Regional Disparities in India's Industrial Development: Discriminant Function Approach

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This paper examines the extent and magnitude of regional disparities in the industrial economy from 1980-81 (pre-reforms) to 2009-10 (post-reforms) using discriminant function approach. Results indicated that huge disparities in industrial development still exist. Inclusion of some states in the list of developed ones in the recent past hints at amiable conditions for the industrialization of any state in the country provided state governments frame proper industrial policies. Further, productivity measures along with the physical measures turned out to be the factors responsible for regional imbalances during post reforms period instead of productivity and profitability measures during the pre-reforms period.

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Introduction

Disparities among different regions or world nations have become a concern to policy makers in most of the countries. As far as India is concerned, regional disparities are inheritance from the colonial past. During the pre-independence period, economic policies of the government were designed to protect the interests of the British economy rather than for advancing the welfare of Indians. It is widely acknowledged that lop-sided government policies led to the decline and decay of India's traditional industries. In the pre-Independence period, due to vested interests of the policy measures big provinces developed around the port towns of Bombay, Madras and Calcutta which eventually turned out to be the most industrially advanced states of contemporary India. On the other hand, many states that possess rich stocks of mineral resources like Bihar, Madhya Pardesh and Orissa experienced stumpy or inconsistent economic growth. The trickling down effects of development of some regions of the union to hinterlands had also not been effective as had been the case in developed countries. Also, the centralized planning that started in 1951

could not yield any significant dispersal of economic activities from the developed to the less or underdeveloped regions of the country. The first two five year plans that laid much stress on increased production or equitable distribution of resources virtually ended up in an effort to break the stagnation in the country. Accordingly, in the process of completing the projects for which the groundwork was already done in the pre planning period or the projects that could be completed in the short span of time, allocation of outlays were made towards those states which had a capacity to spend and achieve the targets. Thus, it practically led to higher inequalities in the development of different regions (Lipton, 1977). In the Third Five Year Plan (1961-66) the concept of balanced development of different parts of the country was taken up and a push was given to spread industries more widely. Several industrialization inducing measures like the establishment of public sector projects in industrially less developed states, prohibiting heavy industries from locating in already industrially developed areas, introduction of special packages for development of industrial infrastructure in poorer states and special financial benefits for industrial development in backward areas along with setting up industrial parks in areas with potential were introduced. It resulted in the spread of industries to many other cities beyond original leaders in the pre-reforms period. However, during the post reforms period inequalities in terms of industrialization tend to widen (Bhattachaharya & Sakthivel, 2004). Awasthi (1991), Chakravorty and Lall (2007) etc. pointed out that interstate disparities amplified during the post-reforms period. Arora and Singh (2012) exploring the fact further found that during the post-reforms period industrial variables followed by infrastructural variables turned out to be the important ones explaining the interstate variations in India. Increasing inequalities in terms of industries also got a mileage from the viewpoint of the advocates of convergence theorem (Barro & Salai-i-Martin, 1992; 1995). They postulated that industrial development followed by general economic development facilitates some regions with better resources to grow faster than the others initially. Subsequently, when the law of diminishing marginal returns sets in, in the industrialized regions due to differential marginal productivity of capital, it trims down the gap in the levels of income across regions. Same seems to be replicated in the context of post economic reforms India. Removal of controls from investment resulted in the attraction of investment by the regions having better infrastructure (Bhattachaharya & Sakthivel, 2004), thus, resulting into greater regional inequalities in the recent past as backward regions that used to get resources from the Central Government through gifts and grants are almost denied the same owing to financial constriction. Accordingly, states like Uttar Pardesh, Bihar and Rajasthan failed to foster in terms of industrialization.

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Industrial development overtime has perpetuated regional inequalities in the industrial scenario of the country. The present study empirically attempts to identify the developed and underdeveloped states of the economy overtime. Also, it aims to examine the factors that are highly responsible for creating these inequalities.

Database & Methodology

In order to fulfill the above mentioned objectives secondary data related to number of factories, workers, employees, fixed capital, invested capital, wages, emoluments, total output, profits, net value added, gross value added, population, and area has been obtained from the Annual Survey of Industries, Handbook of Statistics of Indian Economy, National Account Statistics and Report of Centre for Monitoring Indian Economy for the years 1980-81, 190-91, 2001-02 (data for the year 2000-01 could not be obtained despite best efforts) and 2009-10. Fifteen structural and technical ratios have been analyzed to facilitate comparison. Primarily, the ratios have been formed keeping in view the physical, productivity, profitability and efficiency parameters.

1.	Factories per thousand of population	(X1)	Physical ratio
2.	Factories per thousand square km of area	(X2)	Physical ratio
3.	Invested capital per thousand of population	(X3)	Physical ratio
4.	Invested capital per thousand square km of area	(X4)	Physical ratio
5.	Wages per thousand of population	(X5)	Physical ratio
6.	Total emoluments per thousand population	(X6)	Physical ratio
7.	Employment per thousand population	(X7)	Productivity ratio
8.	Gross value added per thousand population	(X8)	Productivity ratio
9.	Net value added per thousand population	(X9)	Productivity ratio
10.	Gross value added per thousand of invested capital	(X10)	Productivity ratio
11.	Net value added per thousand of invested capital	(X11)	Productivity ratio
12.	Profits per thousand of invested capital	(X12)	ProfitabilitY ratio
13.	Profits per thousand of net value added	(X13)	Profitability ratio
14.	Output per unit of invested capital (in 000)	(X14)	Efficiency ratio
	Invested capital to factories (in 000)	(X15)	Physical ratio

Variables chosen for analysis are converted into standard comparable units in order to minimize the chances of biasness. Method adopted to standardize the variables is:

$$x_{ij} = \frac{X_{ij}}{\delta} \times 100$$

Here, x_{ij} is the scale free observation, X_{ij} is the original observation and ó is the standard deviation. The transformed series will have a standard deviation of unity. For each indicator the standardized values were calculated. To determine the level of industrial development, mean value of 15 indicators was calculated. One indicator for one state may be at the top and in another state can be at the bottom. Therefore, for each indicator overall standard indicator was calculated. For determining the level of industrial development, mean value of 15 indicators was calculated. Further, in order to distinguish between two sets of

states i.e. developed and underdeveloped discriminant analysis is used. Discriminant function facilitates the possibility to measure the effect of one variable keeping other variables constant. The discriminant function used for the analysis is as follows:

$$Z = \sum_{i=1}^{n} LiXi$$

Where, Z = total discriminant score for the two groups

Xi = (i = 1, 2, 3……n) are the variables used

Li = coefficients of the linear discriminant function

Two sets of states, group I (developed states) and group II (underdeveloped states), are calculated using Z scores wherein:

$$Z1 = \sum Li\,\overline{X1}i \qquad \text{(for group 1)}$$

$$Z2 = \sum Li\,\overline{X2}i \qquad \text{(for group 2)}$$

The cutoff point or discriminatory point Z for classifying individuals in two groups is calculated as:

$$Zc = \frac{Z1 + Z2}{2}$$

For the individual states, Z value can be calculated by:

$$Zi = \frac{X - \overline{X}}{\delta}$$

If the individual Z value is mote than the cut off z score, the individual is classified into group I and when it is less than the cut off Z score, the individual is put under group II.

Analysis &Interpretation

Table 1 shows the added values of all the standardized indicators for each state for different years based on which the mean values are computed. Further, the states having value greater than the mean are assigned number 1 while those having values less than the mean are rated as 2. To study the overall level of development discriminant analysis is used.

Value addition at the factory level is the most important discriminator between the high performing and low performing states.

From the results of discriminant analysis (Table 2), it clearly follows that during 1980-81, invested capital and gross value added per unit of population are the two important variables that contributed in the process of development. But over the next one decade i.e. till the year 1990-91 their significance had gone down. Gross value added per unit of invested capital (18.48 percent) replaced the formerly prominent major factor. Further, by the year 2001-02, two variables, gross value added along with net value added per unit of population emerged as important variables contributing immensely in the development process. It clearly demonstrates that value addition at the factory level is the most important discriminator between the high perform-

Table 1 Sum Values of Standardized Indicators for Each State in Different Years

	1980-81	Cate-gory	1990-91	Cate-gory	2001-02	Cate-gory	2009-10	Cate-gory
Andhra Pradesh	1076.09	2	1024.53	2	988.4	1	785.03	1
Assam	767.36	2	448.81	2	324.35	2	265.18	2
Bihar	870.74	2	769.04	2	72.39	2	67.07	2
Chhattisgarh	DNE	-	DNE	-	739.13	2	530.27	2
Delhi	2494.65	1	1711.59	1	1056.73	1	486.68	2
Gujarat	2135.86	1	1774.91	1	2033.93	1	1541.54	1
Haryana	1859.3	1	1656.13	1	1736.58	1	1481.59	1
Himachal Pradesh	880.7	2	1024.46	2	899.65	2	1556.7	1
Jammu & Kashmir	495.63	2	174.99	2	179.8	2	251.63	2
Jharkhand	DNE	-	DNE	-	992.95	1	500.52	2
Karnataka	1256.97	2	986.19	2	1110.24	1	874.65	1
Kerala	1322.47	2	827.23	2	869.98	2	557.51	2
Madhya Pradesh	857.14	2	707.84	2	482.67	2	269.16	2
Maharashtra	2580.62	1	2206.86	1	1710.77	1	1107.96	1
Orissa	746.99	2	612.58	2	426.63	2	499.36	2
Punjab	1647.86	1	1838.8	1	1430.7	1	1119.65	1
Rajasthan	804.75	2	596.93	2	499.2	2	378.71	2
Tamil Nadu	1809.3	1	1732.38	1	1671.92	1	1614.33	1
Uttar Pradesh	745.56	2	625.82	2	513.78	2	373.96	2
Uttrakhand	DNE	-	DNE	-	666.2	2	1602.14	1
West Bengal	1964.94	1	1045.6	2	743.15	2	421.09	2
Mean	1350.94		1098.03		911.86		775.46	

Note: (1) DNE stands for state 'did not exist'
(2) 1 represents the developed state where as 2 represents under developed state

Source: Authors calculations from the data compiled from Annual Survey of Industries, Handbook of Statistics of Indian Economy, and Report of Centre for Monitoring Indian Economy

ing and low performing states. Besides value added, in the recent past i.e. year 2009-10, total emoluments per unit of population has also appeared to be an important contributory factor in the process of development. Its importance has increased from 5.82 percent in 1980-81 to 17.23 percent in the year 2009-10. It reflects the fact that when emoluments are high, it acts as a pull factor in attracting talent that impels better performance. Similarly, net value added per unit of invested capital i.e. the productivity of capital has also turned out to be the significant factor in discriminating the two sets of high and low performing states in recent times. Two indicators associated with effective engagement of human resources in jobs i.e. emoluments and employment per unit of population together contributed more than 26 percent (2009-10) of discriminating coefficient between the two sets of states. The contribution of profits per unit of invested capital contributed 7.5 percent (2009-10) to the discriminating power.

Unambiguously, the factor that consistently figured among the prominent ones in discriminating the two sets of

Table 2 Contribution of Different Variables in Development (in percent)

Factor	1980-81	1990-91	2001-02	2009-10
X1	6.74	7.28	8.63	0.60
X2	8.87	5.38	3.33	5.48
X3	16.71	11.37	5.69	3.65
X4	7.38	7.77	0.49	4.93
X5	9.40	2.38	6.36	3.50
X6	5.82	8.05	0.22	17.23
X7	0.29	3.66	9.94	9.02
X8	15.48	11.41	35.52	6.99
X9	0.001	0.001	26.14	0.001
X10	0.90	18.48	2.29	22.48
X11	1.09	5.02	0.00	14.37
X12	14.76	1.19	0.04	7.54
X13	12.56	8.71	1.32	0.001
X14	0.001	7.50	0.001	0.83
X15	0.001	1.81	0.001	3.37
Total	100.00	100.00	100.00	100.00

Source: Same as table 1

states throughout the years taken for this analysis is the gross value added per unit of population. Though its value has gone down in the year 2009-10, it has been replaced by a different productivity measure i.e. gross value added per unit of invested capital. Another factor i.e. factories per unit of population remained as a significant factor during 1980-81, 1990-91 and 2001-02. However, during 2009-10, its share went down, might be due to the widespread dispersal of industries in physical terms as measured by population. But, in terms of area, the factories have not dispersed as uniformly as in case of population. It may be attributed to the fact that the uninhabited areas do not attract factories despite all the policy initiatives taken by the governments. On the input side of industrial development, invested capital, profits, output and number of factories have less discriminating power but the emoluments and employment indicators have shown a relatively higher discriminating power between the two sets of states. It calls for better emoluments and efficiency of capital as the key determinants of promoting industrial development in less developed states. As far as the least important factors are concerned, it can be concluded that net value added per unit of population, output per unit of invested capital and invested capital per factory turned out to be the three indicators whose relative importance in the process of development remained quite low in the time period studied.

Uninhabited areas do not attract factories despite all the policy initiatives taken by the governments.

On the basis of the discriminant function, two sets of states i.e. developed and underdeveloped have been classified as given in Tables 3, 4 and 5. Z scores for the developed states were calculated and given in Table 3. It is evident from the table that during 1980-81 seven states i.e. Maharashtra, Delhi, Gujarat, West Bengal, Haryana, Tamil Nadu and Punjab could find themselves into the category of developed states. Further, Z score for all the developed states was more than double the cutoff point. Similarly, from Table 4 it can be brought out that as many as 11 states were trapped in the list of un-

derdeveloped states. Among the less developed states Jammu and Kashmir, Uttar Pardesh and Orissa topped the list.

The discriminant function that emerged for the two groups of states for the year 1980-81 was

$$Z = - 2.653 - 0.067X_1 + 0.119X_2 + 0.086X_3 - 0.054X_4 + 0.044X_5 - 0.027X_6 - 0.002X_7 - 0.080X_8 + 0.012X_{10} - 0.012X_{11} + 9.715X_{12} - 74.093X_{13}$$

Table 3 Z Score for Developed States

1980-81		1990-91		2001-02		2009-10	
Maharashtra	1.88	Maharashtra	1.92	Gujarat	2.06	Tamil Nadu	1.61
Delhi	1.75	Punjab	1.28	Haryana	1.51	Uttaranchal	1.59
Gujarat	1.22	Gujarat	1.17	Maharashtra	1.46	Himachal Pradesh	1.50
West Bengal	0.94	Tamil Nadu	1.10	Tamil Nadu	1.39	Gujarat	1.47
Haryana	0.78	Delhi	1.06	Punjab	0.95	Haryana	1.36
Tamil Nadu	0.70	Haryana	0.97	Karnataka	0.36	Punjab	0.66
Punjab	0.45			Delhi	0.27	Maharashtra	0.64
				Jharkhand	0.15	Karnataka	0.19
				Andhra Pradesh	0.14		

Source: Same as table 1

The discriminant function obtained for the year 1990-91 is:

$$Z = - 17.894 + 0.073X_1 - 0.162X_2 + 0.071X_3 + 0.1X_4 + 0.013X_5 - 0.042X_6 - 0.023X_7 - 0.056X_8 + 271.39X_{10} + 513.54X_{11} - 0.080X_{12} - 0.726X_{13} - 20.346X_{14} + 88.396X_{15}$$

Twenty one states were considered for analysis in the year 2001-02. It owes to the addition of three new demerged states i.e. Chhattisgarh, Jharkhand and Uttaranchal along with the previousl 18 states for the analysis. Results for the year 2001-02 show that as many as 9 states figured in the list of developed states. These states comprised Gujarat, Haryana, Maharashtra, Tamil Nadu, Punjab, Karnataka, Delhi, Jharkhand and Andhra Pradesh. So far the underdeveloped states are concerned (Table 4), overall 12 states figured in the list with Bihar, Jammu and Kashmir and Assam being the most underdeveloped. Even the liberalization regime of the Indian economy failed to turn the fate of the majority of non performing states. Only two states i.e. Karnataka and Andhra Pradesh could locate a place in the list of developed states in the post liberalization regime (2001-02).

For the year 1990-91, six out of seven states (except West Bengal) identified as developed states in the year 1980-81 continued to be the developed states. Maharashtra and Gujarat continued to be at the first and third slots. Second slot that was bagged by Delhi in the year 1980-81 was replaced by Punjab in 1990-91. As far as underdeveloped states are concerned (Table 4), 12 states figured in the list with Jammu and Kashmir, Assam and Rajasthan as the top among the laggard states.

The discriminant function obtained for the year 2001-02 is:

$$Z = + 1.956 - 0.043X_1 + 0.121X_2 - 0.025X_3 - 0.004X_4 - 0.022X_5 - 0.001X_6 + 0.038X_7 + 0.128X_8 - 0.096X_9 - 0.520X_{10} + 0.004X_{12} - 0.093X_{13}$$

For the year 2009-10 eight states figured in the list of developed states. These states are Tamil Nadu, Uttaranchal, Himachal Pradesh, Gujarat, Haryana, Punjab, Maharashtra and Karnataka. The inclusion of states like Uttaranchal and Himachal Pradesh in the list of developed states demonstrates that the conditions are congenial for any state for industrial development in the union provided the governments frame proper industrial policies. So far as the underdeveloped states are concerned (Table 4), overall 12 states figured in the list with once again Bihar, Jammu and Kashmir and Assam being the most underdeveloped. Interestingly, three states i.e. Delhi, Jharkhand and Andhra Pradesh that occupied the positions in the developed states in the year 1990-91 though marginally, were weeded out and placed in the list of underdeveloped states in the year 20019-10. It clearly shows that during the liberalization regime if any state government fails to chalk out proper industrial policy that can tap the opportunities prevailing in the market can land the state up in the category of underdeveloped states.

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Table 4 Z Score for Under-developed States

1980-81		1990-91		2001-02		2009-10	
Jammu & Kashmir	-1.31	Jammu & Kashmir	-1.60	Bihar	-1.54	Bihar	-1.36
Uttar Pradesh	-0.93	Assam	-1.12	Jammu & Kashmir	-1.34	Jammu & Kashmir	-1.01
Orissa	-0.92	Rajasthan	-0.87	Assam	-1.08	Assam	-0.98
Assam	-0.89	Orissa	-0.84	Orissa	-0.89	Madhya Pradesh	-0.97
Rajasthan	-0.84	Uttar Pradesh	-0.82	Madhya Pradesh	-0.79	Uttar Pradesh	-0.77
Madhya Pradesh	-0.76	Madhya Pradesh	-0.68	Rajasthan	-0.76	Rajasthan	-0.76
Bihar	-0.74	Bihar	-0.57	Uttar Pradesh	-0.73	West Bengal	-0.68
Himachal Pradesh	-0.72	Kerala	-0.47	Uttaranchal	-0.45	Delhi	-0.56
Andhra Pradesh	-0.42	Karnataka	-0.19	Chhattisgarh	-0.32	Orissa	-0.53
Karnataka	-0.15	Himachal Pradesh	-0.13	West Bengal	-0.31	Jharkhand	-0.53
Kerala	-0.04	Andhra Pradesh	-0.13	Kerala	-0.08	Chhattisgarh	-0.47
		West Bengal	-0.09	Himachal Pradesh	-0.02	Kerala	-0.42
						Andhra Pradesh	0.02

Source: Same as Table 1

The discriminant function obtained for the year 2009-10 is:

$$Z = - 15.001 - 0.005X_1 - 0.317X_2 - 0.032X_3 + 0.093X_4 - 0.024X_5 - 0.115X_6 + 0.060X_7 + 0.062X_8 + 14.447X_{10} - 17.399_{11} - 6.875X_{12} + 0.208X_{14} + 1.047_{15}$$

It becomes clear from Table 5 that during 1980-81 our analysis could correctly predict 72.2 percent

states while during 1990-91our classification as compared to actual data is 100percent correct. Similarly for the years 2001-02 and 2009-10, the results show that 71 percent and 91 percent of the states have been correctly classified as developed or underdeveloped. Cut off points for the years 1980-81, 1990-91, 2001-02 and 2009-10 stands at 0.222, 0.852, 0.118 and 0.198 respectively.

Table 5 Classification of States on the Basis of Discriminant Analysis

Year	Developed States	Underdeveloped States	Cutoff Point	Percent Correct
1980-81	1.221	-0.777	0.222	72.2
1990-91	3.410	-1.705	0.852	100
2001-02	0.951	-0.713	0.118	71
2009-10	1.588	-1.191	0.198	90.5

Source: Same as table 1

From the discussion, it can be drawn that industrialization in India so far has hovered around only a few states i.e. Gujarat, Maharashtra, Tamil Nadu, Haryana, Punjab, Delhi and Karnataka. On the other hand, states like Bihar, Jammu and Kashmir, Rajasthan, Orissa, Assam, Madhya Pardesh and Uttar Pardesh have continuously been dominating in the list of underdeveloped states.

Conclusions & Policy Implications

Regional disparities in terms of industrialization have been an object of concern to numerous scholars but it has drawn the attention of those who are interested in the process of economic development and its management. Recently held studies pointed out that in the post reform Indian economy, regional imbalances in terms of industrialization have widened. Our results indicated that there are huge disparities in terms of industrial development. Few states like Gujarat, Maharashtra, Tamil Nadu, Haryana, Punjab, Delhi and Karnataka dominated the list of developed states whereas states like Bihar, Jammu and Kashmir, Rajasthan, Orissa, Assam, Madhya Pradesh and Uttar Pradesh have continuously been figuring in the list of underdeveloped states. Inclusion of states like Uttaranchal and Himachal Pradesh in the list of developed states in the recent past hints at congenial conditions for the industrialization of any state in the economy provided the state governments frame proper industrial policies. As regards the factors that are responsible for creating interstate variations, it has come to light that in general the factors related to productivity and profitability measures mostly contributed to the interstate disparities in the pre-reforms period whereas productivity measures along with the physical measures are responsible for regional imbalances during the post reforms period. After making a modest attempt to systematically find out the developed and underdeveloped states of the union overtime and the factors responsible for creating this disparity, there is a need to deliberate on the policy interventions required for reducing this gulf.

Since disparities among Indian states have existed since long, it calls for a micro level or area based planning rather than macro level based planning. There is a growing tendency among the entrepreneurs to establish the industrial units in large cities owing to the economies of scale. This needs to be changed by the pro-active participation of the state governments which can direct the setting up of 'centers of growth' in backward areas or regions. For this proposition to be a reality, all the necessary logistics need to be provided by the respective state governments. It will have a manifold effect. On one hand where, unemployed youth or disguised labor in agriculture will get the gainful employment opportunities, it will foster rural development and offer a chance to improve the standard of living of the people.

Despite allocations from the Central Government, local leadership fails to provide the requisite results. Thus, the allocation of funds alone cannot help solve the problem, in reality it calls for the adept execution of the scarce funds also. Keeping in view the mass corruption at different levels in the economy, efficient implementation of resources can be made only by decentralizing the powers into the hands of local bodies. The flow of money for investment should flow from centre to states, states to districts, districts to blocks and from blocks to the local bodies. Only with the judicious and transparent use of resources can we ensure that the funds allotted for development of backward areas are optimally utilized.

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