INFRASTRUCTURAL DEVELOPMENT IN INDIA: PRE AND POST- REFORM INTER-STATE DISPARITIES

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ABSTRACT: *The present paper attempts to investigate the extent and determinants of inter-state disparities in socio-economic infrastructure in India during the pre and post-reform period, based on 22 indicators of infrastructural development, across 15 major states of India. The state level composite indices of infrastructural development have been constructed using the correlation weights. On the basis of this analysis, the states have been classified into three different groups according to their level of infrastructural development. The study shows that relative ranking of the states in terms of infrastructural development remained, more or less, the same at all the three reference points (1981-82, 1991-92 and 2001-02). It has also been found that the states in India converged in terms of infrastructural facilities during 1980s whereas a trend of divergence could be seen during 1990s.*

Keywords: *Infrastructure; reforms; divergence; convergence; disparities; correlation weights; PQLI; indicators of development; determinants of development; regression; composite indices*

1. INTRODUCTION

Vasudeva (1980) suggested that adequate availability of infrastructure stimulates more economic growth in agriculture and industry. During the same year, Sakhalkar, in his study on Maharashtra, also identified the role of infrastructure in economic development and found that infrastructure is one of the key inputs and without it other inputs and even the natural resources become ineffective in ensuring rapid economic development. Growth enhancing nature of infrastructure sector warrants a close scrutiny of infrastructural disparities amongst different regions in a nation.

Disparities in infrastructure tend to increase the disparities in the aggregate level of development as lack of these basic facilities reduces the efficiency of resource use in the backward regions. India also faces the identical problem. Rao (1977) found huge infrastructural disparities across Indian states but held that inter-state disparities

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in banking and education reduced during the first fifteen years of planning in India. Kar and Sakthivel (2007), however, found the rising level of disparity in industrial and service sectors to be the major cause of rising aggregate inequality across states during 1990s.

Here it needs to be mentioned that India does not fulfill the neo-classical assumption of 'other things being equal' as natural resources, demographic characteristics and infrastructural facilities differ widely across Indian states resulting into concentration of poverty and prosperity into a few states only. Indian states differ widely in terms of per capita income with the income of the richest state being approximately five times higher than that of the poorest state. A close association has been observed between the level of infrastructural facilities and GDP growth. Dhingra (2001) indicated that 1% growth in the infrastructure stock is associated with 1% growth in per capita GDP.

Given this linkage, it becomes highly important to estimate the relative levels of infrastructural development across Indian states and to examine the extent and nature of disparities therein.

2. SCOPE AND METHODOLOGY

The study covers the period from 1981-82 to 2001-02. The period 1981-82 to 1991-92 is the pre-reform decade whereas the period 1991-92 to 2001-02 is the post-reform decade. The paper, thus, presents a comparative analysis of inter-state disparities in infrastructural development during the two contrasting policy paradigms in India i.e., pre and post-reform period.

The study uses the data for 15 major states of India[1] viz., Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. These 15 states together represent 90 per cent of the total population of the country and 79 per cent of the total geographical area.

With a view to study overall trend in the level of infrastructural development and disparities across states, composite indices of infrastructural development have been constructed for all the fifteen states during all the reference years by using an indexing scheme[2] similar to that of PQLI indexing. The indicators have been weighed by using the correlation weights[3] which are given in Appendix 1 and are based on the average correlation of the respective indicators with all other indicators.

The analysis is based on 22 indicators of infrastructural development. The list of selected indicators is as follows:

Z_1 Road length per thousand sq. km. of area (RDLPSQ)
Z_2 Length of Railways per thousand sq. km. of area (LRWPSQ)
Z_3 Registered motor vehicles per lakh of Population (RMVPLP)
Z_4 Number of Post and telegraph offices per lakh of population (PTOPLP)
Z_5 Number of post and telegraph offices per thousand sq. km. of area (PTOPSQ)
Z_6 Number of telephone connections per lakh of population (TLCPLP)[4]
z_7 Number of bank branches per lakh of population (BOPLP)
Z_8 Number of bank branches per thousand sq. km. of area (BOPSQ)

Z_9 Credit per capita (CPC)[5]
Z_{10} Deposits per capita (DPC)[6]
Z_{11} Per capita consumption of electricity (PCCE)
Z_{12} Percentage of households having electricity (PHHE)
Z_{13} Number of primary schools per lakh of population (PSPLP)
Z_{14} Number of primary schools per thousand sq. km. of area (PSPSQ)
Z_{15} Teacher-Pupil ratio at primary school level (TPRPS)
Z_{16} Ratio of trained primary teachers to the total number of primary school teachers (RTPST)
Z_{17} Number of hospitals and dispensaries per lakh of population (HDPLP)[7]
Z_{18} Number of hospitals and dispensaries per thousand sq. km. of area (HDPSQ)
Z_{19} Number of hospital beds per lakh of population (HBPLP)
Z_{20} Number of registered medical practitioners per lakh of population (RMPLP)
Z_{21} Percentage of households having safe drinking water facility (PHSDW)
Z_{22} Percentage of households living in pucca houses (PHLPH)

An important point that needs to be mentioned here is that the indicators relating to education, used in the present study, pertain to primary schooling only. The reason thereby is that the social rate of return is considered to be the highest in case of primary education than secondary and higher education (Pracharopoulus, 1993). Malhotra (1999) also argued that higher level of education may have greater direct impact on economic development but the primary education is more important because it widely distributes the conditions conducive to development.

3. INTER-STATE DISPARITY IN SOCIO-ECONOMIC INFRASTRUCTURE: AN ANALYSIS

The composite indices of infrastructural development based on correlation weights, given in table 1, show that during 1981-82, only seven states viz., Gujarat, Haryana, Kerala, Maharashtra, Punjab, Tamil Nadu and West Bengal performed above the average value of the composite index of infrastructural development whereas all other states performed below the all states' average.

On the whole, Gujarat, Kerala, Maharashtra, Punjab and Tamil Nadu continued to occupy first five positions. Karnataka, that had been a below average state during 1981-82, managed to rise to the level of an above average state thereafter. Haryana lost its place among the states performing above average value of composite index in 1991-92 but managed to re-enter the fortunate list in 2001-02. West Bengal, which had above average position during 1981-82, scaled down to below average position thereafter.

It is evident from the tabulated results that Punjab topped the list in terms of infrastructural development throughout the study period, 1981-82 to 2001-02, followed by Kerala and Maharashtra respectively. During the pre-reform period i.e., 1981-82 to 1991-92, only seven states showed some movement (rise or fall) in their relative rankings whereas eight states showed absolute stability in their relative position. Things hardly changed during the post-reform period as almost six states manifested stability in their relative positions during 1991-92 to 2001-02.

Table 1. State-Wise Composite Indices of Infrastructural Development based on Correlation Weights

S.No.	State	1981-82	R	1991-92	R	2001-02	R
1.	Andhra Pradesh	0.5996	9	0.6162	9	0.7346	8
2.	Assam	0.2857	15	0.4859	10	0.2957	15
3.	Bihar	0.3620	13	0.3351	15	0.3759	14
4.	Gujarat	1.0049	4	0.9516	4	0.9893	5
5.	Haryana	0.7906	6	0.6681	7	0.7598	7
6.	Karnatka	0.7237	8	0.7481	6	0.8922	6
7.	Kerala	1.1927	2	1.2603	2	1.3161	2
8.	Madhya Pradesh	0.3610	14	0.3752	14	0.4127	13
9.	Maharashtra	1.0507	3	0.9751	3	1.0780	3
10.	Orissa	0.4265	11	0.4381	13	0.4861	12
11.	Punjab	1.5208	1	1.3402	1	1.4130	1
12.	Rajasthan	0.4574	10	0.4553	11	0.4848	11
13.	Tamil Nadu	0.9078	5	0.7960	5	1.0585	4
14.	Uttar Pradesh	0.4229	12	0.4454	12	0.4944	10
15.	West Bengal	0.7689	7	0.6356	8	0.6058	9
All states' Average		0.7250		0.7017		0.7598	

Source: Computed from: Statistical Abstract of India, Government of India; Statistical Abstracts of Various States of India; CMIE, Basic Statistics Relating to Indian Economy, Vol 2: States; Banking Statistics, Quarterly Handouts; Reports of the Planning Commission, Government of India; Reserve Bank of India Bulletin (RBI), Government of India.
Note: R denotes respective rank of the state in the descending order

By and large, the composite indices of infrastructural development of states indicate the same ranking pattern of the states during all the reference years, as is evident from the highly significant coefficients of rank correlation between the states' rankings in terms of composite indices of infrastructural development between the three subsequent periods i.e., 1981-82 and 1991-92; 1991-92 and 2001-02; and the entire study period, 1981-82 and 2001-02(table 2).

Table 2. Inter-Correlation between the Rankings of States by Composite Indices of Infrastructural Development during the Different Years

Years	Coefficient of Rank Correlation	T-value
Between 1981-82 and 1991-92	0.929*	9.062
Between 1991-92 and 2001-02	0.934*	9.437
Between 1981-82 and 2001-02	0.964*	13.088

Source: Computed from table 1
**significant at 1% level of significance*

With a view to measure inter-state disparities in the level of socio-economic infrastructure, two inequality measures, R and C.V., have been calculated for composite indices of infrastructural development during all the reference years. The values of these inequality measures are given in table 3.

Table 3. Inequality Measures of Composite Indices of Infrastructural Development (Major States of India)

Composite indices of infrastructural development		1981-82	1991-92	2001-02
Coefficient of range	R	0.6837	0.5999	0.6539
Coefficient of variation	C.V.	0.4946	0.4449	0.4624

Source: Computed from table 1

The table projects a clear cut tendency of convergence across Indian states in terms of infrastructural development during the pre-reform period as evident from the decline in the value of both the inequality measures i.e., coefficient of range (R) and coefficient of variation (C.V.) during the pre-reform period, 1981-82 to 1991-92.

The nation, however, failed to sustain this catching-up tendency during the post-reform period, 1991-92 to 2001-02 as manifested by the rise in the value of both the inequality measures during the post-reform period. This shows that the principle of providing level playing field to all the federating units in a federation is being grossly overlooked by the Indian planners and policy masters.

4. CLASSIFICATION OF STATES

On the basis of the values of composite indices of infrastructural development, the states have been classified into three different clusters by applying the following formula:

$$\text{Range} = \frac{\text{Max Ys - Min Ys}}{\text{Number of clusters}} \qquad (1)$$

where, Max Y_s is the maximum value of the composite index
Min Y_s is the minimum value of the composite index

By deducting this range value from the maximum and adding this in the minimum, first and the last clusters have been extracted. For constructing the second cluster, again this range value is added in the upper limit of the last cluster and likewise all the three clusters have been computed. Separate classifications have been done for all the reference years i.e., 1981-82, 1991-92 and 2001-02 as given in table 4.

With a view to measure infrastructural disparities within the different clusters, two inequality measures - coefficient of range (R) and coefficient of variation (C.V.) - have been calculated for all the three clusters, as shown in table 5. An important point that has emerged from this analysis is that infrastructural disparities are highest within

the less developed states as compared to the other two groups of states during all the reference years. This suggests that addressing the problem of inter-state disparities within the less developed states can help to reduce disparities at the national level as well.

Table 4. Classification of States by Composite Indices of Infrastructural Development

Cluster	1981-82	1991-92	2001-02
Highly Developed States (Cluster-I)	Kerala (2) Punjab (1)	Kerala (2) Punjab (1)	Kerala (2) Maharashtra (3) Punjab (1) Tamil Nadu (4)
	[1.3570]	**[1.3003]**	**[1.2164]**
Moderately Developed States (Cluster –II)	Gujarat (4) Haryana(6) Karnataka(8) Maharashtra (3) Tamil Nadu (5) West Bengal (7)	Gujarat (4) Karnataka(6) Maharashtra (3) Tamil Nadu (5)	Andhra Pradesh(8) Gujarat (5) Haryana (7) Karnataka (6)
	[0.8744]	**[0.8677]**	**[0.8439]**
Less Developed States (Cluster –III)	Andhra Pradesh(9) Assam (15) Bihar (13) Madhya Pradesh(14) Orissa (11) Rajasthan (10) Uttar Pradesh (12)	Andhra Pradesh (9) Assam (10) Bihar (15) Haryana (7) Madhya Pradesh(14) Orissa (13) Rajasthan (11) Uttar Pradesh (12) West Bengal (8)	Assam (15) Bihar (14) Madhya Pradesh(13) Orissa (12) Rajasthan (11) Uttar Pradesh (10) West Bengal (9)
	[0.4164]	**[0.4949]**	**[0.4508]**

Source: Based on table 1

Note:1. Figures in the round brackets show respective rank of the state whereas figures in square brackets show the average value of composite index of states in different clusters.

2. Cluster-I represents 13.33% of the states during 1981-82, 1991-92 and 26.67% of the states during 2001-02, Cluster-II constitutes 40% of the states during 1981-82 and 26.67% of the states during 1991-92 and 2001-02 and Cluster-III represents 46.67%, 60% and 46.67% of the states during 1981-82, 1991-92 and 2001-02, respectively.

With a view to find out the extent of infrastructural disparities within the different clusters of states, coefficient of range (R) and coefficient of variation (C.V.) have also been calculated for different clusters. The results show that least developed states witnessed highest level of infrastructural disparities across them as compared to the two other groups of states. The results have been reported in table 5.

Table 5. Intra-Cluster Inequality Measures of Composite Indices of Infrastructural Development during the Different Years

Categories of States	1981-82		1991-92		2001-02	
	R	C.V.	R	C.V.	R	C.V.
HDS	0.1209	0.1709	0.0307	0.0434	0.1439	0.1445
MDS	0.1843	0.1535	0.1317	0.1298	0.1477	0.1410
LDS	0.3546	0.2371	0.3319	0.2387	0.3439	0.2208

Source: Computed from tables 1 and 4.
Note: 1. R and C.V. denote coefficient of range and coefficient of variation, respectively.
2. HDS, MDS and LDS denote highly developed states, moderately developed states and less developed states, respectively.

5. DETERMINANTS OF INFRASTRUCTURAL DEVELOPMENT AND DISPARITIES ACROSS STATES (1981-82 TO 2001-02)

The preceding analysis reveals the presence of considerable disparities across states in terms of socio-economic infrastructure during all the reference years. In view of this, an attempt has been made in the present study to analyze the possible determinants of infrastructural variations across Indian states and to examine their role and relative significance in determining the inter-state pattern of infrastructural development in India.

However, this exercise has been carried out for the year 2001-02 only. This has been done to identify the important determinants after the economic reforms in India started showing their effects at the regional level. In order to meet the said objective, the techniques of simple regression analysis and multiple (step-wise) regression analysis have been used.

However, while carrying out multiple (step-wise) regression analysis, only those variables have been included into the model which was found to be individually significant, as revealed by the results of simple regression analysis. The variables in the multiple regression model have been introduced at different steps in the descending order of their 't' values. The predictors which reduce the value of adjusted R^2, when entered into the multiple regression model, have been dropped from the regression model at that very step. The analysis has been carried out at six possible determinants of infrastructural development and disparities across states.

The possible determinants included into the model are:

- Density of population (DENP)
- Percentage of urban population to total population (URBP)
- Percentage share of manufacturing in net state domestic product (PMNSDP)[8]
- General Literacy rate (GLR)
- Votes casted in proportion to the total voting age population during the last general elections to Lok Sabha (VCVP)[9]
- Per capita public expenditure on development (PCPED)[10]

6. RESULTS OF REGRESSION ANALYSIS

To work out the nature and magnitude of relationship between composite indices of infrastructural development and its various determinants, the simple regression analysis, with composite indices of infrastructural development as dependent variable and possible determinants as independent variable, has been carried out. The results are given in table 6.

Table 6. Results of Simple Regression Analysis with Composite Indices of Infrastructural Development as Dependent Variable (2001-02)

Variable	Constant	Reg. cuff (T-value)	r^2	F (D f. 1, 13)
DENP	0.7068	0.1171 (0.3071)	0.0072	0.09
URBP	0.5625	0.2570* (3.885)	0.5373*	15.09
PMNSDP	0.3858	0.6172* (5.680)	0.7128*	32.26
GLR	0.6668	0.9922 (1.142)	0.0912	1.30
VCVP	0.8331	-0.1197 (-0.990)	0.00075	0.01
PCPED	-0.3490	0.9293* (3.787)	0.5245*	14.34

Source: As that in Table 1

*Note: 1. *significant at 1 percent level of significance, ** significant at 5 percent level of significance*

2. r^2 denotes coefficient of determination

3. The data for VCVP pertains to thirteenth Lok Sabha elections held in Oct 1999

The results highlight that only three variables viz., level of industrialization, level of urbanization and per capita public expenditure on development played significant role in determining the level of inter-state variations in socio-economic infrastructure during 2001-02. Multiple regression analysis has also been carried out to analyse the joint effect of these individually significant determinants of infrastructural development during 2001-02. The results have been given in table 7.

Table 7. Results of Multiple (Step-Wise) Regression Analysis with Composite Indices of Infrastructural Development as Dependent Variable (2001-02)

Constant	PMNSDP	PCPED	R^2	$\bar{R}^2$	F (D.f.= 1,13)
0.3858	0.6172* (5.680)		0.7128*	0.6907	32.26 (1, 13)
-0.5713	0.4587* (4.064)	0.4569** (2.306)	0.8004*	0.7672	24.07 (2, 12)

*Note: 1. *significant at 1 percent level of significance, ** significant at 5 percent level of significance*

2. R^2 denotes coefficient of determination and $\bar{R}^2$ denotes adjusted coefficient of determination

The results show that during 2001-02, level of industrialisation, as measured by PMNSDP, explained about 71 per cent of infrastructural variations across states. Inclusion of per capita public expenditure on development (PCPED) into the model further raised the explanatory power of the model to 0.8004. The regression coefficient of per capita public expenditure on development (PCPED) is found to be significantly positive. The inclusion of URBP into the regression model, however, reduced the value of adjusted R^2 and therefore the variable URBP has been dropped from the regression model.

To sum up, the level of industrialisation and per capita public expenditure on development accounted for about 80 per cent of the observed variations in socio-economic infrastructure across states during the year 2001-02.

7. SUMMING UP

The infrastructural disparities across 15 major states of India reduced during the decade of 1980s whereas the decade of 1990s witnessed increased disparities across states in terms of socio-economic infrastructure. In other words, the infrastructural disparities across states increased during the post-reform period. This has been indicated by the rise in the value of inequality measures of composite indices of infrastructural development during the post-reform period.

The study highlights that the relative position of the states in terms of socio-economic infrastructure also stood, more or less, frozen at all three reference points, at least at the upper and the lower level if not at the middle level. Punjab continued to occupy the top most position in terms of infrastructural development throughout the study period followed by Kerala and Maharashtra. Further, infrastructural disparities are found to be highest within the less developed states as compared to the highly developed and moderately developed states.

The level of industrial development and per capita public expenditure on development emerged to be the significant explanatory variables for inter-state disparities in socio-economic infrastructure. These variables, together, explained 80.04 per cent of the observed variations in infrastructure during the year 2001-02.

It is, thus, clear that in order to sort out the problem of inter-state disparities in infrastructure, industrialization process of the backward states should be given due consideration. Public expenditure can also play a significant role in providing the requisite finance for this purpose which can finally help the lagging states to move upward in terms of development.

In the wake of negative employment elasticity in agriculture in India, the development of non-primary sectors becomes all the more important and the infrastructure sector is the most promising sector amongst all other non-primary sectors. Deep inter-linkage between infrastructure and aggregate development also lends credentials to the policy of developing socio-economic infrastructure in the lagging states of India.

8. NOTES

1. The criterion used for the purpose of including a particular state is that the population of the state must exceed at least one per cent of the total population of the country. Bihar, Madhya Pradesh and Uttar Pradesh have been reorganized to form three new states viz., Jharkhand, Chhattisgarh and Uttaranchal, respectively in Nov. 2000. Separate data for these newly created states is not available for 1981-82 and 1991-92. As such these states have not been included into the study. Further, because of reorganisation of Bihar, Madhya Pradesh and Uttar Pradesh, data for these states is also not separately available for 1981-82 and 1991-92.

2. The index method, as used in the study, runs as under:

$$Yis = \frac{X_{is} - \text{Min } X_{is}}{\text{Max } X_{is} - \text{Min } X_{is}} \; ; \quad \begin{matrix} i = 1, 2, 3, ..., m \\ s = 1, 2, 3, ..., n \end{matrix} \tag{2}$$

where:
i stands for the ith indicator of development
s stands for the sth state
X_{is} is the value of the ith indicator of development for the sth state.
Y_{is} stands for the scaled value of X_{is}
Min X_{is} stands for the minimum value of X_{is}
Max X_{is} stands for the maximum value of X_{is}

From the scaled values (Y_{is}), a composite index of the level of development for any state has been calculated as follows.

$$Y_s = \sum_{i=1}^{m} W_1 \; Yis \tag{3}$$

$$Ys = W_1 \; Y_{1s} + W_2 \; Y_{2s} + W_3 \; Y_{3s} + ...+ W_m \; Y_{ms} \tag{4}$$

where:
W_1, W_2, W_3,…,W_m are the weights assigned to the respective indicators of development.
Y_s is the composite index of development of the concerned state.

3. Correlation weights are calculated as follows:

$$CW_i = \frac{Ci}{\sum Ci} \tag{5}$$

where:
Ci is the value of inter-correlation coefficient of ith indicator summed over m indicators.
ΣC_i stands for the sum of values of inter-correlation coefficients of all the m indicators.
CW_i is the correlation weight assigned to the ith indicator of development.

4. Includes basic telephone connections only. Owing to differences in source material used, the figures for different states are not strictly comparable.

5. Pertains to credit given by the scheduled commercial banks as on the last reporting day of March.

6. Pertains to deposits lying with scheduled commercial banks as on the last reporting day of March.

7. Includes Primary Health Centres as well.

8. Used as a proxy for the level of industrialisation.

9. Used as a proxy for level of political consciousness among people.

10. Includes total budgetary expenditure by the respective state governments on both the revenue and capital account.

Appendix

Correlation Weights of Various Indicators of Development in Socio-Economic Infrastructure

Indicator		1981-82	1991-92	2001-02
RDLPSQ	Z_1	0.06	0.089	0.08
LRWPSQ	Z_2	0.07	0.044	0.02
RMVPLP	Z_3	0.12	0.022	0.12
PTOPLP	Z_4	0.01	0.019	0.03
PTOPSQ	Z_5	0.08	0.081	0.08
TLCPLP	Z_6	0.11	0.133	0.147
BOPLP	Z_7	0.12	0..141	0..132
BOPSQ	Z_8	0.10	0.095	0.081
CPC	Z_9	0.10	0.109	0.112
DPC	Z_{10}	0.12	0.157	0.129
PCCE	Z_{11}	0.07	0.089	0.099
PHHE	Z_{12}	0.12	0.125	0.112
PSPLP	Z_{13}	0.09	0.079	0.002
PSPSQ	Z_{14}	0.01	0.059	0.068
TPRPS	Z_{15}	0.05	0.049	0.043
RTPST	Z_{16}	0.05	0.068	0.086
HDPLP	Z_{17}	0.10	0.097	0.096
HDPSQ	Z_{18}	0.08	0.091	0.085
HBPLP	Z_{19}	0.12	0.126	0.117
RMPLP	Z_{20}	0.11	0.119	0.106
PHSDW	Z_{21}	0.08	0.027	0.008
PHLPH	Z_{22}	0.11	0.124	0.114

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