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Change in Efficiency Level in Achieving Human Development: Inter-Temporal Comparison of Indian States

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In India, research on human development has received considerable importance from both the academic and policy point of view. However, all the previous studies on human development mainly focused on the equity aspects of development without considering the resource base. Therefore, the current study seeks to analyse the change in the efficiency level of the states in achieving the various dimensions of human development through Panel Data Envelopment estimation of efficiency by using the Malmquist index for the periods 1981, 1991, 2001 and 2011. It has been found that the technical efficiency change is significant but technological change is not at all prominent in achieving human development from 1981 to 2011. This indicates that the states are basically attempting to catch up with the production frontier by changing their input levels rather than through new technological improvements. One of the major findings is that Uttar Pradesh faced a negative factor productivity in the health and education sectors, and in terms of the standard of living, which implies that the levels of outcome are extremely poor and still provide no scope for improvement by using the current level of inputs. This is a cause for serious concern and it must be addressed by increasing input allocation and the efficient utilization of such inputs. The public sector also needs to be strengthened in such states.

Keywords: *Human development, Data envelopment analysis, Efficiency, Malmquist index, Indian states*

INTRODUCTION

Recently, human development has begun to be seen as the ultimate objective of human well-being in the place of economic growth. According to the United Nations Development Programme (UNDP), the gross national income represents one of the indicators of a country's level of human development. However, it is not the only one. A country with a high income may not have a strong growth potential if the income of the country has been mostly invested on consumption or import purposes. On the contrary, a growth potential exists if the income of the country has been invested on health and education purposes. The gross domestic income of a country does not measure the 'fitness' of a particular country or society as a whole, but rather summa-

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rizes the current state of economic activities (agriculture, manufacturing, banking, and transport, among others) within a society. One of the limitations of the gross domestic income ranking measure is that it is a uni-dimensional measure and does not capture the basic human needs, inequality, environmental degradation and illiteracy. Development research has come up with new differentiating rules to measure the states of human development. In the 1990s, development economics and policy debates acknowledged that development is about more than the growth of material output and should serve broader objectives of human well-being. UNDP's human development index has been rather successful in serving as an alternative measure of development that supplements the Gross Domestic Product (GDP) (Sen, 1999). Human development is a process of enlarging people's choices by enhancing their functioning and capabilities. At all levels of development, the three essential choices for people are to live a long and healthy life, to acquire knowledge, and to have access to the resources needed for a decent standard of living. The existing studies on human development and its correlates like poverty (Ravallion and Datt, 2002; Mathur, 1983; 1987; Noorbakhsh, 2002) are mainly based on aggregate (regional) income or consumption levels as indicators of the development level. In those studies, they examined the regional disparities in human development.

However, inequality in human development is not unexpected. In large federal structures like that of India, the level of efficiency and effectiveness of the delivery of services (health, education) depends on who provides them. Both health and education are subjects in the concurrent list of the Indian Constitution, and hence both the Union and state governments have a claim on the provision of these services. However, traditionally, the major responsibility of providing social services such as healthcare and education lies primarily with the state governments. Sadly, different states started off at different levels of provision and outcomes, and expanded with different degrees of intensity and efficiency, reflecting their differential capacities, willingness and financial inputs. This has resulted in imbalances in inputs and outputs/outcomes in these sectors. Thus, there has been a divergence in the performance of the states in providing healthcare, education, standards of living, and finally human development. This paper is an attempt to investigate how the resources are allocated across various Indian states for the purpose of achieving human development by using Data Envelopment Analysis (DEA). For each of the three human development index components, the efficiency of each state or decision-making unit (DMU in DEA terminology) is measured by its ability to transform the appropriate inputs into the corresponding output. The objective of this study is to determine how the efficiency of the states has changed in terms of achieving human development over the period 1981-2011, in order to study the implementation of the government policy to achieve targeted human development. Thus, this paper is devoted to measuring the changes in the efficiency level of Indian states in achieving human development during four time periods, viz. 1981, 1991, 2001 and 2011. The study relies on the panel DEA estimation of efficiency by using the Malmquist index, which

is useful for measuring the changes in efficiency. It is important to understand the present situation for any current day policy. This paper is organized as follows. After this introduction, the second section provides a brief review of the various issues related to the Human Development Index (HDI). In Sections 3 and 4, the paper describes the data and methodology, respectively. The main empirical results are presented in Section 5. Section 6 concludes the paper.

LITERATURE ON HUMAN DEVELOPMENT: A BRIEF REVIEW

The HDI was first introduced to the public in the UNDP's Human Development Report in the year 1990. Much of the literature on human development has focused on the appropriate measures of human development and whether economic growth or per capita income levels are sufficient measures for assessing of the well-being of the population. There are various studies which have been directed towards the comparison of various indices from various policy points of view (Anand and Sen, 1994). Their basic objective was to review the Human Development Reports of 1990, 1991 and 1992, and to formulate the HDI in terms of the country's deprivation or shortfall in each of the three separate dimensions, that is, life expectancy, education, and adjusted income. This perspective has some merit in drawing attention to the distance that a country still has to travel in order to achieve what is regarded as a desirable target or goal. In order to modify it, they measure the HDI in terms of the attainment rather than shortfall of a country. This is more useful if one wishes to assess changes in the HDI over time. Therefore, it is more relevant for assessing how well a country is doing, whereas the shortfall perspective is more relevant in terms of examining the difficulty in performing the remaining task. There is another study, which tries to bridge the gaps between the 1990 and 1994 methods of computing the goal posts (Majumdar, 2003). Various studies (Mathur, 1983; 1987; Noorbakhsh, 2002; Dholakia, 2003) have also tried to trace the path of development in India with a special focus on its regional pattern. Most of them have used the 'states' as the unit of the region and studied cross-sectional disparity in development over a few time points to emphasize the long-term trend in it. According to Noorbakhsh (2002), there is still a high degree of disparity in India. This is basically due to the lack of infrastructure in backward states, which are caught in a vicious circle of deprivation, but he concludes that 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 circles goes on. Dholakia (2003) examines the trends in regional disparity in India's economic and human development over the past two decades, and the direction of their causality. This suggests a two-way causality between human and economic development. This paper argues that the Planning Commission and the Finance Commissions need not be unduly concerned about the regional imbalance in human or economic development. Dreze and Sen (1995) have found remarkable diversities in economic and social development amongst the Indian states. In a cross-state study of poverty in 15 major states in India, Ravallion and Datt

(2002) concluded that various states have different capacities for poverty reduction for a variety of reasons. They argue that a substantial difference in poverty reduction is due to the difference in literacy rates between the states.

While in most of the recent literature, equity or the distributional aspect of human development is focused, there is still a dearth of studies on the efficiency of resource allocation in achieving the targeted human development. Several proposals seek to correct these computational measurements of the HDI. Despotis has proposed an adjustment to correct the "arbitrary and contestable" nature of the weights associated with the three indicators (Despotis, 2005). Using DEA, the author has created an algorithm which estimates the relative efficiency of the countries in converting income to knowledge and life opportunities. The author has tried to re-assess the HDI in the light of DEA. Similarly, Arcelus, *et al.* (2005) have also applied DEA in measuring the HDI to capture the differences in the efficiency in resource allocation for achieving human development outcomes. Mahlberg and Obersteiner (2001) have used DEA to compare the performance in a multiple output setting in the country-wise HDI. They try to empirically re-estimate the HDI and make its actual measurement scientifically more accurate. The basic limitation of these studies is that there is an overlapping between the input and output used in DEA formulation. Thus, there is a probability of over-and under-estimation of the efficiency scores as compared to the benchmarked countries. Secondly, these three studies are static in nature. The analysis is based only on the outcome values of UNDP, 1998. Therefore, implementation of the government policy on these changes in the efficiency levels is beyond the scope of their analysis. Hence, this study is expected to identify the change occurring over time in the efficiency of Indian states in achieving the targeted level of human development.

DATA

The outputs considered in this paper are the three components of the HDI, namely the health achievement index, the education achievement index, and the standard of living achievement index. The health output-related variables for which data are available are the infant mortality rate (IMR), total fertility rate (TFR), stillbirth rate, and life expectancy at birth. Data are reported by the *Sample Registration System* (SRS). The education output-related variables such as the literacy rate and school enrolment data are collected from *Education in India,* Government of India. For the standard of living, the study considers all types of household amenities like the percentage of households having access to a toilet facility, drinking water facility, electricity consumption, *pucca* house, semi-*pucca* house, and *kutcha* house based on Census data. All the data are collected for four time periods, viz. 1981, 1991, 2001 and 2011. On the basis of all those variables, the study has constructed the health achievement index, the education achievement index, and the standard of living achievement index, and taking the average of all these three indices, the study has calculated the overall human development achievement index. The model also includes several inputs that have been hypothesized to

impact upon each output. As far as the health inputs are considered, the factors considered are the number of primary health care centres (PHCs), sub-centres, community health centres, hospitals and number of beds (per lakh population) published by the Health Information of India. The paper also includes various inputs for education such as the number of primary, secondary and higher secondary schools (per lakh population) and the teacher–student ratio in primary, secondary and higher secondary schools published by Education in India. The per capita consumption expenditure has been considered as the input for the standard of living, which has been collected from the National Sample Survey Organization (NSSO) 38th, 50th, 56th, and 66th Rounds.

METHODOLOGY

Construction of the Output Index

For constructing the output index (the HDI), the paper follows the following methodology. Let *Maxi* and *Mini* denote the maximum and minimum values of indicator *i* for the time periods 1981, 1991, 2001 and 2011. Then, the deprivation index for State *j* with respect to indicator *i* is given by

$$I_{ij} = \frac{Max_i - X_{ij}}{Max_i - Min_i}$$

The human development achievement is defined as the absence of deprivation. Hence,

$$\text{(Human Development) } j = 1 - \frac{1}{3}\sum I_{ij}$$

The achievement values of healthcare, education, standard of living and the overall HDI are given in the Appendix Tables 1A to Table 4A.

Model for the Malmquist Productivity Index

In macroeconomic literature, there is a keen interest to study the variation in productivity across countries and over time. Unfortunately, the increase in output per hour ignores differences in the other inputs used and fails to measure the Total Factor Productivity Growth (TFPG). In order to address this problem, it is necessary to construct measures of input and output changes for all individual outputs and inputs. Two of the major popular measures of the Total Factor Productivity (TFP) are the Tornquist and the Fisher productivity indices, both of which use the price information along with the quantity data to construct the quantity index of output and input. The ratio of the output and input quantity index is the TFP index. Both indices are descriptive measures of productivity change, but they do not consider any knowledge of the underlying production technology faced by the firm. In contrast, the Malmquist pro-

ductivity index introduced by Caves, Christensen and Diewert (Caves, *et al.*, 1982) is a normative measure that constructs a production frontier representing the technology and uses the corresponding distance functions evaluated at different input–output combinations for the comparison of productivity. Following Fare, *et al.* (1994), specifications as outlined in Coelli, *et al.* (1998), an output-based (under CRS) Malmquist productivity change index is

$$M0\ (yt+1, xt+1, yt\ , xt\ ) = \left[\frac{d_0^t(x_{t+1}, y_{t+1})}{d_0^t(x_t, y_t)} \times \frac{d_0^{t+1}(x_{t+1}, y_{t+1})}{d_0^{t+1}(x_t, y_t)} \right]^{1/2}$$

This represents the productivity of the production point (x_{t+1},y_{t+1}), relative to the production point (x_t,y_t). If an index value is greater than one, it indicates that the total factor productivity growth from period t to $t+1$ is positive. This index is, in fact, the geometric mean of two output-based Malmquist total factor productivity indices under constant return to scale. The Malmquist index is first decomposed into two factors: one showing the technical/technological change, and the other, changes in technical efficiency, which can be interpreted as 'catching up'. The term 'catching up' is further factored into two terms: one representing pure technical efficiency change, and the other, changes in scale efficiency. This extended decomposition conceptualizes a technology characterized by variable returns to scale (VRS).[1] However, Ray and Desli (1997) have pointed out that Fare, *et al.* (1994) use CRS and VRS within the same decomposition of the Malmquist index, which raises a problem of internal consistency. Their technological change (TECHCH) measure corresponds to the shifts over time in the CRS frontier. The other factors—pure efficiency change (PEFFCH) and scale efficiency change (SCH)—are derived from VRS frontiers from two different periods, however. If the CRS is assumed to hold, the TECHCH term correctly shows the shift in the frontier. But, under CRS, no scale effect exists at all. Hence, the extended decomposition is misleading. On the other hand, if the VRS assumption is correct, the TECHCH measure of Fare, *et al.* (1994) does not show how the maximum producible output changes due to the technical change holding the input bundle constant. In other words, it does not measure the autonomous shift in the frontier. The Malmquist productivity index is correctly measured by the ratio of CRS distance functions even when the technology exhibits VRS. However, Ray and Desli (1997) measure the productivity index itself in the same way as Fare, *et al.* (1994) do. There are alternative ways to decompose the same Malmquist index, which, in empirical applications, lead to different conclusions about the technical change and efficiency change experienced by individual countries. Ray and Desli (1997) propose a decomposition by using a VRS frontier as the benchmark. They measure technical change by the ratio of the VRS distance functions. While this affects the measured value of the scale efficiency change, the pure technical efficiency change measure remains unaffected, but this study follows the Fare, *et al.* (1994) decomposition because of the availability of the decomposition result through DEAP 2.1 programming. In view of the conceptual problem in the decomposition of technical efficiency change into two factors, both pure technical efficiency and

scale efficiency change; the study has considered only the decomposition of the total factor productivity change (TFPCH**)** into two products, that is, the technical efficiency change **(**TEFFCH**),** and technological change (TECHCH). It captures the proportion of technical change and technological change in the total factor productivity change. It would thus be useful for the study to analyse how across states, the productivity level of human development and its dimensions change due to technical efficiency or technological change. This is the novelty of the study.

EMPIRICAL FINDINGS

This study has attempted to examine how the efficiency level of the targeted human development level changes from 1981 to 2011. In order to obtain a dynamic picture of the efficiency change, the study reports the change in the efficiency level first from 1981 to 1991, followed by that from 1991 to 2001, and then from 2001 to 2011. The study also reports the overall change from 1981 to 2011.

Using the computer programme DEAP 2.1, the output-oriented Malmquist DEA is applied, assuming that there exists CRS. The results are given in Tables 5A to 8A in the Appendix. The study first applies the Malmquist DEA model to healthcare, education and the standard of living in order to determine how the efficiency level has changed over time, then it takes the geometric mean of that efficiency change to obtain the efficiency change in the overall human development, following the same decomposition technique.

The analysis shows that in the case of the health sector, in most of the states, except Mizoram and Uttar Pradesh, the total productivity change from 2001 to 2011 was positive. Basically, this denotes that where the TFP change has been positive, the efficiency of the states improved while in states where the TFP change is less than 1, the efficiency deteriorated. However, improvements in state-specific efficiencies do not mean that the states reached the most efficient position. It is evident that the states of Arunachal Pradesh, Assam, Bihar, Delhi, Gujarat, Jammu & Kashmir, Manipur, Punjab and Orissa had a negative total factor productivity in the health sector from 1981 to 2001. However, because of an improvement in the efficiency in input allocation and technological upgradation in the health sector, these states have been able to achieve the positive total factor productivity growth during the recent period.

In the case of the education sector, all the states except Uttar Pradesh have a positive total factor productivity growth during the period of 2001-2011. It can be seen that the states of Arunachal Pradesh, Assam, Bihar, Goa, Jammu & Kashmir, Madhya Pradesh, Manipur and Orissa had a negative total factor productivity growth during the previous year. However, all other states except Bihar increased their efficiency in input allocation in the education sector, which led to a positive total factor productivity growth. Significantly, Bihar improved its technology in comparison to the efficiency level, which facilitated a positive total factor productivity growth in the same sector in the state. In the case of the standard of living, the states of Assam, Nagaland, Orissa

and Uttar Pradesh still showed a negative total factor productivity growth during the period 2001-2011. However, the states of Arunachal Pradesh, Bihar, Haryana, Jammu & Kashmir, Manipur, Meghalaya, Mizoram, Sikkim, Tripura and Rajasthan mainly improved their efficiency levels, which helped them achieve a positive total factor productivity growth during the period 2001-2011.

The study also finds that in all the other states, except Uttar Pradesh, the change in the total factor productivity from 2001 to 2011 for achieving the HDI was positive. It has been seen that during every sub-period, the change in technical efficiency is more prominent than technological change. Since technological change is not prominent, it can be inferred that much quality up-gradation has not taken place in any of the dimensions, which hinders the level of productivity.

The main implication of that study is that the states with a negative total factor productivity growth have extremely poor levels of outcome and indicate no scope for improvement in the use of the current level of inputs. On the other hand, states like Jammu & Kashmir, and Arunachal Pradesh, among others, registered an improvement in efficiency during the decade 2001-2011 in various sectors, but these improvements were still below the efficiency envelopment. In these states, for the given inputs, including access to schooling facilities and teacher facilities, and hospitals, there is still scope for improving outcomes with respect to the achievement values.

CONCLUSION

This study has made an important contribution, particularly in examining the change in the efficiency level of the states in achieving human development. The study relies on the panel DEA estimation of efficiency by using the Malmquist index to judge the change in the efficiency level of the states in terms of achieving the targeted HDI.

It has been seen that the efficiency level of achieving human development varied not only from state to state but also from period to period. This indicates that the difference in efficiency is one of the reasons for the difference in the achievement level of the states in terms of human development. It has been seen that during every sub-period, the change in technical efficiency is more prominent than that in technological change. Therefore, it can be concluded that technical efficiency has played a dominant role in changing the total factor productivity, whereas correspondingly, technological change played a very dormant role. Consequently, it can be inferred that basically the states have attempted to catch up with the production frontier by changing their input levels rather than through new technological improvements. The analysis shows that in the case of overall human development, the total factor productivity change from 1981 to 2011 has been positive in most of the states except Uttar Pradesh. There was an improvement in the efficiency change in states like Arunachal Pradesh, Assam, and Jammu & Kashmir during the decade 1981 to 2011 in the areas of healthcare, education and standard of living, but they were still below the efficiency frontier. In these states, for the given inputs, that is, access to schooling facilities and teacher facilities, and

hospitals, they could still improve their outcomes with respect to achievement values. On the other hand, Uttar Pradesh faced a negative factor productivity in the healthcare and education sectors, and standard of living, which implies that the levels of outcome are extremely poor and show no scope for improvement by using the current level of inputs. This is a cause for serious concern and must be addressed by increasing input allocation and ensuring the efficient utilization of such inputs. The public sector also needs to be strengthened in such states.

NOTE

1. Decomposition of the Malmquist productivity index as defined by Caves, *et al.* (1982) into technical change and 'catching up' was introduced by Fare and Grosskopf (1992). The extended decomposition is due to Fare, *et al.* (1994).

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APPENDIX

Table 1A
Human Development Achievement Index 1981

States	*Health*	*Education*	*Standard of Living*	*Human Development*
Andhra Pradesh	0.412	0.101	0.178	0.23
Arunachal Pradesh	0.402	0.116	0.156	0.225
Assam	0.398	0.12	0.189	0.236
Bihar	0.298	0.084	0.22	0.201
Delhi	0.559	0.237	0.519	0.438
Goa	0.4	0.193	0.328	0.307
Gujarat	0.431	0.129	0.36	0.307
Haryana	0.319	0.102	0.319	0.247
Himachal Pradesh	0.437	0.113	0.349	0.3
Jammu & Kashmir	0.403	0.071	0.299	0.258
Karnataka	0.491	0.115	0.232	0.279
Kerala	0.596	0.299	0.345	0.413
Madhya Pradesh	0.336	0.104	0.295	0.245
Maharashtra	0.476	0.168	0.307	0.317
Manipur	0.534	0.146	0.239	0.306
Meghalaya	0.457	0.12	0.182	0.253
Mizoram	0.426	0.23	0.201	0.286
Nagaland	0.397	0.158	0.193	0.249
Orissa	0.305	0.101	0.124	0.177
Punjab	0.396	0.113	0.386	0.298
Rajasthan	0.359	0.079	0.251	0.23
Sikkim	0.407	0.12	0.17	0.232
Tamil Nadu	0.434	0.249	0.23	0.304
Tripura	0.394	0.144	0.199	0.246
Uttar Pradesh	0.302	0.152	0.232	0.229
West Bengal	0.358	0.22	0.255	0.278
All India	**0.412**	**0.146**	**0.26**	**0.273**
CV	**0.18**	**0.4**	**0.33**	**0.21**

Source: Author's calculations.

Table 2A
Human Development Achievement Index 1991

States	*Health*	*Education*	*Standard of Living*	*Human Development*
Andhra Pradesh	0.468	0.12	0.272	0.287
Arunachal Pradesh	0.456	0.126	0.247	0.276
Assam	0.413	0.157	0.251	0.274
Bihar	0.312	0.09	0.242	0.215
Delhi	0.612	0.247	0.532	0.464
Goa	0.492	0.207	0.421	0.373
Gujarat	0.551	0.14	0.443	0.378
Haryana	0.411	0.115	0.411	0.312
Himachal Pradesh	0.506	0.133	0.432	0.357
Jammu & Kashmir	0.398	0.098	0.395	0.297
Karnataka	0.495	0.145	0.389	0.343
Kerala	0.67	0.317	0.42	0.469
Madhya Pradesh	0.397	0.099	0.373	0.29
Maharashtra	0.514	0.181	0.36	0.352
Manipur	0.526	0.158	0.276	0.32
Meghalaya	0.461	0.163	0.268	0.297
Mizoram	0.474	0.261	0.296	0.344
Nagaland	0.436	0.22	0.282	0.313
Orissa	0.341	0.11	0.18	0.21
Punjab	0.49	0.128	0.437	0.352
Rajasthan	0.428	0.088	0.323	0.28
Sikkim	0.425	0.13	0.361	0.305
Tamil Nadu	0.559	0.358	0.31	0.409
Tripura	0.433	0.163	0.25	0.282
Uttar Pradesh	0.41	0.134	0.274	0.273
West Bengal	0.389	0.23	0.34	0.32
All India	**0.464**	**0.167**	**0.338**	**0.323**
CV	**0.17**	**0.42**	**0.25**	**0.19**

Source: Author's calculations.

Table 3A
Human Development Achievement Index 2001

States	*Health*	*Education*	*Standard of Living*	*Human Development*
Andhra Pradesh	0.49	0.181	0.37	0.347
Arunachal Pradesh	0.49	0.171	0.27	0.31
Assam	0.46	0.228	0.29	0.326
Bihar	0.39	0.109	0.252	0.25
Delhi	0.654	0.271	0.546	0.49
Goa	0.501	0.27	0.496	0.422
Gujarat	0.518	0.168	0.465	0.384
Haryana	0.484	0.176	0.49	0.383
Himachal Pradesh	0.517	0.183	0.491	0.397
Jammu & Kashmir	0.42	0.14	0.41	0.323
Karnataka	0.5	0.214	0.45	0.388
Kerala	0.695	0.342	0.516	0.518
Madhya Pradesh	0.438	0.171	0.404	0.338
Maharashtra	0.526	0.215	0.412	0.384
Manipur	0.556	0.188	0.323	0.356
Meghalaya	0.525	0.23	0.271	0.342
Mizoram	0.506	0.292	0.323	0.374
Nagaland	0.515	0.251	0.331	0.366
Orissa	0.399	0.15	0.2	0.25
Punjab	0.495	0.176	0.442	0.371
Rajasthan	0.443	0.169	0.357	0.323
Sikkim	0.482	0.185	0.378	0.348
Tamil Nadu	0.569	0.375	0.391	0.445
Tripura	0.485	0.17	0.467	0.374
Uttar Pradesh	0.418	0.125	0.404	0.316
West Bengal	0.427	0.245	0.431	0.368
All India	**0.496**	**0.208**	**0.39**	**0.365**
CV	**0.14**	**0.3**	**0.23**	**0.16**

Source: Author's calculations.

Table 4A
Human Development Achievement Index 2011

States	*Health*	*Education*	*Standard of Living*	*Human Development*
Andhra Pradesh	0.69	0.481	0.39	0.52
Arunachal Pradesh	0.52	0.271	0.29	0.36
Assam	0.56	0.268	0.33	0.39
Bihar	0.49	0.139	0.27	0.30
Delhi	0.76	0.371	0.646	0.59
Goa	0.601	0.47	0.596	0.56
Gujarat	0.63	0.468	0.576	0.56
Haryana	0.484	0.576	0.51	0.52
Himachal Pradesh	0.717	0.383	0.53	0.54
Jammu & Kashmir	0.62	0.34	0.44	0.47
Karnataka	0.67	0.314	0.49	0.49
Kerala	0.795	0.342	0.54	0.56
Madhya Pradesh	0.478	0.271	0.42	0.39
Maharashtra	0.576	0.415	0.45	0.48
Manipur	0.576	0.288	0.35	0.40
Meghalaya	0.575	0.26	0.28	0.37
Mizoram	0.516	0.302	0.35	0.39
Nagaland	0.525	0.291	0.37	0.40
Orissa	0.459	0.18	0.28	0.31
Punjab	0.517	0.196	0.48	0.40
Rajasthan	0.487	0.189	0.39	0.36
Sikkim	0.492	0.19	0.38	0.35
Tamil Nadu	0.589	0.408	0.41	0.47
Tripura	0.489	0.19	0.48	0.39
Uttar Pradesh	0.468	0.167	0.43	0.36
West Bengal	0.477	0.276	0.473	0.41
All India	**0.57**	**0.31**	**0.43**	**0.44**
CV	**0.16**	**0.36**	**0.23**	**0.19**

Source: Author's calculations.

Table 5A
Panel Data DEA Results for Health Sector Efficiency

	TEFFCH				*TECHCH*			
States	*1981-1991*	*1991-2001*	*2001-2011*	*0verall*	*1981-1991*	*1991-2001*	*2001-2011*	*0verall*
Andhra Pradesh	1.1	0.88	1.23	1.07	0.68	1.93	1.21	1.27
Arunachal Pradesh	0.98	1	1.08	1.02	0.59	0.73	1	0.77
Assam	0.98	1	1.06	1.01	0.6	0.81	1	0.80
Bihar	0.79	0.59	1	0.79	0.61	1.49	1.54	1.21
Delhi	1.01	1.01	1.08	1.03	0.75	2.84	3.67	2.42
Goa	2.23	0.24	1.98	1.48	1	6.41	6.09	4.50
Gujarat	2.59	0.27	1.87	1.58	0.96	0.75	1.43	1.05
Haryana	0.75	1.07	1.98	1.27	0.43	0.96	1	0.80
Himachal Pradesh	1.02	1.01	1.23	1.09	0.56	1.34	1.87	1.26
Jammu & Kashmir	1	1.08	1.32	1.13	0.63	0.9	1	0.84
Karnataka	1.97	1	1.23	1.40	0.55	1.46	1.76	1.26
Kerala	1.56	1	1.21	1.26	0.97	1.97	3.56	2.17
Madhya Pradesh	0.97	0.92	0.98	0.96	0.61	1.39	1.4	1.13
Maharashtra	1.07	1.23	1.67	1.32	0.56	0.79	1.41	0.92
Manipur	1.01	1.02	1.11	1.05	0.54	0.76	1.23	0.84
Meghalaya	1.08	1.06	1.09	1.08	0.62	1.1	1.31	1.01
Mizoram	1	1	1	1.00	0.58	0.71	0.81	0.70
Nagaland	1.99	1	1	1.33	0.6	1.49	1.56	1.22
Orissa	0.78	0.94	1.21	0.98	0.65	0.83	0.91	0.80
Punjab	0.98	1.08	1.09	1.05	0.44	0.81	1.67	0.97
Rajasthan	0.96	1.12	1.34	1.14	0.59	1.28	1.56	1.14
Sikkim	1.02	1.1	1.41	1.18	0.6	0.95	1	0.85
Tamil Nadu	0.89	1.13	1.23	1.08	0.42	1.13	1.23	0.93
Tripura	0.93	1	1.65	1.19	0.6	0.81	0.91	0.77
Uttar Pradesh	0.65	0.98	1	0.88	0.5	0.79	0.87	0.72
West Bengal	1.01	1.02	1.45	1.16	0.43	1.11	1.56	1.03
Mean	**1.09**	**0.9**	**1.29**	**1.09**	**0.6**	**1.16**	**1.64**	**1.13**

Source: Author's calculations.

Table 5A
Panel Data DEA Results for Health Sector Efficiency (contd.)

	TFPCH			
States	*1981-1991*	*1991-2001*	*2001-2011*	*0verall*
Andhra Pradesh	0.75	1.7	1.49	1.31
Arunachal Pradesh	0.58	0.73	1.08	0.80
Assam	0.59	0.81	1.06	0.82
Bihar	0.48	0.88	1.54	0.97
Delhi	0.75	2.84	3.96	2.52
Goa	2.22	1.53	12.06	5.27
Gujarat	2.5	0.2	2.67	1.79
Haryana	0.32	1.03	1.98	1.11
Himachal Pradesh	0.56	1.34	2.30	1.40
Jammu & Kashmir	0.63	0.97	1.32	0.97
Karnataka	1.09	1.46	2.16	1.57
Kerala	1.52	1.97	4.31	2.60
Madhya Pradesh	0.59	1.28	1.37	1.08
Maharashtra	0.6	0.97	2.35	1.31
Manipur	0.54	0.76	1.37	0.89
Meghalaya	0.67	1.17	1.43	1.09
Mizoram	0.58	0.71	0.81	0.70
Nagaland	1.19	1.49	1.56	1.41
Orissa	0.51	0.78	1.10	0.80
Punjab	0.43	0.88	1.82	1.04
Rajasthan	0.57	1.44	2.09	1.37
Sikkim	0.6	1.04	1.41	1.02
Tamil Nadu	0.37	1.28	1.51	1.05
Tripura	0.56	0.81	1.50	0.96
Uttar Pradesh	0.32	0.78	0.87	0.66
West Bengal	0.43	1.11	2.26	1.27
Mean	**0.66**	**1.05**	**2.11**	**1.27**

Source: Author's calculations.

Table 6A
Panel Data DEA Results for Education Sector Efficiency

States	TEFFCH				TECHCH			
	1981-1991	*1991-2001*	*2001-2011*	*Overall*	*1981-1991*	*1991-2001*	*2001-2011*	*Overall*
Andhra Pradesh	1.24	1.68	1.76	1.56	0.77	0.91	1	0.89
Arunachal Pradesh	1.16	1.26	1.46	1.29	1.05	0.73	1.65	1.14
Assam	1.13	1.2	1.34	1.22	0.9	0.81	1.23	0.98
Bihar	0.49	0.59	0.98	0.69	1.05	1.21	1.23	1.16
Delhi	1.67	1.76	1.98	1.80	0.86	1.6	1	1.15
Goa	1.01	1.24	1.87	1.37	1.04	0.68	1.13	0.95
Gujarat	1.43	1.27	1.56	1.42	0.79	1.05	1	0.95
Haryana	0.95	1.07	1.17	1.06	0.75	0.96	1	0.90
Himachal Pradesh	0.82	1.01	1.9	1.24	1.04	1.01	1.14	1.06
Jammu & Kashmir	0.99	1.08	1.28	1.12	1.02	0.9	1.12	1.01
Karnataka	1.12	1.35	1.45	1.31	0.91	1.02	1.23	1.05
Kerala	1.98	2.56	3.67	2.74	1.12	1.07	1.32	1.17
Madhya Pradesh	0.91	0.92	1	0.94	0.8	0.92	1	0.91
Maharashtra	1.12	1.23	1.67	1.34	0.79	1.09	0.87	0.92
Manipur	1.07	1.09	1.19	1.12	1.13	0.69	1.34	1.05
Meghalaya	1.25	1.06	1.16	1.16	0.99	1	1	1.00
Mizoram	1.01	1.07	1.27	1.12	0.98	0.99	1	0.99
Nagaland	1.07	1.06	1.56	1.23	1.01	1.01	1.03	1.02
Orissa	0.85	0.94	1	0.93	0.94	0.83	1	0.92
Punjab	0.82	1.08	1.9	1.27	0.94	1	1.34	1.09
Rajasthan	0.85	1.12	1.32	1.10	0.82	0.99	0.94	0.92
Sikkim	1.16	1.1	1.34	1.20	1.03	1.15	1.07	1.08
Tamil Nadu	1.67	1.73	1.45	1.62	0.89	1.13	1.21	1.08
Tripura	1.19	1.5	1.68	1.46	0.87	0.81	1	0.89
Uttar Pradesh	0.79	0.98	1.34	1.04	0.57	0.79	0.67	0.68
West Bengal	1.17	1.98	2.12	1.76	0.94	1.01	1.32	1.09
Mean	**1.07**	**1.21**	**1.55**	**1.31**	**0.92**	**0.98**	**1.11**	**1.00**

Source: Author's calculations.

Table 6A
Panel Data DEA Results for Education Sector Efficiency (contd.)

	TFPCH			
States	*1981-1991*	*1991-2001*	*2001-2011*	*0verall*
Andhra Pradesh	0.96	1.52	1.76	1.41
Arunachal Pradesh	1.22	0.92	2.41	1.52
Assam	1.02	0.97	1.65	1.21
Bihar	0.51	0.72	1.21	0.81
Delhi	1.45	2.82	1.98	2.08
Goa	1.04	0.84	2.11	1.33
Gujarat	1.13	1.34	1.56	1.34
Haryana	0.72	1.03	1.17	0.97
Himachal Pradesh	0.85	1.01	2.17	1.34
Jammu & Kashmir	1	0.97	1.43	1.13
Karnataka	1.02	1.37	1.78	1.39
Kerala	2.23	2.74	4.84	3.27
Madhya Pradesh	0.73	0.84	1.00	0.86
Maharashtra	0.89	1.34	1.45	1.23
Manipur	1.2	0.76	1.59	1.18
Meghalaya	1.24	1.06	1.16	1.15
Mizoram	0.98	1.06	1.27	1.10
Nagaland	1.07	1.08	1.61	1.25
Orissa	0.8	0.78	1.00	0.86
Punjab	0.77	1.08	2.55	1.47
Rajasthan	0.7	1.11	1.24	1.02
Sikkim	1.2	1.26	1.43	1.30
Tamil Nadu	1.48	1.96	1.75	1.73
Tripura	1.04	1.21	1.68	1.31
Uttar Pradesh	0.45	0.78	0.90	0.71
West Bengal	1.11	2.01	2.80	1.97
Mean	**1.03**	**1.25**	**1.75**	**1.34**

Source: Author's calculations.

Table 7A
Panel Data DEA Results for Standard of Living Efficiency

	TEFFCH				*TECHCH*			
States	*1981-1991*	*1991-2001*	*2001-2011*	*0ver-all*	*1981-1991*	*1991-2001*	*2001-2011*	*0verall*
Andhra Pradesh	0.94	1.1	1.54	1.19	0.6	0.98	1	0.86
Arunachal Pradesh	0.89	1.13	1.45	1.16	0.62	0.71	0.78	0.70
Assam	1	1.08	1.19	1.09	0.59	0.7	0.8	0.70
Bihar	1.09	1.1	1.34	1.18	0.58	0.73	0.98	0.76
Delhi	1	1.09	1.19	1.09	1.02	1.87	1.97	1.62
Goa	1	1.05	1.35	1.13	1.12	1.07	1.08	1.09
Gujarat	1.05	1.6	1.87	1.51	0.51	0.67	0.78	0.65
Haryana	1.34	1.4	1.89	1.54	0.52	0.67	0.86	0.68
Himachal Pradesh	1.01	1.75	2.01	1.59	0.51	0.67	0.91	0.70
Jammu & Kashmir	1.02	1.03	1.78	1.28	0.52	0.67	0.94	0.71
Karnataka	0.81	1	1.78	1.20	0.58	0.68	0.79	0.68
Kerala	1.09	1.3	1.56	1.32	1.08	1.8	1.9	1.59
Madhya Pradesh	1.02	1.06	1.56	1.21	0.53	0.67	0.77	0.66
Maharashtra	1.01	1.02	1.12	1.05	1	1.07	1.21	1.09
Manipur	1.02	1.1	1.7	1.27	0.57	0.69	0.89	0.72
Meghalaya	0.94	1.16	1.26	1.12	0.6	0.71	0.87	0.73
Mizoram	0.95	1.13	1.54	1.21	0.58	0.7	0.9	0.73
Nagaland	0.94	1.09	1.18	1.07	0.59	0.69	0.76	0.68
Orissa	0.89	1	1.06	0.98	0.66	0.82	0.93	0.80
Punjab	1.02	1	1.07	1.03	1.01	1.1	1.67	1.26
Rajasthan	1	1.08	1.69	1.26	0.65	0.68	1.56	0.96
Sikkim	0.95	1.07	1.27	1.10	0.88	0.67	1.67	1.07
Tamil Nadu	1.9	1.03	1.34	1.42	1.6	1.77	1.89	1.75
Tripura	1.01	0.92	1	0.98	0.78	0.98	1.09	0.95
Uttar Pradesh	0.78	0.99	1.01	0.93	0.77	0.88	0.9	0.85
West Bengal	1	1	1.54	1.18	1.04	1.08	1.09	1.07
Mean	**1.01**	**1.11**	**1.43**	**1.18**	**0.75**	**0.91**	**1.12**	**0.93**

Source: Author's calculations.

Table 7A
Panel Data DEA Results for Standard of Living Efficiency (contd.)

	TFPCH			
States	*1981-1991*	*1991-2001*	*2001-2011*	*Overall*
Andhra Pradesh	0.57	1.07	1.54	1.06
Arunachal Pradesh	0.55	0.8	1.13	0.83
Assam	0.59	0.76	0.95	0.77
Bihar	0.63	0.8	1.31	0.91
Delhi	1.02	2.04	2.34	1.80
Goa	1.12	1.12	1.46	1.23
Gujarat	0.54	1.08	1.46	1.03
Haryana	0.69	0.94	1.63	1.09
Himachal Pradesh	0.51	1.17	1.83	1.17
Jammu & Kashmir	0.52	0.69	1.67	0.96
Karnataka	0.47	0.68	1.41	0.85
Kerala	1.18	2.34	2.96	2.16
Madhya Pradesh	0.54	0.71	1.20	0.82
Maharashtra	1.01	1.09	1.36	1.15
Manipur	0.58	0.76	1.51	0.95
Meghalaya	0.56	0.82	1.10	0.83
Mizoram	0.55	0.79	1.39	0.91
Nagaland	0.55	0.76	0.90	0.74
Orissa	0.59	0.82	0.99	0.80
Punjab	1.03	1.1	1.79	1.31
Rajasthan	0.65	0.74	2.64	1.34
Sikkim	0.84	0.72	2.12	1.23
Tamil Nadu	3.04	1.83	2.53	2.47
Tripura	0.78	0.9	1.09	0.92
Uttar Pradesh	0.6	0.87	0.91	0.79
West Bengal	1.04	1.08	1.68	1.27
Mean	**0.80**	**1.02**	**1.54**	**1.06**

Source: Author's calculations.

Table 8A
Panel Data DEA Results for Human Development Efficiency

	TEFFCH				*TECHCH*			
States	*1981-1991*	*1991-2001*	*2001-2011*	*Overall*	*1981-1991*	*1991-2001*	*2001-2011*	*Overall*
Andhra Pradesh	1.09	1.18	1.49	1.25	0.68	1.20	1.07	0.98
Arunachal Pradesh	1.00	1.12	1.32	1.15	0.73	0.72	1.09	0.85
Assam	1.03	1.09	1.19	1.11	0.68	0.77	0.99	0.82
Bihar	0.75	0.73	1.10	0.86	0.72	1.10	1.23	1.01
Delhi	1.19	1.25	1.37	1.27	0.87	2.04	1.93	1.61
Goa	1.31	0.68	1.71	1.23	1.05	1.67	1.95	1.56
Gujarat	1.57	0.82	1.76	1.38	0.73	0.81	1.04	0.86
Haryana	0.98	1.17	1.64	1.26	0.55	0.85	0.95	0.78
Himachal Pradesh	0.95	1.21	1.67	1.28	0.67	0.97	1.25	0.96
Jammu & Kashmir	1.00	1.06	1.44	1.17	0.69	0.82	1.02	0.84
Karnataka	1.21	1.11	1.47	1.26	0.66	1.00	1.20	0.95
Kerala	1.50	1.49	1.91	1.63	1.05	1.56	2.07	1.56
Madhya Pradesh	0.97	0.96	1.15	1.03	0.64	0.95	1.03	0.87
Maharashtra	1.07	1.16	1.46	1.23	0.76	0.97	1.14	0.96
Manipur	1.03	1.07	1.31	1.14	0.70	0.71	1.14	0.85
Meghalaya	1.08	1.09	1.17	1.11	0.72	0.92	1.04	0.89
Mizoram	0.99	1.07	1.25	1.10	0.69	0.79	0.90	0.79
Nagaland	1.26	1.05	1.23	1.18	0.71	1.01	1.07	0.93
Orissa	0.84	0.96	1.09	0.96	0.74	0.83	0.95	0.84
Punjab	0.94	1.05	1.30	1.10	0.75	0.96	1.55	1.09
Rajasthan	0.93	1.11	1.44	1.16	0.68	0.95	1.32	0.98
Sikkim	1.04	1.09	1.34	1.16	0.82	0.90	1.21	0.98
Tamil Nadu	1.41	1.26	1.34	1.34	0.84	1.31	1.41	1.19
Tripura	1.04	1.11	1.40	1.19	0.74	0.86	1.00	0.87
Uttar Pradesh	0.74	0.98	1.11	0.94	0.60	0.82	0.81	0.74
West Bengal	1.06	1.26	1.68	1.33	0.75	1.07	1.31	1.04
Mean	**1.06**	**1.07**	**1.42**	**1.18**	**0.75**	**1.01**	**1.27**	**1.01**

Source: Author's calculations.

Table 8A
Panel Data DEA Results for Human Development Efficiency (contd.)

	TFPCH			
States	*1981-1991*	*1991-2001*	*2001-2011*	*Overall*
Andhra Pradesh	0.74	1.41	1.59	1.25
Arunachal Pradesh	0.73	0.81	1.43	0.99
Assam	0.71	0.84	1.18	0.91
Bihar	0.54	0.80	1.35	0.89
Delhi	1.04	2.54	2.64	2.07
Goa	1.38	1.13	3.34	1.95
Gujarat	1.15	0.66	1.83	1.21
Haryana	0.54	1.00	1.56	1.03
Himachal Pradesh	0.63	1.17	2.09	1.30
Jammu & Kashmir	0.70	0.87	1.47	1.01
Karnataka	0.80	1.11	1.76	1.22
Kerala	1.58	2.33	3.95	2.62
Madhya Pradesh	0.62	0.92	1.18	0.90
Maharashtra	0.81	1.12	1.67	1.20
Manipur	0.73	0.76	1.49	0.99
Meghalaya	0.78	1.01	1.22	1.00
Mizoram	0.68	0.84	1.13	0.88
Nagaland	0.89	1.06	1.31	1.09
Orissa	0.62	0.79	1.03	0.81
Punjab	0.70	1.01	2.02	1.25
Rajasthan	0.64	1.05	1.90	1.20
Sikkim	0.85	0.98	1.62	1.15
Tamil Nadu	1.19	1.66	1.89	1.58
Tripura	0.77	0.96	1.40	1.04
Uttar Pradesh	0.44	0.81	0.89	0.71
West Bengal	0.79	1.35	2.20	1.45
Mean	**0.79**	**1.08**	**1.80**	**1.22**

Source: Author's calculations.