividing the deviation of a country actual value from a prescribed minimum value for each component by its prescribed *fixed* value range which is different for each component. That is the three components of longevity, education and income are indexed as follows:

$$\text{Index} = \frac{(\text{actual value} - \text{minimum value})}{(\text{maximum value} - \text{minimum value})}$$

each indexed component in HDI is affected by the prescribed range for the denominator of that particular component and hence adding these indices together may be questionable. It should be noted that the method of indexation of HDI was recently adopted in response to the criticism - of *the moving goal posts* through time - addressed to the methodology used previously. In our case, as we are dealing with disparities which are relative concepts, the case of 'moving goal post' is indeed highly appropriate as disparities should be seen within the context of all states which in turn change as we go through time – the goal post is indeed moving and the adopted method should reflect this.

Thirdly, instead of constructing the composite index on the basis of the averages of the constituent indices, as is the case with HDI, we propose to construct it on the basis of considering the length of the composite distance vector as this approach has a superior mathematical foundation for combining numerous components of disparity.

We start with the matrix of data for the 1980s on J (15) socio-economic indicators for R (16) States. We first standardise the data in order to have each indicator spread around the same mean and variance and hence comparable. The standardised indicators would then constitute J vectors in a multi-dimensional vector space. Conceptually this makes sense as any composite socio-economic index for human development in our case should be defined within the context of all States.[8] In other words each state can be mapped as a J-dimensional vector in the space of the selected indicators. The distance between any two such vectors may then be measured by the length of the so-called distance vector.

As we are concerned with disparities we measure the composite distance vector between state r and the state with the maximum standardised score, h, for

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where values for maximum and minimum are as suggested by the UNDP(for example the suggested minimum and maximum for income component are \$100 and \$40000). The HDI is then computed as the simple average of these three indices.

[8] As the length of a standardised indicator is equal to the square root of the number of provinces which remains the same for all indicators, the length of the standardised indicator vectors are equal. These vectors of equal length can constitute the axes of a space within which each state is presented by a vector. In effect in the standardised data matrix, where rows and columns are the provinces and indicators respectively, the vector space consists of the row vectors and the matrix columns are a co-ordinate system for this space (see Noorbakhsh 2002 for details).

an individual indicator. The length of the distance vector d_r for state r, containing J components, from the states with the best values is then measured by:

$$d_r = \left[\sum_{j=1}^{J} (Z_{rj} - Z_{hj})^2 \right]^{1/2} \quad , \text{ for } r = 1,2,\ldots,R \qquad (3)$$

where Z_{hj} is the highest standardised score for indicator j. The lower the d_r the better the position of state r relative to the *best State.* We can rank different states according to the value of d_r .

We may also re-scale the values of this composite index to remain between 1 and 0 by dividing the results by the maximum value in the set.[9]

The second Column of Table 4 presents the computed Regional Human Development Index (RHDI) for different States in India. The nearer the RHDI to 1 the more developed is the state, in terms of the selected indicators, and vice versa.

The disparities revealed by RHDI are far more extensive than those which we see from HDI. The value of RHDI for the bottom eight states is less than a quarter of the same for the top state - disparities far more serious than revealed by HDI.

4. Weighted Composite Indices

It should be noted that as in the case of the HDI the components of this regional composite index are treated as having equal weights. One possible argument against HDI and our composite index is that its constituent indicators may be of different degrees of importance and hence require to be weighted.

Technically, it would be possible to introduce different weights, if desired, for various components as follows:

$$d_r = \left[\sum_{j=1}^{J} (Z_{rj} - Z_{hj})^2 w_j \right]^{1/2} \quad , \text{ for } r = 1,2,\ldots,R \qquad (4)$$

[9] More specifically we have computed 1 minus (the ratio of d_r to the maximum value in the set) in order to impose the appropriate direction. Various methods may be employed for this purpose ranging from the method we employed to the method employed by the UNDP. We later make use of only the ranking results for developing our procedure hence we are indifferent to which re-scaling method is employed as all will give the same ranking order.

where w_j are the appropriate weights. However, the question of selecting these weights is an important one which has been a matter of debate in the literature. The controversy about the selection of weights revolves around the subjectivity of the criteria for determining these weights. This combined with the desire for these weights to be universally acceptable becomes very controversial as the relative importance of socio-economic aspects, measured by relevant indicators, vary from country to country depending on their circumstances.

We employed two arguments for deriving three separate sets of weights and attempt to test the *validity* of the results based on these weights.

(i) First we may argue that development is a multidimensional interrelated phenomena, which for a specific country at a specific time, might be broken down into its major components. These components may be further broken down to their sub-components and indicators may be selected to represent the elements of such sub-components. It then follows that the interrelationship between the elements (indicators) would give a theoretically sound set of weights. On the basis of the above argument we first employed the principal component model of factor analysis to find the interrelationship between our selected indicators.

There were three factors with eigenvalues of greater than one with the first one being a dominant factor accounting for more than 64% of the total variance. All our selected indicators, with the exception of one (TPRS), had very high loadings on the first factor indicating a high interrelationship amongst them. These are presented in Table C1 in Appendix C. The loadings of our indicators on this dominant factor were used as their weights in equation (4) to compute the weighted regional human development index (RHDIFA). These results and the ranks are presented in columns 4 and 5 of Table 4. There are some changes in the ranking order and the extent of weighted disparities seems to be higher.

(ii) We then took the GiniC coefficient for each indicators (from Table 2) as a measure of concentration over States and weighted the indicators by their GiniC coefficients. The argument is that the more skewed the distribution the more deprived are the states and the more deprived a state of a particular socio-economic aspect the more important that aspect to this state.

The regional human development index weighted by the respective GiniC coefficients (RHDIG) and the relevant rank are presented in columns 6 and 7 of Table 4. Once again there are some changes in the ranking order but the weighted disparities have worsened.

(iii) In the third approach we weight indicators by the product of factor loadings in (i) and GiniC coefficients in (ii) and recompute the composite index (RHDIFAG).

The results are presented in column 8 and 9 of Table 4. Once again the weighted composite index reveals much wider disparities though there are some changes in the ranking order.

From the results in Table 4 we can conclude that the introduction of weights as derived on the basis of criteria explained above does not alleviate the vast extent of disparities amongst the states in India, if anything it amplifies the extent of such disparities.

Table 4. Unweighted and weighted RHDIs and their ranks (1980s)

State	RHDI	rank	RHDIFA	RankFA	RHDIG	RankG	RHDIFAG	RankFAG
Delhi	0.820	1	0.848	1	0.870	1	0.885	1
Punjab	0.470	2	0.462	2	0.385	2	0.388	2
Kerala	0.381	3	0.408	3	0.333	3	0.355	3
Himachal Pradesh	0.349	4	0.355	4	0.270	5	0.279	5
Gujarat	0.346	5	0.344	5	0.275	4	0.280	4
Maharashtra	0.307	6	0.324	6	0.260	6	0.273	6
Tamil Nadu	0.270	7	0.264	8	0.241	7	0.247	7
Haryana	0.269	8	0.285	7	0.231	8	0.238	8
West Bengal	0.194	9	0.201	9	0.169	10	0.172	10
Karnataka	0.192	10	0.193	10	0.174	9	0.179	9
Andhra Pradesh	0.107	11	0.100	11	0.095	11	0.093	11
Rajastan	0.071	12	0.047	12	0.069	12	0.061	12
Madhya Pradesh	0.039	13	0.043	13	0.050	14	0.055	13
Orissa	0.037	14	0.022	14	0.041	15	0.042	15
Uttar Pradesh	0.012	15	0.009	15	0.052	13	0.051	14
Bihar	0.000	16	0.000	16	0.000	16	0.000	16

To investigate the validity of these composite indices we matched them with the composite index of human poverty, namely HPI, and the percentage of people below poverty line (PPbPL) in various states. More specifically we regressed these two poverty indices on various RHDIs to see which one explains poverty better. Table 5 represents the results.

Table 5. Regression results for indicators of poverty and various RHDIs (1980s)

	Explanatory variable	Constant	Coefficient	R^2	F Statistics
Dependent variable HPI	RHDI	63.94 (35.16)**	-58.33 (-12.60)**	0.92	158.73**
	RHDIFA	61.38 (16.05)**	-42.22 (-5.21)**	0.66	27.12**
	RHDIG	63.57 (23.55)**	-57.75 (-8.28)**	0.83	68.62**
	RHDIFAG	61.25 (15.80)**	-42.05 (-5.10)**	0.65	26.02**
Dependent Variable PPbPL					
	RHDI	55.77 (7.57)**	-46.79 (-2.50)*	0.31	6.23*
	RHDIFA	46.47 (5.26)**	-16.82 (-.90)	0.05	.81
	RHDIG	54.14 (6.81)**	-42.50 (-2.07)*	0.23	4.28*
	RHDIFAG	46.20 (5.22)**	-16.22 (-0.86)	0.05	0.74

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

The results indicate that RHDI is by far the best in terms of explaining poverty indices followed by RHDIFA by a considerable margin for HPI only. RHDIFA results are poor with PPbPL as the dependent variable.

One possible concern is that our indices include indicators of poverty and also some of the constituents of HPI. We removed these indicators and recomputed all our composite indices and re-run the above regressions. The results are presented in Table D1 in Appendix D. Once again RHDI and RHDIFA come out to be the best in explaining HPI. However, poverty as measured by PPbPL is explained equally well by RHDIFA. On balance we preferred RHDI to RHDIFA as the weighting procedure used may be arguable. We proceed to the next stage of our investigation choosing RHDI for further analysis.[10]

[10] Although the follow up analyses could also be applied to any one of the weighted indices if desired.

5. A Counter Factual Analysis

From the results so far it seems that disparities have persisted during the decade of the 1980s (indeed these may be even worse for more recent years) and if no action is taken they are likely to increase or remain at the existing alarmingly high levels. The fact that the four bottom states, in terms of RHDI in Table 4, of Bihar, Uttar Pradesh, Madhya Pradesh and Orrisa together have 55% of all people living below the poverty line in India (Mehta and Shah, 2003) illustrates the seriousness of the problem of regional disparities and the need to deal with this problem. In a study of chronic poverty in various states in India these authors observe that "…better-off states remained relatively affluent and reduced poverty, while poorer states remained poor and made less progress in poverty reduction." (page 492).

Most literature of inequality, in the context of equalisation, considers the effect of transfer from one beneficiary to another. Datt and Ravallion (1993) in a study of the effect of regional disparities in India on national poverty conclude "…small transfer from a donor region with a higher mean consumption than the recipient region will generally (though not always) lead to a reduction in national poverty." (Page 109).

In this section we propose a systematic way of decreasing these disparities and also find out, through a counter factual analysis, whether the suggested method would results in such a reduction. Our aim is to compute a set of targets for various States, which would be in the direction of reducing the disparities. We start with the data for the 1980s.

Our computed RHDI for the 1980s (first column of Table 4) would give us a measure of development for ranking all States. For each state this measure will reveal the States that are at a higher level of development. We may compute the targets for each state from the actual values of the indicators for those at a higher level of human development. However, the question is would the respective state have the *capacity* to achieve such higher targets? To answer this question we need to identify those States which are homogenous, with the state under consideration, in terms of our indicators.

For all (R) States we compute the elements, d_{pq}, of a distance matrix D- the matrix of proximity - which represents the composite distances as measured by J indicators.

$$d_{pq} = \left[\sum_{j=1}^{J} \left(Z_{pj} - Z_{qj} \right)^2 \right]^{1/2} \quad \text{, for p = 1, 2, …, R; and q = 1, 2, …, R} \qquad (5)$$

Each element of matrix D is a mathematical expression of J distances between two states of p and q. This matrix of Euclidean distances is presented in Appendix E. Across every row of this matrix the minimum non-zero value shows the shortest distance between the two closest states represented by the respective row and column. These are presented with the matrix of composite distances in Table E1 in Appendix E.

These minimum distances could be used to find a critical distance: $d_c = \bar{d} + 2s_d$ where $\bar{d}$ and s_d are the mean and standard deviation of all minimum distances belonging to R states.[11] The computed d_c shown in Table E1 is 5.183. For each state, r, all distances with a length greater than the computed d_c may be regarded as belonging to heterogeneous states, that is too far for the respective state to be included in the computation of targets for state r. All composite distances lower than d_c may be regarded as belonging to a group of comparatively homogenous states within close proximity of each other.[12]

As table E1 shows there are two states with the minimum distances above d_c, Delhi and Kerala. The average distances, presented at the bottom of Table E1, for three states of Delhi, Kerala and Punjab are also above d_c. Furthermore the average distances for most States are far above the average of the minimum distances indicating that the overall results are more skewed towards larger disparities than lower.

The targets for state r can be now computed as the average of the values for all states which are at a higher level of human development and at the same time have a distance lower than d_c with state r. More specifically from the rth row of Table D1 we

[11] This is based on the expectation that in a normal distribution approximately 95% of cases fall between the mean plus 2 standard deviation and the mean minus 2 standard deviation.

[12] Conceptually distances lower than mean minus 2 standard deviation may be regarded as belonging to almost *identical* states; not surprisingly no state qualified for this.

can find out all states whose distances from state r are below d_c. Exclude from this group those states which are at a lower level of human development according to RHDI in the first column of Table 4. The averages of actual values for indicators belonging to the remaining States and state r would constitute a set of acceptable and attainable targets for state r.

For example from Table 6 for Rajasthan in the 1980s we have 11 states with their RHDI at a higher level than that of Rajasthan. From Table D1 we can see that the distance between Rajesthan and five of these states - Maharashtra, Hichamel Pradesh, Kerala, Punjan and Delhi – are above the minimum critical distance of d_c =5.183. The average of the actual values of the remaining six states (Gujarat, Tamil Nadu, Haryana, West Bengal, Karnataka and Andhra Pradesh) and Rajastahn itself would constitute an achievable target for Rajasthan.

The suggested procedure, with the aim of reducing disparities, computes the targets for a state from the average values of a group of states which are at a higher level of development and at the same time are within close proximity of the state concerned. Hence the question of *capacity* is taken into account implicitly. On the other hand if we are still concerned with the question of *capacity* we may wish to compute different sets of targets (for short run, medium run and long run) for each indicator by computing the averages from those states which are below, around or above the overall mean, respectively.

It should be noted that the suggested approach results in reducing the disparities amongst the homogenous states in the first instance with some (one-sided though right-directioned) effect on between-group disparities. If we are interested in reducing between-group disparities more directly this could be accommodated by including those states which are above the critical distance in the computation of targets, though this would be at the expense of foregoing capacity concerns.

It must be also noted that we excluded those states which have a lower RHDI from the computation of targets. This may need some justification. Our main reason is that we intend to make improvement in the indicator under consideration and therefore there is no point in including those states which are at a lower level of development in the computation of targets. This may be arguable as states may have been developed disproportionately at the expense of another state being left behind, and/or they may have been developed disproportionately in a few aspects at the expense of being left behind in other aspects. This view throws some doubt on excluding the worse off states from the computation of targets. However, as homogeneity is based on all selected indicators of social and economic aspects one can expect that the extent of this bias in the computed targets would be limited.

Furthermore, in employing the recommended procedure for the computation of targets we may encounter a few problems. In some cases we may end up having a target lower than the actual value for some states. Strictly speaking this is an outcome of attempting to reduce disparities. Indeed when we take into account the cost of maintaining specific levels of different aspects of development (as presented by our indicators) and bearing in mind the inter-state transferability of central government development funds this seems to be an acceptable outcome.[13] Nevertheless it is conceivable that aiming for a drop in the level of welfare may prove to be impractical from a policy maker's stance, except perhaps when we are faced with severe budget constraints. Assuming the undesirability of a drop in the level of indicators in cases where there is a drop in the targets, as compared with the actual value, we keep the level of the indicator constant – that is no change in the level.[14] Computed targets for all States and all indicators are computed and presented in Table F1 in Appendix F.

Intuitively we expect that the computed targets are in the direction of reducing disparities, however, it would be interesting to find out if this is the case. Table 6 contains RHDI for the 1980s, 1990s and computed targets. All columns are ranked according to the value of RHDI80s. In comparing the computed targets with RHDI80s and RHDI90s, in particular, it should be noted that we did not take into account the length of the period involved. We certainly do not envisage a decade for implementing the new targets, rather a period much shorter, more likely to be a couple

[13] Bearing in mind the existence of state development funds and central government development funds as two sources of financing projects the suggested method in this section is more relevant to the latter.

[14] The other problem that we may face is that the computed targets may be unachievable due to the existing constraints such as the budget constraint.

of years or at most for the duration of a medium term plan of four to five years. Nevertheless, even in comparison to the figures for the 1980s and 1990s the computed targets exhibit a reduction in disparities at the first glance. It is also notable that the order (of development) has changed for some States for the computed targets.[15]

Table 6. RHDIs for the 1980s, 1990s and the computed targets

State	RHDI80s	RHDI90s	RHDITargets
Delhi	0.820	0.787	0.767
Punjab	0.470	0.412	0.401
Kerala	0.381	0.397	0.284
Himachal Pradesh	0.349	0.372	0.352
Gujarat	0.346	0.329	0.328
Maharashtra	0.307	0.382	0.311
Tamil Nadu	0.270	0.322	0.281
Haryana	0.269	0.320	0.276
West Bengal	0.194	0.251	0.214
Karnataka	0.192	0.258	0.203
Andhra Pradesh	0.107	0.122	0.132
Rajastan	0.071	0.104	0.126
Madhya Pradesh	0.039	0.091	0.070
Orissa	0.037	0.109	0.000
Uttar Pradesh	0.012	0.000	0.030
Bihar	0.000	0.025	0.023

6. Inequality and Regional Polarisation

In order to compare further RHDI80s, RHDI90s and the RHDI targets we computed measures of inequality for all these composite indices. The first column of Table 7 presents the coefficient of variation which is particularly sensitive to the top section of the distribution. The figure for the 90s shows a slight drop as compared to the 80s while the drop for the targets is much more pronounced indicating a higher reduction in disparities. The middle-sensitive GiniC, in the next column of this table, also shows the same pattern: a slight drop in inequality after a decade but a higher drop in inequality for the computed targets.

As discussed before these measures do not take into account different sizes of population in various states. The third column in Table 7 presents the population-weighted Lorenz-consistent GINI coefficient showing a worsening situation in the 1990s indicating that relatively more of the population were suffering from regional disparities. As for targets it must be noted that the third and fourth rows in Table 7

[15] Recall that RHDI is computed on the basis of the collective distance from the best states

show the results for the measures applied to computed targets using population distribution for the 1980s and 1990s respectively.[16] Both assumptions regarding population distribution demonstrate a significant drop in population affected by disparities. In other words there is a significant drop in population-consistent disparities if we assume that the population distribution remained the same (or nearly the same) and there is also a significant reduction if we take the population distribution for the 1990s. This implies that, amongst others, the computed targets have a tendency in reducing disparities in the more populated states. It is significant to note that the reduction in disparities for targets in both cases are comparable to those of the 1980s and 1990s.

The GE (c=0) measure, particularly sensitive to the bottom section of the distribution, shows a slight improvement for the 1990s as compared to the 1980s, however, this measure for targets, under both population assumptions, shows a relatively more significant improvement. The GE (c=1), responsive to all parts of the distribution, reveals a worsening of disparities in the 1990s but an improvement for the computed targets as compared to both the 1980s and 1990s. Finally, the GE (c=2), sensitive to changes in the middle part of the distribution, reveals a worsening of disparities in the 1990s but a significant reduction in the case of targets. We shall discuss the last two columns of Table 7 at a later stage.

Table 7. Measures of distribution and polarisation

RHDI	**CV**	**GiniC**	**Gini**	**GE(c=0)**	**GE(c=1)**	**GE(c=2)**	**ER**	**W**
RHDI80s	0.2719	0.1362	0.2060	0.0843	0.1372	0.2749	0.0573	0.1480
RHDI90s	0.2591	0.1301	0.2272	0.0826	0.1384	0.2788	0.1195	0.1475
RHDI Targets Pop80	0.2405	0.1189	0.1833	0.0746	0.1145	0.2296	0.0540	0.1244
RHDI Targets Pop90	-	-	0.1836	0.0736	0.1154	0.2311	0.1157	-

Note: Population-weighted measures have been computed for the composite index before re-scaling it.

The measures discussed above reflect the regional distribution of the composite index but do not show the degree of concentration in clusters of regions. More recent literature on inequality distinguishes between inequality and polarisation. The latter is the phenomenon of the *disappearing middle class* and *clustering around extremes* in a

[16] Equations (1) and (2) require the population distribution, we used both sets of distribution to see if the results would be different. It is also important to reiterate that the way that the recommended targets are derived makes them attainable within a much shorter period than a decade.

distribution which may be existing and/or taking place over time.[17] Polarisation in the context of regions may be described as a situation where there are groups of regions at the extremes of the distribution with high intra-group homogeneity but with a high inter-group heterogeneity. This reflects a different feature of the distribution than that of the inequality. Technically speaking, an equalising transfer of welfare, of the Pigou-Dalton type, from a region above the median of the distribution to a region below the median would reduce inequality and polarisation, provided that none of the regions move to the other side of the median because of the transfer. However, if such a transfer was from a region on one side of the median to another region on the same side then inequality would decrease but polarisation would increase (Wolfson 1997).

Esteban and Ray (1994) link the phenomena of polarisation in a society to the generation of tensions and social unrest. In the context of regions the proposed *convergence* of regions may take place around local means at extremes of the distribution as opposed to the global mean. That is regions will cluster around the highly developed and highly backward poles (Esteban and Ray, 1994), the case of further deprivation.

We employ two of the more commonly used measures of polarisation in order to investigate if polarisation has taken place over the decade and find out if our computed targets exhibit a reduction or increase in polarisation. Esteban and Ray measure (ER) can be presented as follows:

$$ER = A\sum_{i=1}^{R}\sum_{j=1}^{R} p_i^{1+a} p_j \left| y_i - y_j \right| \qquad (6)$$

where A is a normalisation scalar, R the number of states, p_i and y_i are the population size and the value of the composite index for state i, respectively. The parameter a reflects the degree of polarisation whose range is between 0 and 1.6, where for $a = 0$ the ER index is equivalent to the Gini coefficient as can be seen from

[17] See for example Esteban and Ray (1994) and Wolfson (1994 and 1997) on the concept and measurement, Zhang and Kanbur, (2001) and Fedorov (2002) on the application of the recommended measures.

comparing equations (1) and (6). The higher a the higher the weight attached to polarisation. We set $a = 1.5$ in order to give a high weight to polarisation.[18]

The second measure of polarisation we employ is the Wolfson index which is based on the Lorenz curve and derived from the Gini coefficient (Wolfson 1997). It can be written as:

$$W = 2(2T - Gini)/(m/m) \qquad (7)$$

where T=0.5-L(0.5) and L(0.5) indicates the share of the bottom half of regions of the index, Gini is the Gini coefficient of the distribution, m and m are the median and mean respectively.

The penultimate column in Table 7 presents the ER results for various RHDIs. The figure for the 1990s as compared to that of 1980s shows that polarisation has worsened amongst the states in India. The relative magnitude is alarming as the ER measure is population oriented indicating that states with relatively higher population sizes have polarised. Our computed targets for both population assumptions indicate a significant drop in polarisation as compared to both dates.

The last column of Table 7 presents the result for the Wolfson measure of polarisation. This measure shows a small improvement for the 1990s however, the reduction in polarisation for the computed targets is much higher.[19]

7. Conclusion

Regional inequalities in India, initially high in the 1980s, have not been reduced significantly after a decade and as judged by a number of measures have increased in some aspects. Furthermore polarisation has followed more or less the same pattern.

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[18] This is the most common value employed in the empirical literature on polarisation, for example see Zhang and Kanbur (2001) and Fedorov (2002).

[19] We may prefer the ER measure in this case as the Wolfson index has been computed using the mean and median values for the regions which necessitated the use of GiniC as opposed to Gini hence the computed measure does not take into account various population sizes of different states.

There is little evidence to suggest that any convergence of b type or of s type is taking place amongst the states in India. On the contrary the evidence points at divergence rather than convergence. This may be due to the lack of infrastructure in the backward states, which are caught in a vicious circle of deprivation. The worsening of polarisation could be an evidence of such deprivation. The expectation of a reduction in marginal returns to investment in richer states relative to poorer states may have to be qualified by considering that in most developing countries regions are far from the socio-economic threshold which may be required for triggering such possible relative advantages. Indeed the underlying assumption of convergence hypothesis is that structural fundamentals are similar. The lack of social and economic infrastructure in some backward regions encourages further investment and progress in the richer regions which race ahead and the vicious circle goes on.

The method suggested in this paper for the systematic reduction of regional disparities amongst the Indian states, and thereby breaking this vicious circle, exhibited significant improvements in both inequality and polarisation.

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Appendix A

The following indicators were selected for this study. Data were collected for the early 1980s and early 1990s from the National Human Development Report 2001 for India (PCGI, 2002). The dates are stated in brackets.

NSDPP	Per capita net state domestic product in 80-81 prices (1981-82 and 1991-92).
IIAPC	Inflation and inequality adjusted per capita consumption expenditure (1983 and 1993-94).
ROADsk	The length of roads per 100 square kilometres (1981 and 1991).
HPUCCA	Percentages of house holds with Pucca houses (solid materials) (1981 and 1991).
HSDW81	Percentages of households with safe drinking water (1981 and 1991).
HELEC	Percentages of households with electricity connection (1981 and 1991).
ADLIT	Adult literacy rate (1981 and 1991).
ER1114	Enrolment ratio for the age group of 11 to 14 years (1981 and 1991).
IFEA	Intensity of formal education (years) adjusted for population age group of 6 to 18 years (1978 and 1993)*.
TPRS	Teacher-pupil ratio for secondary school level (1982-83 and 1992-93).
ADFLIT	Adult female literacy rate (1981 and 1991).
FER1114	Female enrolment ratio for the age group of 11 to 14 years (1981 and 1991).
IFEAF	Intensity of formal education (years) for females adjusted for population age group of 6 to 18 years (1978 and 1993).
U5MR**	Under 5 mortality rate (per 1000) (1981 and 1991).
PPbPL**	Percentage of population below poverty line (1983 and 1993-94).

* Intensity of formal education has been estimated by the above report as the "…weighted average of the enrolled students from Class I to Class XII (where weights being 1 for Class I, 2 for Class II and so on) to total enrolment in Class I to Class XII. This has been adjusted by proportion of total enrolment to population in age group 6-18." (PCGI, 2002, page 212).

** In order to keep the direction of indicators positive in some part of this study U5SR (under five survival rate) and PPaPL (percentage of population above the poverty line) have been computed from these indicators and used when appropriate.

Appendix B

Table B1. Data for the selected indicators for the early 1980s.

State	NSDPP	IIAPC	ROADsk	HPUCCA	HSDW	HELEC	ADLIT	ER1114	IFEA	TPRS
Andhra Pradesh	1525	87.85	43.38	26.22	25.89	21.41	32.50	65.7	1.61	3.44
Bihar	945	73.28	48.08	23.64	37.64	9.20	29.37	68.7	1.34	3.03
Gujarat	2038	103.77	29.63	48.96	52.41	44.81	48.26	75.4	2.45	3.84
Haryana	2455	112.64	52.00	39.82	55.11	51.53	39.21	74.3	2.02	3.03
Himachal Pradesh	1738	115.71	35.21	43.94	44.50	54.86	43.72	87.6	2.84	3.57
Karnataka	1584	91.01	57.31	29.33	33.87	32.98	43.05	67.2	2.17	3.44
Kerala	1502	100.29	268.24	38.80	12.20	28.78	78.11	87.1	3.79	3.33
Madhya Pradesh	1387	78.36	23.62	25.02	20.17	17.11	35.63	71.3	1.53	3.03
Maharashtra	2485	95.59	57.38	39.63	42.29	40.65	51.84	79.2	2.45	3.22
Orissa	1278	75.74	76.98	13.00	14.58	17.75	38.72	65.8	1.74	4.76
Punjab	2846	123.51	91.18	58.12	84.56	60.90	42.65	75.0	2.79	4.34
Rajasthan	1282	89.74	19.65	49.08	27.14	20.54	28.20	64.5	1.51	4.54
Tamil Nadu	1570	86.12	93.23	36.62	43.07	37.21	50.38	69.3	2.86	4.16
Uttar Pradesh	1318	77.72	49.84	29.29	33.77	12.91	30.76	59.3	1.99	3.22
West Bengal	1749	85.26	64.03	28.40	69.65	21.09	48.10	72.6	1.69	3.12
Delhi	4341	153.12	937.56	88.73	92.97	73.57	68.95	80.4	3.95	4.00
INDIA	**1671**	**86.59**	**45.13**	**32.48**	**38.19**	**26.19**	**40.83**	**70.8**	**2.04**	**3.44**

Tabe B2. Data for the selected indicators for the early 1990s.

State	NSDPP	IIAPCC	ROADsk	HPUCCA	HSDW	HELEC	ADLITR	ER1114	IFEA	TPR
Andhra Pradesh	2099	98.56	54.32	38.41	55.08	46.30	38.51	74.6	2.28	2.94
Bihar	1120	83.08	49.12	30.18	58.76	12.57	35.13	75.3	1.69	2.70
Gujarat	2738	109.39	41.26	56.93	69.78	65.93	55.88	77.2	3.45	3.84
Haryana	3521	110.98	59.85	50.14	74.32	70.35	48.92	84.2	2.95	2.63
Himachal Pradesh	2268	102.94	45.13	53.03	77.34	87.01	57.28	93.3	4.30	2.85
Karnataka	2215	96.58	68.57	42.55	71.68	52.47	50.94	77.1	3.00	3.44
Kerala	1876	121.11	348.84	55.97	18.89	48.43	88.00	95.4	3.94	3.33
Madhya Pradesh	1636	85.47	31.58	30.47	53.41	43.30	40.02	78.6	2.84	2.38
Maharashtra	3615	104.07	72.07	52.20	68.49	69.40	60.37	84.6	3.41	3.44
Orissa	1480	94.87	125.84	18.71	39.07	23.54	46.10	75.8	2.58	5.55
Punjab	3873	128.82	107.74	76.97	92.74	82.31	52.90	81.9	2.96	3.22
Rajasthan	1916	96.53	35.80	56.13	58.96	35.03	35.53	72.7	2.29	4.00
Tamil Nadu	2303	105.45	151.23	45.54	67.42	54.74	57.02	79.8	3.86	2.43
Uttar Pradesh	1648	84.88	68.21	41.03	62.24	21.91	38.62	64.2	2.19	1.81
West Bengal	2257	109.73	69.50	32.61	81.98	32.90	56.19	76.4	2.31	5.88
Delhi	5972	195.46	1406.14	85.60	95.78	79.48	72.19	84.9	4.47	4.76
INDIA	**2213**	**97.53**	**61.27**	**41.61**	**62.30**	**42.37**	**48.54**	**77.5**	**2.70**	**3.44**

Appendix C

Table C1. Factor loading on the first factor using principal component model of Factor Analysis

Indicator	Factor 1
NSDPP	.837
IIAPC	.916
ROADsk	.750
HPUCCA	.839
HSDW	.635
HELEC	.872
ADLIT	.827
ER1114	.777
IFEA	.917
TPRS	.128
ADFLIT	.836
FER1114	.819
IFEAF	.908
U5SR	.816
PPaPL	.587
Percentage of Variance	64

Appendix D

Table D1. Regression results for indicators of poverty on various MHDIs excluding poverty variables from composite indices for the early 1980s.♦

Dependent variable HPI	Explanatory variable	Constant	Coefficient	R^2	F Statistics
	MHDI	63.91 (34.54)***	-58.97 (-12.36)***	0.92	152.8***
	MHDIFA	64.06 (37.81)***	-57.32 (-13.60)***	0.93	185.0***
	MHDIG	62.43 (21.27)***	-56.64 (-7.23)***	0.80	52.3***
	MHDIFAG	62.62 (22.18)***	-55.95 (-7.60)***	0.81	57.7***
Dependent Variable PPbPL	MHDI	55.64 (7.53)***	-47.00 (-2.47)**	0.30	6.1**
	MHDIFA	55.64 (7.53)***	-45.35 (-2.47)**	0.30	6.1**
	MHDIG	52.32 (6.58)***	-38.75 (-1.83)*	0.19	3.3*
	MHDIFAG	52.55 (6.63)***	-38.57 (-1.87)*	0.20	3.5*

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level.

♦ The excluded variables are: HPUCCA, HSDW, HELEC and PPbPL.

Appendix E

Table E1. Euclidean distances and the minimum distance

Sates	1	2	3	4	5	6	7	8	9	10	11
1.Andhra Pradesh	0	2.897	3.684	3.419	5.227	1.721	7.832	2.715	3.925	3.861	5.881
2.Bihar	2.897	0	5.149	5.011	6.609	3.345	8.675	2.474	4.815	3.844	7.568
3.Gujarat	3.684	5.149	0	2.420	2.821	2.520	5.691	4.722	1.940	5.324	2.879
4.Haryana	3.419	5.011	2.420	0	3.116	2.918	7.153	4.437	2.632	6.105	3.734
5.Himachal Pradesh	5.227	6.609	2.821	3.116	0	4.401	5.686	5.796	3.075	6.964	3.614
6.Karnataka	1.721	3.345	2.520	2.918	4.401	0	6.589	2.866	2.645	3.807	5.011
7.Kerala	7.832	8.675	5.691	7.153	5.686	6.589	0	8.170	5.333	8.618	6.879
8.Madhya Pradesh	2.715	2.474	4.722	4.437	5.796	2.866	8.170	0	4.003	3.579	7.223
9.Maharashtra	3.925	4.815	1.940	2.632	3.075	2.645	5.333	4.003	0	5.323	4.247
10.Orissa	3.861	3.844	5.324	6.105	6.964	3.807	8.618	3.579	5.323	0	7.490
11.Punjab	5.881	7.568	2.879	3.734	3.614	5.011	6.879	7.223	4.247	7.490	0
12.Rajasthan	2.925	4.129	4.655	4.944	6.299	3.583	9.332	3.798	5.355	3.434	6.401
13.Tamil Nadu	3.663	4.591	2.382	4.162	4.604	2.235	5.769	4.374	2.886	3.882	4.577
14.Uttar Pradesh	2.549	2.660	5.118	4.883	6.740	2.989	9.093	2.256	4.978	3.584	7.298
15.West Bengal	3.396	3.170	3.180	3.586	4.963	2.591	6.626	3.582	2.767	4.752	5.437
16.Delhi	10.500	11.798	7.552	8.295	7.798	9.374	7.835	11.338	7.969	11.622	6.058
Average distance	4.012	4.796	3.752	4.176	4.857	3.537	6.830	4.458	3.868	5.137	5.269
Standard deviation	2.453	2.804	1.839	1.969	1.988	2.126	2.230	2.671	1.828	2.645	2.053
d_c (critical distance)											

Appendix F

Table F1. Computed targets for all states

State	NSDPP	IIAPC	ROADsk	HPUCCA	HSDW	HELEC	ADLIT	ER1114	IFEA	TPR
Andhra Pradesh	1915	94.61	56.71	35.57	46.04	35.67	44.76	72.0	2.18	3.47
Bihar	1635	88.09	51.26	32.42	37.97	27.27	39.67	69.4	1.95	3.57
Gujarat	2207	114.33	52.01	50.34	60.49	53.52	48.26	79.3	2.69	3.92
Haryana	2455	112.64	59.77	44.52	55.11	51.53	46.01	76.8	2.57	3.69
Himachal Pradesh	2292	119.61	63.20	51.03	64.53	57.88	43.72	87.6	2.82	3.96
Karnataka	2058	101.70	60.00	40.60	53.18	43.00	45.90	75.1	2.41	3.59
Kerala	1502	100.29	268.24	38.80	12.20	28.78	78.11	87.1	3.79	3.33
Madhya Pradesh	1786	92.26	48.91	35.90	41.07	31.93	41.91	71.1	2.03	3.54
Maharashtra	2485	109.65	57.38	47.66	55.94	50.31	51.84	79.3	2.63	3.74
Orissa	1482	84.87	76.98	29.67	33.48	24.01	39.51	68.1	1.87	4.76
Punjab	2846	123.51	91.18	58.12	84.56	60.90	42.65	75.0	2.79	4.34
Rajasthan	1743	93.77	51.32	49.08	43.88	32.80	41.39	69.9	2.04	4.54
Tamil Nadu	2135	104.94	93.23	45.45	53.37	47.69	50.38	77.3	2.68	3.83
Uttar Pradesh	1697	89.44	51.55	33.22	38.00	28.91	40.60	69.5	2.00	3.62
West Bengal	2006	99.85	64.03	39.56	69.65	41.69	48.10	76.4	2.39	3.49
Delhi	4341	153.12	937.56	88.73	92.97	73.57	68.95	80.4	3.95	4.00