Role of Infrastructure in Regional Development

A Study over the Plan Period

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In literature, the impact of public investment and physical infrastructure on both private investment behaviour and regional economic development has been found to be highly significant and positive. The latter hypothesis is tested here on Indian states over the Plan period using OLS regression. For this purpose, a physical infrastructure development indicator is formulated with the help of principal component analysis. With various unavoidable data limitations, the results are significantly conclusive: first, regional disparity has been rising in recent period, and Plan outlay has not played any major role in this regard; second, regional imbalance in physical infrastructure has been found to be responsible for rising income disparity across the states.

I
Introduction

THE indispensable role played by Social Overhead Capital (SOC) in helping productive activities, both direct and indirect, was recognised by the pioneers of development economics [Hirschman 1958 and Myrdal 1958]. The concept of infrastructure is essentially a flow of service out of a certain stock of infrastructural facilities created over a length of time. For example, creation of a dam or a power plant or certain stretch of a national highway or an underground railway may take more than two decades, while a telephone exchange just a couple of years. Depending on the nature of input services, infrastructure can be broadly divided into two types: physical and social. The former consists of transport (roads, railways, aviation, waterways and ports), electricity, irrigation, telecommunication, housing and water supply. They work as direct intermediate inputs to production, and improvement in these inputs in any geographical location attracts flows of additional resources ('crowding-in' private investment from both domestic and international sources). Secondly, this also raises the productivity of other factors of production (labour and other capital) and profitability of the producing units thereby permitting higher levels of output, income and/or employment. The positive contribution of physical infrastructure[1] to economic growth and development comes through increases in investment, employment, output, and income in a chain of 'cumulative causation'. Thus, 'economies of agglomeration' develop over time leading to further concentration of economic activities in a particular location or region.[2]

On the other hand, social infrastructure broadly includes education, health, nutrition, sanitation, child care, recreation, and banking and other forms of financial facilities. Their contribution to productive activity, although indirect in some occasions, is no less important.[3]

The process of cumulative causation should ultimately lead to better allocation of existing and hitherto unutilised resources of the region. This should raise international competitiveness in the chosen lines of production in such centres of economic activity. In the same logic, from the view–point of the sub-region of a nation, namely, the state, the 'crowding in' effect is encouraging as this would raise the productive potentials of the region in the state, although in the long run, the 'crowding out' effects may exert the negative impacts on further development. But given the phenomenon of 'historical accident' and 'cumulative causation hypothesis' [Myrdal 1958],[4] the play of market forces normally tends to increase rather than to decrease the inequalities between the competing regions. These favoured localities and regions, if happen to coincide with natural geographic scopes for port, road, good soil condition and proximity to raw materials, may gain a 'competitive advantage'. Even the movements of labours, capital, goods and other services generate ever-increasing internal and external economies in the preferred regions which have strong 'backwash effects' on the unlucky regions.

Backwash effects exert a retarding pull on other regions. There are diseconomies of agglomeration also, as well as 'spread effects' to other regions. It is not possible to predict at any particular point of time which effects will dominate. Hirschman (1958) strongly propagated the case for governmental intervention to counteract the 'polarisation effects' of free market forces.[5]

Thus there is no natural smooth tendency toward inter-regional transmission of growth from the richer to the poorer ones. In sharp contrast to the above reasoning, under the neo-classical framework, with perfect mobility of factors and decreasing returns to capital, convergence is the general outcome.[6] But under either paradigms, the role of SOC may become decisive in explaining the geographical bias of economic development within a single country. Barro (1984, 1991), Barro and Sala-I-Martin (1992, 1995), Quah (1993) and others have tried to test the hypothesis of convergence of economic growth or levels of economic development as between different regions within a single country in the league of advanced economies as also between different advanced countries themselves .

The purpose of this study is to understand the role of physical infrastructural facilities and planning in regional income determination in Indian states since independence. The paper is mainly concerned with the level of income differentials rather than growth.

The organisation of the paper is as follows. Section II deals with the literature on the studies relating to the role of infrastructure along with a few recent researches on inter-state disparities in India. The nature of data and their sources and limitations along with the period of our study are described in Section III. We have constructed a physical infrastructure development indicator (PIDI) for each state with the help of Principal Component Analysis (PCA) in Section IV. Section V briefly analyses the symptoms of regional disparity. Section VI tries to consolidate the association between PIDI, PCNSDP and PCPO over different time spans with the help of various scatter diagrams and also undertake some multiple regressions. Section VII briefs the findings, and outlines some policy implications with emphasis on north-eastern states, and also scopes for future research.

II
Review of Studies

In Dandekar (1993) it was claimed that the economic disparity between Indian states have been increasing rather than decreasing over time. Marjit and Mitra (1996) have examined the issue of regional convergence in 24 Indian states over the period from 1961-62 to 1989-90. On the basis of real per capita net state domestic product (PCNSDP), the authors have concluded that there is no prima facie evidence in favour of convergence of PCNSDP among the states in India. Subsequently, Ghosh, Marjit and Neogi (1997) have constructed a measure of real PCNSDP with the help of state level deflators. Their findings indicated that Indian states have significantly moved apart during last 30 years. This means that the richer states have grown at higher rates and the poorer states at lower rates. This is a clear case of divergence. As a sequel to this, Ghosh and Chattopadhya (1997) have tried to link the relationship between PCNSDP and some crude measure of infrastructure. Their observation also supports the findings of the earlier works.

In contrast, Dholakia (1994) has observed a tendency towards convergence among Indian states. Using sectoral classification of data, his study of 20 state economies of India over 1961-62 to 1989-90 has indicated that most of the states experiencing growth acceleration are relatively less well off. Interestingly, Cashin and Sahay (1995), in sharp contrast to what their data speak, have claimed that there is evidence of 'absolute' convergence, i e, initially poor states indeed grew faster than their initially rich counterparts.

In judging between these conflicting claims, it will be useful to start with some basic concepts. In Figure 1, we have plotted two marginal cost curves of a typical firm, with two different levels of infrastructure in the region in which it is situated. A low level of infrastructure causes the production unit to face higher marginal cost (MC_1) at every level of production. With better physical infrastructure services, the whole marginal cost curve shifts down to MC_2. Thus, there is total cost saving, or higher output effect. In what follows, improvement in infrastructural facilities exerts its positive impact on the production process through indirect cost reduction or output expansion.

The pioneering works in the field of economic growth are Schultz (1961), Hansen (1965), Denison (1967) and Maddison (1970) to name only a few.[7] In recent years, a series of mainstream economics researches on infrastructure and public investment have concluded that the impact of infrastructure on growth is substantial, significant and frequently greater than that of investment in other forms of capital.[8]

Some of the recent works on the Indian economy in this line are Binswanger, Khandkur and Rosenweig (1989), and Elhance and Lakshmanan (1988). These studies link infrastructure and sectoral output. The former with cross-district Indian data shows that the major effect of roads in rural India does not work through their impact on private investment but rather on marketing and distribution opportunities, and also on reduced transaction costs relating to agricultural activities. They admit that the determinants of agricultural output growth are complex and include road and irrigation infrastructure, but in combination with prices, markets and credit availability. Elhance and Lakshmanan (1988), on the other hand, using physical as well as social infrastructural indicators have shown that production cost reductions in manufacturing result from infrastructure investments.

III
Data, Coverage of States and Time Period

The major economic variables used for this study are per capita net state domestic products (PCNSDP), per capita plan outlay (PCPO), agricultural yield (AY), productivity of employees in manufacturing industries (PEMI), and also the infrastructural variables such as (i) railway

TABLE 1: RANKING OF STATES BY PCNSDP AT CONSTANT PRICES
(BASE : 1960-61 =100)

1961-62			1971-72			1981-82			1991-92			1994-95		
PCNSDP	States	Rank	PCNSDP	States	Rank	PCNSDP	States	Rank	PCNSDP	States	Rank	PCNSDP	States	Rank
687.5	Delhi	1	651.5	Delhi	1	762.26	Delhi	1	1299.43	Delhi	1	1200.28	Delhi	1
420.41	Maharashtra	2	560.5	Punjab	2	661.82	Punjab	2	1001.22	Goa	2	1107.97	Goa	2
389.22	Gujarat	3	486.76	Goa	3	641.56	Goa	3	949.04	Punjab	3	997.75	Punjab	3
378.85	Punjab	4	480	Haryana	4	594.7	Gujarat	4	840.52	Haryana	4	985.86	Maharashtra	4
378.1	WB	5	464.61	Gujarat	5	557.7	Haryana	5	759.83	Maharashtra	5	893.41	Gujarat	5
334	TN	6	396.08	Maharashtra	6	531.82	Maharashtra	6	685.9	Gujarat	6	854.99	Haryana	6
332.98	Rajasthan	7	375.96	WB	7	454.81	Sikkim	7	652.88	AP	7	724.55	TN	7
324.24	Assam	8	356.36	J and K	8	412.95	All States	8	643.39	Aru P	8	673.73	AP	8
321.15	Haryana	9	352.17	T N	9	410.12	AP	9	624.68	TN	9	657.44	Aru P	9
320.21	All states	10	348.89	AP	10	401.08	HP	10	608.09	Nagaland	10	630.91	Karnataka	10
320	Karnataka	11	347.34	Rajasthan	11	399.04	Nagaland	11	592.43	All States	11	603.76	All Staes	
294.06	A P	12	346.34	All States	12	397.92	WB	12	585.9	Mizoram	12	578.39	WB	12
289.9	Tripura	13	344	HP	13	395.91	Aru P	13	581.88	Karnataka	13	572.33	Mizoram	13
261.54	J and K	14	340	Karnataka	14	377.88	Tripura	14	564.89	Sikkim	14	547.4	HP	14
257.55	Kerala	15	279.25	Kerala	15	376.92	J and K	15	545.11	HP	15	503.08	Nagaland	15
252.43	UP	16	268.65	UP	16	376.68	Manipur	16	541.72	WB	16	476.98	Kerala	16
251.46	MP	17	265.57	Tripura	17	375	TN	17	493.28	Kerala	17	461.35	Meghalaya	17
223.53	Orissa	18	263.05	MP	18	358.23	Karnataka	18	483.73	Meghalaya	18	451.05	Assam	18
213.59	Bihar	19	262.26	Nagaland	19	349.88	Kerala	19	461.83	Assam	19	436.92	Sikkim	19
153.54	Manipur	20	258.49	Assam	20	317.31	Mizoram	20	458.88	Manipur	20	434.25	MP	20
			227.36	Aru P	21	312.98	Assam	21	437.96	Rajasthan	21	405.94	Manipur	21
			217.97	Orissa	22	309.98	Rajasthan	22	402.51	MP	22	399.15	Orissa	22
			215.57	Manipur	23	308.41	Meghalaya	23	396.52	J and K	23	375.27	Rajasthan	23
			203.43	Bihar	24	287.17	UP	24	377.12	Orissa	24	368.42	UP	24
						278.52	MP	25	363.71	Tripura	25	337.38	J and K	25
						274.33	Orissa	26	362.86	UP	26	323.38	Tripura	26
						224.57	Bihar	27	280.21	Bihar	27	299.53	Bihar	27
SD	108.5		SD	114.41		SD	131.33		SD	224.41		SD	251.41	
CV	33.88		CV	33.03		CV	31.8		CV	37.88		CV	41.46	

FIGURE1: IMPACT OF IMPROVEMENT IN INFRASTRUCTURE AT THE FIRM LEVEL

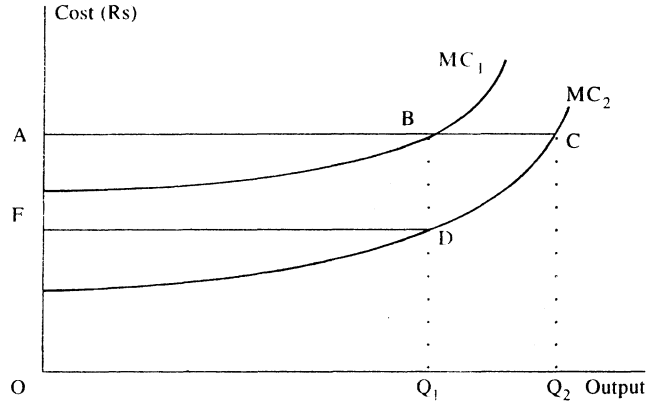
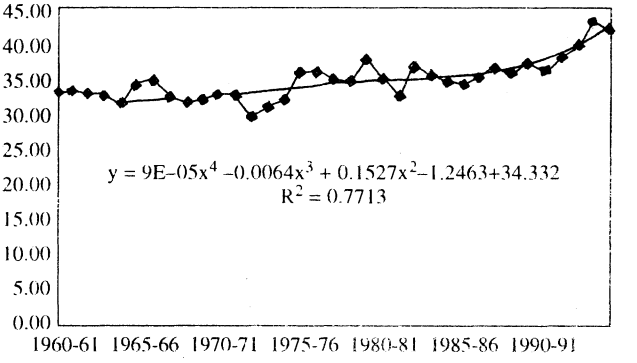
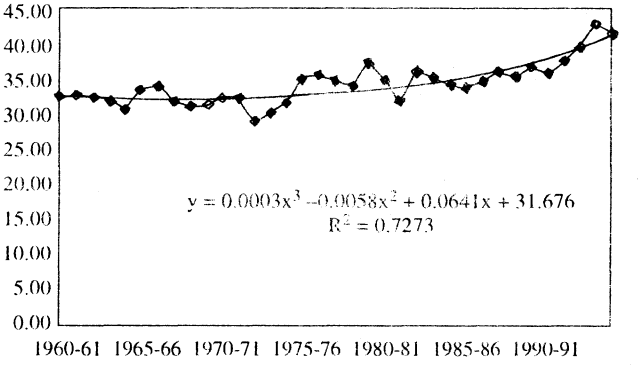


FIGURE 2: TRENDS OF CV OF PCNSDP WITH ALTERNATIVE FITS: 1960-61 TO 1994-95





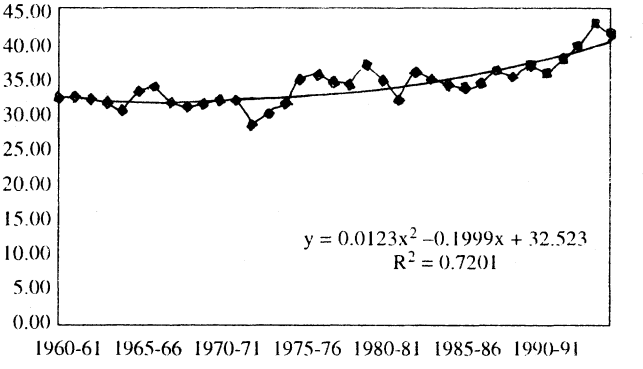


TABLE 2 (A): PHYSICAL INFRASTRUCTURE DEVELOPMENT INDEX (PIDI)

States	1971-72		1994-95	
	PIDI	Rank	PIDI	Rank
Delhi	25.07	1	25.79	1
Punjab	23.59	2	24.01	2
Tamil Nadu	21.59	3	21.28	3
Kerala	20.88	4	17.70	10
Haryana	19.99	5	20.71	4
Maharashtra	18.60	6	18.73	7
Karnataka	18.31	7	17.72	9
West Bengal	17.66	8	11.06	18
Gujarat	16.79	9	19.81	6
Bihar	16.27	10	12.50	15
Goa	15.66	11	20.20	5
Andhra Pradesh	14.54	12	18.57	8
Uttar Pradesh	13.92	13	13.46	12
Himachal Pradesh	12.94	14	15.22	11
Jammu and Kashmir	12.79	15	10.71	19
Orissa	12.02	16	13.31	13
Manipur	10.95	17	10.14	20
Madhya Pradesh	10.84	18	11.87	17
Rajasthan	9.73	19	12.10	16
Assam	9.05	20	8.82	21
Nagaland	8.33	21	13.15	14
Meghalaya	7.78	22	6.05	22
Tripura	5.79	23	5.48	24
Sikkim	5.69	24	5.80	23
Arunachal Pradesh	4.39	25	3.00	26
Mizoram	1.39	26	4.82	25

Notes: 1 In 1971-72, PIDI = 0.1645 (RRL + RDL) + 0.2361 (PCE) + 0.2367 (VE) + 0.1378 (GIA) + 0.2249 (TL).
2 In 1994-95, PIDI = 0.1879 (RRL + RDL) + 0.2401 (PCE) + 0.1598 (VE) + 0.1997 (GIA) + 0.2125 (TL).
3 Rank correlation of PIDI between 1971-72 and 1994-95 = 0.89

route length in kms per thousand square km of area (RRL), (ii) road length in kms per thousand square kms of area (RDL), (iii) per capita consumption of electricity in kwh (PCE), (iv) villages electrified as a percentage of total number of villages in each state (VE), (v) gross irrigated area as a percentage of gross cropped area (GIA), (vi) number of telephone lines per 100 persons (TL). With this data set, we have also used three deflators, namely (i) consumer price indices for agricultural labourers (CPIAL), (ii) capital formation deflator(CFD), (iii) wholesale prices of manufactured goods (WPMG).

The major sources of our data are (i) Estimates of State Domestic Products, (ii) Economic Survey, (iii) National Accounts Statistics, and (iv) Agricultural Situation in India – all published by the government of India. This data set is supplemented by various publications of the Centre for Monitoring the Indian Economy (CMIE), Mumbai, and India Database – the Economy by H L Chandk and the Policy Group.

Unlike all previous works in this area, following Ghosh, Marjit and Neogi (1997), we have used state-level deflators, namely, CPIAL for converting the nominal PCNSDP into real terms.[9] PCPO is deflated by CFD as this is largely a developmental expenditure. PEMI is estimated by dividing net value added with total employees, and deflated by WPMG. This can be taken as a surrogate of labour productivity. AY is taken in kg per hectare. Finally, as usual, the infrastructural indicators are taken either in physical number or in percentage terms.

Unfortunately, limitations of data and reorganisation of the states on several occasions[10] prevent us from choosing all the fifty years since independence. In terms of geographical area, we have covered all the states comprising about 99 per cent of India's population. As to the infrastructure indicators, we could not go back beyond 1971-72. Although the major states existed from the First Five-Year Plan, further reorganisation of the states in later period

has affected PCPO data accordingly. To be more specific, there were only 19 states in 1961-62 and 26 at the end in 1994-95 upto which the latest data are available. It may be noted that the plan outlay on port sector although accounts for a moderate share in transport sector accrue to the nine coastal states only, with eleven major ports. This part goes to these states over and above the formula share for all other states.

IV
Construction of PIDI: Principal Component Analysis

An attempt is here made at developing some composite index of regional infrastructural development, which is so far called PIDI, after giving varying weights to six commonly used representative indicators of physical infrastructure such as transport network (railway + road PCE, VE, irrigation facility and telephon density. A serious shortcoming of th conventional methods of estimation o PIDI[11] is that while combining the physica variables they either give subjective ad hoc weights to different factors or leave them unweighted. Since there is every possibility for the variables to vary in terms of their relative importance over

TABLE 2(B): INDIVIDUAL PIDI

States	Transport		Power (PCE)		Power (VE)		Irrigation		Telephone	
	1971-72	1994-95	1971-72	1994-95	1971-72	1994-95	1971-72	1994-95	1971-72	1994-95
Andhra Pradesh	1.65	2.25	3.54	4.56	4.26	4.15	2.62	4.19	2.47	3.40
Arunachal Pradesh	0.49	0.75	1.18	0.48	0.47	0.16	1.79	1.40	0.45	0.21
Assam	2.80	3.57	1.42	0.96	1.42	2.24	2.07	1.20	1.35	0.85
Bihar	3.62	1.69	3.07	1.92	2.60	0.64	2.48	3.99	4.50	4.25
Goa	4.11	4.51	4.49	5.76	5.21	4.15	0.28	2.80	1.57	2.98
Gujarat	1.48	2.07	5.19	5.52	3.79	4.15	1.38	3.39	4.95	4.68
Haryana	2.14	2.44	4.25	5.28	6.15	4.15	3.17	4.79	4.27	4.04
Himachal Pradesh	1.32	1.88	2.12	3.12	4.02	4.15	1.65	1.60	3.82	4.46
Jammu and Kashmir	0.16	0.19	2.60	2.88	3.31	1.92	2.89	3.59	3.82	2.13
Karnataka	3.13	2.82	4.72	4.32	4.50	4.15	1.24	2.60	4.72	3.83
Kerala	4.28	4.70	3.78	3.36	5.44	4.15	2.20	0.60	5.17	4.89
Madhya Pradesh	1.15	1.50	2.83	3.84	1.89	1.76	0.69	1.80	4.27	2.98
Maharashtra	1.97	3.01	5.67	5.04	4.73	4.15	0.83	1.00	5.40	5.53
Manipur	2.63	1.13	0.71	1.44	1.66	1.44	3.03	3.79	2.92	2.34
Meghalaya	0.99	0.94	1.65	2.16	1.18	0.32	1.93	2.00	2.02	0.64
Mizoram	0.33	0.38	0.24	1.20	0.24	0.96	0.14	0.80	0.45	1.49
Nagaland	1.81	3.38	1.18	0.72	2.13	4.15	0.96	3.20	2.25	1.70
Orissa	2.30	3.95	4.01	4.08	2.84	0.80	1.52	3.00	1.35	1.49
Punjab	3.29	3.76	5.90	6.00	4.97	4.15	3.58	4.99	5.85	5.10
Rajasthan	0.82	1.32	2.60	3.60	2.37	1.60	1.24	2.40	2.70	3.19
Sikkim	0.66	0.56	1.89	1.68	0.71	2.08	0.41	0.40	2.02	1.06
Tamil Nadu	3.78	4.32	5.43	4.80	5.92	4.15	3.31	4.39	3.15	3.61
Tripura	2.47	4.13	0.47	0.24	0.95	0.48	0.55	0.20	1.35	0.43
Uttar Pradesh	2.96	3.19	3.31	2.64	3.55	1.12	2.76	4.59	1.35	1.91
West Bengal	3.45	2.63	4.96	2.40	3.08	1.28	2.34	2.20	3.82	2.55
Delhi	3.95	4.89	6.14	6.24	5.92	4.15	3.45	5.19	5.62	5.31
State Average	2.22	2.54	3.21	3.24	3.20	2.56	1.87	2.70	3.14	2.89

TABLE 2(C): RANK OF INDIVIDUAL PIDI

States	Transport		Power (PCE)		Power (VE)		Irrigation		Telephone	
	1971-72	1994-95	1971-72	1994-95	1971-72	1994-95	1971-72	1994-95	1971-72	1994-95
Andhra Pradesh	17	15	12	8	9	1	8	6	16	11
Arunachal Pradesh	24	23	22	25	25	26	14	20	25	26
Assam	10	8	21	23	21	13	12	21	21	23
Bihar	5	18	14	19	16	23	9	7	7	7
Goa	2	3	8	3	5	1	25	13	20	13
Gujarat	18	16	5	4	11	1	17	10	5	5
Haryana	14	14	9	5	1	1	4	3	8	8
Himachal Pradesh	19	17	18	14	10	1	15	19	10	6
Jammu and Kashmir	26	26	16	15	13	15	6	9	10	17
Karnataka	8	12	7	9	8	1	18	14	6	9
Kerala	1	2	11	13	4	1	11	24	4	4
Madhya Pradesh	20	19	15	11	19	16	22	18	8	13
Maharashtra	15	11	3	6	7	1	21	22	3	1
Manipur	11	21	24	21	20	18	5	8	14	16
Meghalaya	21	22	20	18	22	25	13	17	18	24
Mizoram	25	25	26	22	26	21	26	23	25	20
Nagaland	16	9	22	24	18	1	20	11	17	19
Orissa	13	6	10	10	15	22	16	12	21	20
Punjab	7	7	2	2	6	1	1	2	1	3
Rajasthan	22	20	16	12	17	17	18	15	15	12
Sikkim	23	24	19	20	24	14	24	25	18	22
Tamil Nadu	4	4	4	7	2	1	3	5	13	10
Tripura	12	5	25	26	23	24	23	26	21	25
Uttar Pradesh	9	10	13	16	12	20	7	4	21	18
West Bengal	6	13	6	17	14	19	10	16	10	15
Delhi	3	1	1	1	2	1	2	1	2	2
Rank Correlation	0.82		0.88		0.79		0.74		0.88	

different time spans in a comparative static framework across the states, assignment of equal or varying ad hoc weights could lead to unwarranted results. To overcome this problem, the statistical technique employed is 'principal component analysis' (PCA) which is a branch of well-known old multivariate technique of 'factor analysis'.[12] Besides clustering the variables as mentioned earlier, here one can search for such a combination of them which as a single measurement accounts for a large proportion of the total variability in the sample. In effect thus, we have taken only the first principal component which is the linear combination corresponding to the largest amount of variability.[13]

The main features of this index are indicated below. First, we have added RRL and RDL as their relationship is one of substitutability rather than complementarity. For example, the hilly states have been provided with higher road density as it would be difficult and costlier to endow them with railway networks. Second, the weights derived from the PCA corresponding to each infrastructural variable have substantially changed from 1971-72 to 1994-95. Thus, following PCA, the distribution of weights corresponding to the infrastructural variables in 1971-72 and 1994-95 are given below:

	1971-72	1994-95	Arbitrary Fixed Weight
Transport	16.45	18.79	40.00
Irrigation	13.78	19.97	25.00
VE	23.67	15.98	10.00
PCE	23.61	24.01	15.00
TL	22.49	21.25	10.00
	100.00	100.00	100.00

The PIDIs thus derived from PCA across the states are compared with the same derived from the arbitrary fixed weights. Interestingly, although no major difference is observed, the former is more representative of the corresponding PCNSDP ranking. On the other hand, in any subjective method, the weights remain fixed out time even if relative importance of the factors changes. Third, these weights are used as multiplying factors with the ranks of the states in terms of each indicator. The states are ranked in descending order, i e, the best state is ranked 26th while the worst state first. Then after multiplying the rank with the weights of each of the six factors we have obtained the individual indices. After adding all the six individual indices for a particular state in a particular year we have derived the PIDI for that state. The reverse ranking gives a higher value of PIDI for better endowed state and vice versa.

V
Symptoms of Regional Disparity

The most widely preferred measure of regional economic development is to identify the level of development of a region by using reliable estimates of per capita income. Table 1 presents the rankings of the states in terms of PCNSDP at constant prices, deflated by CPIAL with base 1960-61 = 100, for five different time points. The salient features relating to regional concentration of income over the entire period of planning as revealed from this table are as follows. First, from the clustering of the states above and below average PCNSDP it is clear that the positions of the states have remained fixed on both sides over last 35 years. On the higher side, these states are Delhi, Goa, Punjab, Maharashtra, Gujarat, Haryana, TN, and Andhra Pradesh whose growth rates happen to be high relative to all other states. Interestingly, if one draws a perpendicular line from north to south across the country starting from Lucknow, the entire left falls in this group except Kerala, Rajasthan, Jammu and Kashmir and Himachal Pradesh. Conversely, the entire right side of the line has stabilised below the mean per capita income. Second, the entire north-eastern region except Arunachal Pradesh has stagnated in the same low level of income position as it was in 1961-62. It is of particular significance that WB, the main centre of gravity for the north-eastern region, has gone down in PCNSDP ladder since the 1970s. It has failed to maintain its position among the top 10 group. On the other hand, the position of Kerala has always remained much below the mean income. Moreover, it is clear from the last row of the table that the coefficient of variation (CV) has been going up since the 1970s, strengthening the hypothesis of regional disparity much more in the post-liberalisation period. It is seen that the coefficient of variation has been steadily rising from 31.8 in 1981-82 to 37.88 in 1991-92 and 41.46 in 1994-95 reaching the maximum of 43 in 1993-94. For better understanding,

TABLE 4: CORRELATION BETWEEN PCNSDP, PIDI AND PCPO –1971-72 AND 1994-95

1971-72	PCNSDP	PIDI	PCPO
PCNSDP	1	0.703	–0.032
PIDI		1	–0.034
PCPO			1
1994-95			
PCNSDP	1	0.722	0.127
PIDI		1	–0.328
PCPO			1

TABLE 3: PER CAPITA PLAN OUTLAY (PCPO)

	Rank of PCPO		Cumulative
	1971-72	1994-95	PCPO (Rs)*
Andhra Pradesh	15	22	1180.17
Arunachal Pradesh	na	3	4549.37
Assam	12	21	1269.00
Bihar	19	25	923.97
Goa	na	4	4098.10
Gujarat	6	13	1963.96
Haryana	17	12	2027.60
Himachal Pradesh	4	10	2574.23
Jammu and Kashmir	3	6	2910.18
Karnataka	10	17	1454.01
Kerala	11	20	1269.11
Madhya Pradesh	na	26	849.59
Maharastra	8	15	1774.38
Manipur	7	7	2855.72
Meghalaya	20	9	2673.29
Mizoram	na	5	3836.64
Nagaland	1	1	5035.27
Orissa	9	16	1490.63
Punjab	2	8	2853.34
Rajasthan	14	18	1331.73
Sikkim	na	2	4794.54
Tamil Nadu	13	19	1310.54
Tripura	5	11	2225.72
Uttar Pradesh	18	24	1084.11
West Bengal	16	23	1110.47
Delhi	na	14	1923.45

Note: Comulative values count PCPO from 1st Five Year Plan (FYP) to 8th FYP for most of the States except Arunachal Pradesh, Goa, Haryana, MP, Maghalaya, Mizoram, Nagaland Sikkim and Delhi for which this is available from 4th FYP onwards. na: not available. * At the end of 8th FYP.

the values of CV over the period from 1960-61 to 1994-95 with three alternative polynomial fits (with maximum R^2 of 0.77) are presented in Figure 2. It is obvious that there is an exponentially rising tendency toward disparity across the states in foreseeable future. One plausible explanation for this phenomenon may be that the role of planning in fostering balanced regional development started eroding since the seventies. Third, while the high income states have maintained high growth rates, the low income states in general and the north-east and eastern states in particular have registered negative rates of growth of PCNSDP during the 1990s.

Therefore, there are reasons to believe that the poor states have remained poor and the rich states have remained rich after 50 years of independence. Moreover, inter-states disparity in income had declined upto the 1970s, and it has been rising steadily since then, particularly during the post-liberalisation period.

VI
Linkages between PCNSDP, PIDI and PCPO

The income disparity among the states just observed appears to have important linkages with PIDI and PCPO. Tables 2(a), (b), (c), and 3 respectively, present the values of PIDI and PCPO (cumulative) for all the states at two different time points, 1971-72 and 1994-95. We think that had there been any natural inequality in productive capabilities across the states (which really is), then the distribution of per capita plan outlay should have taken care of this initial disparity. Because, one of the professed goals of India's Five-Year Plan is to foster balanced regional development. Moreover, even in a diagnostic manner, one expects the development of infrastructural facilities across the states to be normalised in the long run, given the initial differentials to start with.

Even a cursory look at Table 2 makes it clear that the poorer states have failed to improve their positions in PIDI between 1971-72 and 1994-95. The very high value of rank correlation (= 0.89) proves the fact that relative productive capability of the states has remained unchanged over time. Moreover, the PIDI ranking highly resembles the PCNSDP ranking. The only exception is Arunachal Pradesh which has very low PIDI even with high PCNSDP. Infrastructural retrogression is very significant for WB (8 to 18), Kerala (4 to 10) and Bihar (10 to 15), although their achievements in infrastructure are out of harmony with corresponding PCNSDP rankings (5 to 12, 14 to 15, and 18 to 26). Moreover, all the seven sisters of the north-east frontier along with Jammu and Kashmir, Sikkim and Rajasthan represent very low values of PIDI relative to the best performing states. Quite remarkably, Goa has improved its ranking from 11 to 5. Thus, the best and worst ten states (in order of ranking) in infrastructure in the 1994-95 are listed below:

Best Ten	Worst Ten
Delhi, Punjab, TN, Haryana, Goa, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Kerala	Arunachal Pradesh Mizoram, Tripura, Sikkim, Meghalaya, Assam, Manipur, and Jammu and Kashmir, West Bengal and Madhya Pradesh

Hence, it can be taken to imply that there are huge scopes for improvement in the lagging regions which will attract further investments from the private sector. The critiques of inter-regional comparisons cannot refute the fact that lower inter-state variations in PIDI (and which are achievable) could facilitate better utilisation of unused resources in the lagging regions. As the construction of PIDI implies, the lagging states consistently represent lower values for most of the individual infrastructural facilities. This is presented in Table 2(b) showing the values of the individual PIDI across states at two different points. Here again, the fall of West Bengal and rise of Gujarat, Tamil Nadu, Karnataka and Andhra Pradesh are praiseworthy. We have presented in Table A a list of selected states corresponding to each individual infrastructure for which urgent public action may be called for and/or private initiatives should be encouraged. It is obvious that the north-east region is the most backward one in terms of all infrastructural variables. It is clear from the rank correlation coefficients that the positions of the states have remained unchanged between 1971-72 and 1994-95 with respect to the individual infrastructures. Very limited spillovers have occurred with respect to VE and irrigation.

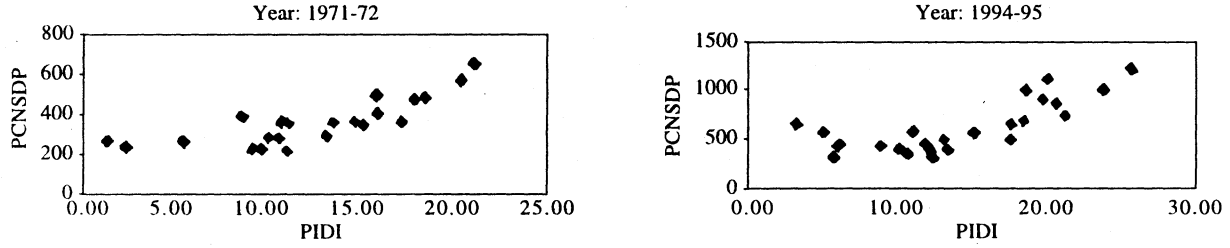
Let us now see whether union government disbursement of funds through Five-Year Plans has any practical relationship with PCNSDP and PIDI. The results of the rank correlation test are presented in Table 4. Although the correlation values should not be stretched too far for drawing any strong conclusion, it is obvious that the positive association between PCNSDP and PIDI has been strengthened over time: from 0.703 in 1971-72 to 0.722 in 1994-95. Another important observation is that the association between PCPO and PIDI has been negative in both years although with very low value (-0.034 in 1971-72 and –0.328 in 1994-95). The arithmetic implication say that states with lower PIDI correspond to higher PCPO and vice versa. It cannot be concluded that richer states have received lower amounts and vice versa. On the contrary, very low values of cumulative PCPOs over the entire plan period for the states of Madhya Pradesh, Bihar, Uttar Pradesh, West Bengal and

TABLE 5: ESTIMATED COEFFICIENTS OF REGRESSION ON PCNSDP

Types	Years	Coefficients of Independent Variables: Intercept	PIDI	PCPO	AY	PEMI	Adjusted R^2	R^2	Multiple R	F	Obs.
1	1971-72	129.13	17.88				0.61	0.62	0.79	34.78	23
		(3.24)	(5.9)								
	1994-95	188.27	29.84				0.50	0.52	0.72	26.21	26
		(2.13)	(5.12)								
2	1971-72	351.64		-0.01			-0.05	0.01	0.03	0.02	23
		(7.99)		(-0.15)							
	1994-95	544.62		0.03			-0.03	0.16	0.13	0.4	26
		(5.09)		(0.63)							
3	1971-72	127.87	14.88	-0.01			0.44	0.49	0.70	9.77	23
		(2.13)	(4.42)	(-0.05)							
	1994-95	-78.05	35.37	0.08			0.64	0.67	0.82	23.4	26
		(-0.70)	(6.76)	(3.22)							
4	1971-72	140.51	18.96		-0.07	-0.01	0.51	0.57	0.76	8.51	23
		(2.66)	(4.91)		(-1.88)	(-0.78)					
	1994-95	194.51	39.72		-0.10	-0.01	0.57	0.63	0.79	12.21	26
		(2.34)	(5.66)		(-2.32)	(-0.77)					
5	1971-72	126.76	19.20	0.02	-0.08	-0.01	0.48	0.58	0.76	6.15	23
		(2.01)	(4.81)	(0.42)	(-1.88)	(-0.67)					
	1994-95	-26.60	38.58	0.07	-0.05	-0.001	0.63	0.69	0.83	11.87	26
		(-0.21)	(5.92)	(2.17)	(-1.24)	(0.06)					

Notes: 1 The figures in the bracket represent t-statistics.
2 Values of NSDP for three states were not available at 1971-72.

FIGURE 3: SCATTER BETWEEN PCNSDP AND PIDI



Andhra Pradesh are matters of serious concern as their PIDI values are also very low (Table 3). On the whole, there is some indication to the fact that states with higher PIDI have received lower amounts and vice versa. But it cannot be said that states with higher PCNSDP have received relatively lower PCPO. Because, the negative correlation in 1971-72 (–0.032) has become positive in 1994-95 (0.127), although both being insignificant. In a recent paper, Sarkar (1994) has argued that plan outlay has played a positive role in fostering regional development.

In order to have a more transparent picture, two scatter diagrams between PCNSDP and PIDI for 1971-72 and 1994-95 are presented in Figure 3. We have fitted simple straightlines to each. The fitted relationship is presented in Figure 4 with corresponding R^2. It is obvious that the strength of the relation has improved over the years.

The above findings have shown that PIDI plays an important role in determining the differential income performances of the states. That is, even if infrastructure creation may be a long-run objective of a plan, PCNSDP is the ultimate target. Also, impact of PIDI on PCNSDP falls on the longer run. Moreover, as shown above, there is no significant association between PIDI and PCPO. Hence, use of PCPO as another independent variable will not do any major harm. Barring these, we have also used agricultural yield (kg per hectare) and productivity of labour in manufacturing industries as independent variables. This follows from the simple growth accounting process that outside the service sector (which is beyond the purview of the present analysis), productivity differentials will ultimately be reflected in income differentials.

Under such a background, we have estimated a couple of OLS regressions at two different points, 1971-72 and 1994-95. The dependent variable in all the cases is PCNSDP. The results for both years would have been better had we omitted the outliers as shown in the scatter diagrams in Figure 3. For test and verification purposes, we have also fitted non-linear curves for both years and presented them in Figure 4. It is remarkable that for both years the values of R^2 have substantially improved (about 80 per cent) compared to linear fits. The exponential relationship between PCNSDP and PIDI implies that for initial scales the decreasing benefits of the latter to the former drastically reverts in the higher scales. That means higher PIDI beyond certain critical minimum level has very significant impact on PCNSDP. However, the following regression results are based on linear fits as given on the top of Figure 4.

The estimated coefficients of the regressors along with corresponding t-statistics, adjusted R^2, F value, and number of observations are presented in Table 5 for 1971-72 and 1994-95.

(1) The results of the first regression confirm the high level of significance of PIDI in determining PCNSDP with very high value of F-statistics. The value of the coefficient of PIDI has also increased to 29.84 in 1994-95 from 17.88 in 1971-72. In both years more than 50 per cent of income is explained by PIDI alone. The immediate policy implication is that development of physical infrastructure facilities is indispensable for curing regional income differentials which has lasting growth potential in the long run.

(2) Replacement of PIDI by PCPO does not have much significance. The negative sign is explained earlier.

(3) Inclusion of both PIDI and PCPO as independent variables substantially improves the results in terms of both R^2 (from 0.44 in 1971-72 to 0.64 in 1994-95), t-statistics and F-value. Although the impact of PCPO is very significant, its low coefficient may be a cause of concern about the role of planning in state income.

(4) Inclusion of AY and PEMI along with PIDI has not improved the result, although the coefficient and t-statistics of PIDI have improved a lot. But the negative coefficient of AY is not apparently consistent with the role of infrastructure in agricultural productivity. This might be linked in indirect way with the inverse relationship between holding size and productivity. We think transport and power in agricultural uses might have important impact on AY. The lower values of t-statistics imply insignificant impact of industrial productivity on PCNSDP.

(5) All these four factors taken together have greatly improved the value of R^2 and produced positive sign for PCPO.

Therefore, it may be concluded that both physical infrastructure, plan outlay and agricultural productivity have played very determining role in explaining PCNSDP across the states over the Plan period.

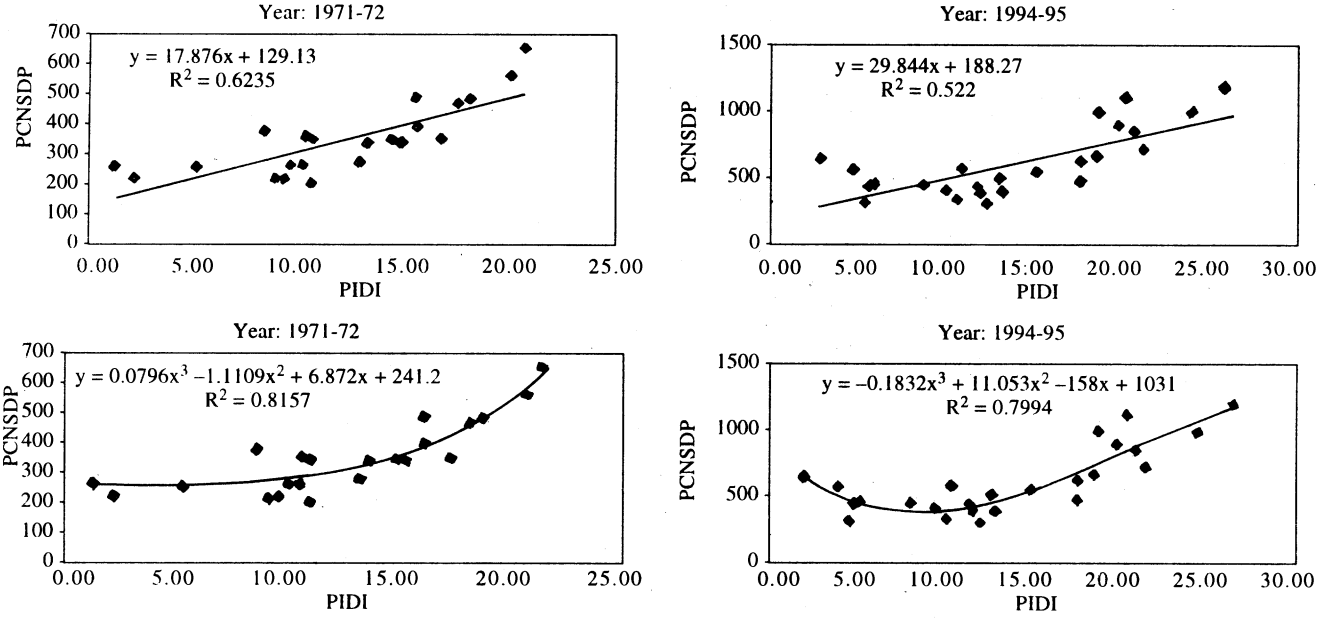
VII
Summary, Implications and Future Research

Unlike all Asian and also other developed countries, India is a country of acute heterogeneity in every respect of economy, polity, society and culture. During the initial phases of planning, the main emphasis was placed on overall national development rather than better utilisation of these highly differential eco-geographical potentialities across various regions. After 50 years of independence (and eight five-year plans), India has been able to establish a wide diversification of the industrial base as a result, in part, of the 'heavy industrialisation strategy' of the Second Plan (the Mahalanobis model). Also, the country has achieved a relative self-sufficiency in food production. But in two very important areas, India's poor performance has tremendous ominous implication for international competitiveness and national integration. The first is that India's productivity in both industry and agriculture have not only been one of the lowest in the world but also stagnating during the last few decades [see Ghosh and Neogi 1993, 1996 and Neogi and Ghosh 1994 for industry, and

TABLE A: LAGGING STATES IN INFRASTRUCTURE

Transport	PCE	VE	Irrigation	Telephone
Arunachal Pradesh, Jammu and Kashmir, Meghalaya, Mizoram Sikkim	Arunachal Pradesh Assam, Mizoram, Nagaland, Tripura	Arunachal Pradesh, Bihar, Meghalaya, Mizoram, Tripura	Kerala, Mizoram, Sikkim, Tripura	Arunachal Pradesh, Assam, Meghalaya, Tripura

FIGURE 4: FITTED RELATIONSHIP BETWEEN PCNSDP AND PIDI



Kawagoe et al, 1985 and Chaudhuri 1993 for agriculture]. The second is related to rising regional imbalance in infrastructure. Although there had been no explicit concern among the policy-makers relating to the former prior to economic reforms, the problem of regional imbalance in income rather than in infrastructure has been continuously drawing attention from both policy-makers and economists since the Second Plan. The Industrial Policy resolution of 1956 explicitly recognised the need to correct regional imbalances. All the subsequent plans have been continuously improving upon the formula for more equitable distribution of funds with special emphasis on the poorer states. The development of the Gadgil formula for allocation of central funds to the states during the 1970s was an improvement over the ad hoc basis followed during the earlier Plans. Its main emphasis was on total population and incidence of poverty. But the paradox is that the largest backward region of the country, namely, the north-eastern states[14] (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura), is characterised by low population (1971 Census), low poverty and high literacy compared to the more populous states. The High Level Commission Report to the prime minister [Government of India 1997] entitled 'Transforming the Northeast: Tackling Backlogs in Basic Minimum Services and Infrastructural Needs', is of great significance at this juncture. But it remains to be seen how long it would take to start the initiatives towards pulling the north-eastern region into the mainstream. The India Infrastructure Report [GOI 1996] has done very many things but failed to focus on the regional imbalance in manmade resources (that is, physical infrastructure) which is fundamentally responsible in the long run for low export potential on which it is explicit, and even for biased distribution of poverty across the states. Such causal reasoning is crystal clear from the following story. Why a man in a particular region is poor? Because he has low income. Why low income? Because, there is low economic activity, other things equal. Why low activity? Because there is low potential capability for income generating activity. Why low potential capability? Because there is low infrastructural development. Why? Because flow of investments (both public and private) is concentrated in limited regions, given total funds for the nation as a whole. Such prognosis leaves enough scope to verify the relationship between convergence theory and regional concentration of poverty.

Therefore, the main conclusion that unequal distribution of infrastructure is largely responsible for the same in income is proposed to be extended further to the following areas. (1) An in-depth study may be undertaken at the district level in each major region; (2) there is room for identifying in a more practical way the shortage of specific infrastructure in the lagging regions[15]; (3) the issue of social infrastructure may also be incorporated to investigate its impact on regional disparity, (4) the possibility of private initiative in selected infrastructure (e g, ports as a sub-sector of transport) should also be searched out, given the rising budget deficits of the government, (5) states' own contribution towards development should also be taken into account in the plan outlay.

Notes

[We are indebted to by A K Bagchi and S Marjit for the motivation and some crucial insights. We also grategully acknowledge D Coondoo, M Pal, A Majumder, C Neogi and K Chattopadhyay for their valuable suggestions. But the usual disclaimer applies.]

1 Beyond the conventional wisdom in economics, the role of defence as a stimulant to economic progress is not incorporated in contemporary studies.

2 This does not mean that de-ruralisation is the ultimate goal of economic progress. There is in fact no conflict in creating infrastructural facilities in rural areas even with developed agricultural practices such as the case of Punjab.

3 The absence of these facilities would ultimately lead to have 'lower productive efficiency' of the population in the concerned regions.

4 Capital movements also tend to have similar effect of increasing inequality. The lack of expansionary effects in the lagging regions siphon off the savings to the richer and more progressive regions where both demand for and returns to capital are high and secure due to various external economics. Social institutions including banking add to this process of cumulative causations.

5 The most obvious and less 'risky' approach is to endow the backward regions with a good system of transportation, effective power stations, and other SOC facilities as are available in the developed regions.

6 The convergence theorists have done their experimentation on the advanced economies, and not on the complex imperfect and capital-poor LDCs.

7 It may be mentioned here that some studies which may be categorically divided into micro-economic and macro-economic approaches to infrastructure have very important policy implications relating to structural adjustment as well as industrial organisation.

8 Some of the recent works in this area are Aschauer (1989), Shah (1992), Costa et al (1987), Romer (1986) and Lucas (1988). On

the other hand, Looney and Frederiksen (1981) and Mera (1973) deal directly with the impact of infrastructure proper on regional growth differentials. On a quite different plane in the context of new trade theory, the most influential works in recent period are Krugman (1979, 1991a, 1991b) and Porter (1990).

9 CPIAL is not available for all the states. We have used the value of CPIAL of a given state for those adjacent states for which it is not constructed, and hence not available in government sources. We have even preferred this type of replacement rather than WPI or CPI for industrial workers, because (1) agriculture still accounts for the largest share of income, and (2) there is no other acceptable regional deflator.

10 Although most of the major states were formed around 1950 as a result of the States Reorganisation Act 1956, most of the states had been further reorganised during the later period, and also some states have been formed much later.

11 In its Profile of states, March 1997, CMIE has accorded weights to physical and social infrastructure facilities in the following order: Transport = 26 per cent, Energy = 24 per cent, Irrigation = 20 per cent, Banking = 12 per cent, Communication = 6 per cent, Education = 6 per cent and Health = 6 per cent. Naturally, the weights used by us cannot be strictly compared with CMIE, because we have used the physical infrastructures only, and the weights are derived from PCA.

12 See Fruchter (1967).

13 The PCA is done by using BMDP. The first principal component alone explains about 59 per cent and 62 per cent of the total variance in 1971-72 and 1994-95 respectively. The eigen vector corresponding to each factor is derived from the formula:

$$\text{Eigen Vector} = \text{Factor Loading} / \sqrt{\text{Eigen Value}}.$$

14 Their share in national population has increased from 3.57 per cent (1971) to 3.77 per cent (1995). But their share in NSDP, agriculture, manufacturing value added, employment and fixed capital has fallen respectively in the following proportions: 2.51 to 2.42, 3.70 to 3.50, 2.00 to 1.01, 2.06 to 1.47 and 1.99 to 0.74.

15 One such digression may be that the absence of adequate port facilities (which is a most important sub sector of transport) and lack of proper logistics chain in external trade in India are primarily responsible for low export-initiative on the part of Indian producers [Ghosh and De 1997a, 1997b, 1998]. In a very recent study, Ghosh and Mukherjee (1998) has shown that lack of agro infrastructure is largely responsible for the inability of the farmers to realise the gains from higher productivity and lower price in case of some selected crops in West Bengal. Infrastructural facilities as bottlenecks for economic development (particularly export-led growth) is very common to all the South Asian countries (SAARC) [De and Ghosh 1998].

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