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AVAILABILITY OF INFRASTRUCTURAL FACILITIES AND ITS IMPACT ON ECONOMIC GROWTH IN INDIA

Flora Pandya[1]
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Abstract

In this paper, we analyse the availability of infrastructural facilities across the Indian States and Union Territories through Infrastructure index. In Literature, the impact of infrastructure on economic growth and development is positive and highly significant. On the basis of literature, the paper tries to find out the relationship between availability of infrastructure and PCNSDP using OLS regression model in various States and Union Territories. The result indicates that there exists inter-state disparity in availability of infrastructural facilities in Indian States and Union Territories. There exists a significant positive relationship between Infrastructure Index and PCNSDP.

***Key Words*:** Infrastructure Index (INFRAINDEX), Physical Infrastructure Development Index (PIDI), Social Infrastructure Development Index (SIDI), PCNSDP, Economic Growth**.**

***JEL Code (s)*:** O18

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1. INTRODUCTION:

Infrastructure plays a vital role in Economic Growth and Development of a country. American Heritage Dictionary Editors (2002) defines the term "infrastructure" as the basic facilities, services and installations needed for the functioning of a community or society such as transportation and communications systems, water and power lines and public institutions including schools, post offices and prisons. "If the nation aspires to attain maturity in economic growth, it must give a big-push to the upliftment of the network of physical infrastructure like energy, transport, communication, irrigation and social infrastructure including education, health, sanitation, water supply and environment, *etc*." Infrastructure can be classified into two major types: 'Economic Infrastructure' and 'Social Infrastructure'. Economic infrastructure is defined as the infrastructure that promotes economic activity, such as Roads, Highways, Railroads, Airports, Sea Ports, Electricity, Telecommunications, Water Supply and Sanitation whereas Social infrastructure such as Schools, Libraries, Universities, Clinics, Hospitals, Courts, Museum, Parks. It is defined as the infrastructure that promotes the health, education and cultural standard of the population- activities that have both direct and indirect impact on the welfare. According to the Schultz, "expenditure on education and health contributes to increase the labor productivity". Investment in social infrastructure was more emphasized because it contributes human capital formation and development. "Investment in health and education are complementary because the skill formation through education can be effectively utilized through maintenance of health and a longer life span". All types of infrastructure are equally important as social infrastructure is necessary for the education sector as many of the rural schools and colleges still lack the proper and adequate infrastructure which has an indirect relation with the development of the individual and skilled manpower. Proper health services in the economy lead to healthy workforce and improve efficiency at workplaces indirectly contribute to the growth of the economy.

According to the World Development Report (1994), "Productivity growth is higher in countries with an adequate and efficient supply of infrastructure services.

Provision of infrastructure services to meet the demands of business, households and other users is one of the major challenges of the economic development. The report also points out that adequate and good quality of infrastructure is a crucial factor in attracting foreign investments". The Global Competitiveness Report 2010-2011 of the 2010 World Economic Forum uses 12 determinants *i.e*. "Pillars" to measure competitiveness and one of the pillar is Infrastructure. The report emphasis on the need of infrastructure for effective functioning of the economy, as it is important factor in determining the location of the economic activity. A country's development is linked to its infrastructural facilities and its ability to expand trade, cope with population growth and reduce poverty. Infrastructure is an input to production and raises the productivity of other factors. Infrastructure connects goods to the markets, workers to the industry, professional to the services and the poorer in rural areas migrate to urban commercial business centre. Millennium Development Goals (MDG's) of United Nations (UN) emphasized the role of infrastructure in reducing poverty has been recognized by increasing the access to water supply, health and educational services which helps in narrowing the gap between rich and poor. Hence the infrastructure is a determinant of growth and development of a country. The various literature discusses the growth model incorporating the infrastructure and a debate issue as there are externalities associated with infrastructure being positive with growth or the negative is questionable so it is important to study growth with infrastructure into Indian context.

This paper is organised as follows section 2 is review of literature. Section 3 discusses the data and methodology and analysis of results. Section 4 provides conclusions of the study.

2. LITERATURE REVIEW:

Infrastructure has both direct and indirect effect. Direct effect on the productive activities to increase the aggregate output and indirect effect which further enhances the human and labour productivity, reduces the cost and economies of scale in the production. Hirschman (1958) theory of unbalanced growth stresses on the need of

investment in strategic sectors than all other sectors simultaneously. The role of social overhead capital (SOC) is important not because of direct impact on productive activities but also indirect impact on directly productive activities (DPA). The SOC comprises those basic services without which primary, secondary and tertiary cannot function. The investment in these projects creates more economies and is called divergent series of investment. Since the SOC and DPA cannot be done simultaneously in less developed countries. Growth of SOC simulates the investment in DPA or Investment in DPA influences investment in SOC. Further Hansen (1965) emphasized the role of public investment in economic development, divides public infrastructure into two categories: economic overhead capital (EOC) and social overhead capital. EOC is oriented primarily towards the direct support of productive activities or toward the movement of economic goods. SOC is designed to enhance human capital and consists of social services such as education, public health services, fire and police protection and homes for the aged.

Frederiksen (1985) analysed the regional economic development using the regression. His finding concludes that electrification plays a very important role in economic development. The paper examined the role of one type of infrastructure investment – electrification on income levels in Philippines. He regresses population, area and electrification on income levels. His finding concludes that electrification plays a very important role in economic development.

Aschauer (1990) raised a very important question in his paper that "why infrastructure is important?" as it also increases the public expenditure of the country and thus increases fiscal deficit but some of the public expenditure are necessary for the growth and development of the country. So infrastructure can be considered as a merit good which enhances the productivity, growth and also human capital through health and education. He mentioned the work of Terleckyi (1975) his approach involved the consideration of various policy actions and their ultimate impact on social concerns, public health, public safety and education. Further terleckyi pointed out that past investment in infrastructure has improved overall quality of life in terms of health, safety, economic opportunity but the future we need an infrastructure with a cleaner

environment, with safer urban streets with increased mobility and economic opportunity for the disadvantaged. Such type of infrastructure would be more productive

Ghosh and De (1998) studies the role of infrastructure in regional development. The paper contributes to the literature in relation to infrastructure and growth. The physical infrastructure has been found highly significant and positive relation to both private investment behaviour and regional economic development. The methodology adopted in this paper over the plan periods is using the OLS regression and the physical infrastructure development is developed using principal component analysis. The paper also concludes that rising income disparity among the states is due to the regional imbalance in physical infrastructure.

Majumder (2003) study includes all the district of 15 major Indian states. The 379 districts are included as observation. The variables used to measure the infrastructure index are agriculture infrastructure, transport infrastructure, financial infrastructure, educational infrastructure and health infrastructure using principal component analysis. The paper concludes that there exists variation in the levels of infrastructure level which has decreased over time. The paper concludes that there is a need for proper identification of projects, quick completion, profitable management of services can increase the efficient infrastructure and can fulfil the balanced regional economic development.

De and Ghosh (2005) analysed the effects of infrastructure on regional income in South Asian association for Regional cooperation (SAARC) countries. He pointed out that improved transport infrastructure not only help to reduce transaction cost but also to generate higher trade and market access in member countries. The study comprises of 11 infrastructure variables across the period 1971-2002. The methodology used in the paper to construct the index and for relationship with infrastructure and income OLS regression is used. The paper concludes the statistical significant positive relationship between infrastructure and income.

Raychaudhuri, Haldar (2009) studies the inter-district disparity in West Bengal from 1991-2005. The paper includes 17 districts of West Bengal and studies the disparity in relation to physical and social infrastructure. The methodology in the paper used is Gini coefficient, Theil's index, Atkinson's index to measure the inequality. The paper concludes that physical infrastructure plays an important in facilitating output and social infrastructure helps to build human capital. Hence physical infrastructure has a greater influence on income distribution in West Bengal.

Snieska and Simkunaite (2009) analyse the theoretical and practical results for infrastructure investment on socio-economic development in Baltic States, Latvia and Estonia for the period of 1995-2007.The variables used for infrastructure are regressed on GDP. The results in Lithuania shows that only paved road length had a positive relationship with GDP, while telephone lines, water supply and drainage had a negative relationship with GDP. Whereas in Latvia and Estonia paved roads and telephone lines had positive relationship with GDP and water supply and drainage have negative relationship with GDP.

Raychaudhuri and De (2010) analysis on study of Trade, Infrastructure and Income Inequality tries to find out the inter-linkages between them using panel data of 14 Asian Pacific countries over 1975 to 2006. The paper not only tries to link infrastructure and growth but also the role of infrastructure in inclusive growth in terms of access and affordability by the poor. The study also reveals that infrastructure development helps in poverty reduction. His finding shows that level of inequality increases with trade openness and improvement in infrastructure stocks and development in infrastructure quality leads to fall in inequality.

Patra and Acharya (2011) paper try to show regional disparities in infrastructural facilities. The analysis was carried out in 16 major Indian states showing disparities in Indian states using composite infrastructure development index. The effect of infrastructural variables on growth is observed using correlation matrix and path

regression analysis. The study shows a positive relationship on infrastructure and growth and negative relationship on infrastructure and poverty

Bhandari (2012) analyse the performance of Indian states in mainly 3 major sectors health, education and infrastructure. The paper constructed each sector index using principal component analysis. The focus of the study is on the performance of each sector in each state. The result shows that among BIMARU states Orissa, Bihar and Chhattisgarh are among the best performer while the Uttarakhand, Rajasthan and Jharkhand are amongst worst.

Haider, Amjad, Ullah, Naveed (2012) study supported the empirical literature of the relation between infrastructure and growth in Pakistan. He analysed a time series data from the year 1972 to 2009. The variables which are included in the analysis as a proxy to measure infrastructure are gross fixed capital formation (GFCF), per capita health expenditure (PCHE), and total generation of electricity (TGE) as independent variables. These variables are regressed on gross domestic product (GDP) using OLS regression to find the short - run relationship between infrastructure and growth. The result indicates that an increase in 1% in GFCF cause 0.4375% increase in GDP and PCHE by 0.2688% and 0.0434% respectively. Results show the positive relationship and are statistically significant.

Bajar (2013) studies the 17 Indian states for the period of 1981 to 2010 to find out the nexus between per capita NSDP and infrastructure availability. Using the panel data estimation, it was realized that influence on output by physical infrastructure is not uniform for all periods. For the period 1980-89 found that electricity has a huge impact on output compare to transport sector and the number of school is not significant whereas health centres shows significance. In 1990-99 the contribution of transport infrastructure declined and was not significant. Even the health infrastructure shows insignificance relation to output. In this period the tele-density played a very important role in output generation. In period 2000-2010 electricity and tele-density both contributes well to the

output. The analysis was also done for the sector growth where electricity had a greater elasticity for secondary sector and tele-density had a greater elasticity in service sector.

The empirical studies have contributed to the positive relation between the infrastructure and economic growth. Infrastructure is one of the crucial factor which have hurdle the growth of Indian economy. The various studies have highlighted the disparity and regional inequality that persists in the Indian states. These studies are mostly confined to some of the major states of the India whereas we have analysed all states and union territories of India. The study includes the variables like physical and social infrastructure among which transportation, electricity and telecommunication are crucial in increasing the productivity in manufacturing and industries whereas health and education sectors are important to raise the human capital which can be raised by increasing the investment in merit goods. The study focuses on the disparity among the states which will add to policy implications that which states are lagged by infrastructural facilities and simultaneously hinders the growth of that region.

3. DATA METHODOLOGY AND ANALYSIS:

To construct the infrastructure index (INFRAINDEX) for period 2002-03 and 2009-10. We need to combine all variables which are used to measure the infrastructure. We divide the infrastructure into two main types as Economic overhead capital (EOC) and Social overhead capital (SOC). Economic overhead capital is mainly the physical infrastructure which includes roads, highways, railways, airports, seaports, electricity, telecommunication, water supply and sanitation. Social overhead capital is mainly the social infrastructure which includes schools, libraries, clinics, hospitals, banks, courts *etc*. We first construct physical infrastructure development index (PIDI) and social infrastructure development index (SIDI) with the help of principal component analysis (PCA) technique to calculate weights. The variables which are selected are used to measure the availability of infrastructure used to construct index PIDI, SIDI and INFRAINDEX (includes all variables) are as follows:

For physical infrastructure development index (PIDI)

- Total length of roads per thousand sq. km
- Total length of railway lines per thousand sq. km.
- Percentage of villages electrified.
- Tele-density per thousand populations.

For social infrastructure development index (SIDI)

- Total Number of recognized institutions (degree and above /colleges for both general education and professional education) per thousand populations.
- Number of Government Allopathic hospitals per thousand populations.
- Number of beds in Government hospitals per thousand populations.
- Number of branches of scheduled commercial banks per thousand populations.

The data sources from which the data have been collected are Ministry of Road Transport and Highways, Ministry of Railways, Ministry of Power (Central Electricity Authority),Ministry of Communication and Information Technology(Department of Telecommunication), Reserve Bank of India, Ministry of Human Resource Development, Ministry of Health and Family welfare(Central Bureau of Health Intelligence) and Central Statistical Organization (CSO).The PCA is also known for multivariate analysis which is also known as "Factor analysis". The PCA assigns the weights according to their relationship with the variables. Thus PCA is used to compute factor loadings and weights. Before using PCA the raw data needs to be converted into normalized form. So that the raw data becomes unit free and further can be used to make a composite index. Using the formula which is been used by UNDP for constructing human development index for normalizing the data. The dimension index formula is used across the States and UT for both the period 2002-03 and 2009-10. The value of each variable lies between 0 and 1 (which is notified as Xi).

Dimension index

Xi = Actual value – Minimum value / Maximum value – Minimum value.

Formulas to determine the index are as follows:

$$\mathbf{PIDI = \sum wiXi / \sum W} \quad \text{---------- (1)}$$

Where PIDI is the physical infrastructure index, ∑wiXi is the sum of multiplication of weights and Xi of each variable of physical infrastructure, ∑W is the total weight of physical infrastructure.

$$\mathbf{SIDI = \sum wiXi / \sum W} \quad \text{---------- (2)}$$

Where SIDI is the social infrastructure index, ∑wiXi is the sum of multiplication of weights and Xi of each variable of social infrastructure, ∑W is the total weight of social infrastructure.

$$\mathbf{INFRAINDEX = \sum wiXi / \sum W} \quad \text{---------- (3)}$$

Where INFRAINDEX is the infrastructure index (both physical and social), ∑wiXi is the sum of multiplication of weights and Xi of each variable of infrastructure, ∑W is the total weight of infrastructure.

We summarize the Table 1 infrastructure index in 3 tier, in first tier infrastructure availability is higher, second tier infrastructure availability is the medium and the third infrastructure availability is lowest. Thus States/ UT are categorized in these 3 tier according to their infrastructure index.

First-tier - In period 2002-03, the States/UT which are the highest in physical infrastructure development index are Delhi, Chandigarh, A and N Island, Puducherry, Kerala, Punjab, Tamil Nadu, Haryana and Goa. In period 2009-10 the states/UT are the highest in physical infrastructure development index are Chandigarh, Delhi, Kerala, West Bengal, Puducherry, Punjab, Haryana and Tamil Nadu among which West Bengal has significantly improved in physical infrastructure. In period 2002-03 the States/UT which are the highest n social infrastructure development index are Lakshadweep, Chandigarh, Goa, Puducherry, Arunachal Pradesh, Sikkim, A and N Island, Uttarakhand, Karnataka and Mizoram. In period 2009-10 the States/UT which are the highest n social infrastructure development index are Goa, Kerala, Puducherry, Chandigarh, Delhi,

Table 1: State-wise physical infrastructure index, social infrastructure index and overall infrastructure index.

	2002-03			2009-10		
STATES	**PIDI**	**SIDI**	**INFRAINDEX**	**PIDI**	**SIDI**	**INFRAINDEX**
Andhra Pradesh	0.27	0.33	0.31	0.27	0.25	0.28
Arunachal Pradesh	0.06	0.17	0.12	0.08	0.41	0.25
Assam	0.22	0.14	0.18	0.26	0.09	0.18
Bihar	0.18	0.09	0.13	0.19	0.08	0.14
Chhattisgarh	0.21	0.08	0.14	0.23	0.12	0.18
Goa	0.3	0.93	0.63	0.29	0.59	0.46
Gujarat	0.29	0.31	0.3	0.28	0.19	0.25
Haryana	0.31	0.14	0.22	0.31	0.22	0.27
Himachal Pradesh	0.24	0.31	0.28	0.25	0.3	0.28
Jammu and Kashmir	0.21	0.13	0.17	0.22	0.15	0.19
Jharkhand	0.05	0.05	0.05	0.06	0.06	0.06
Karnataka	0.26	0.28	0.28	0.27	0.31	0.3
Kerala	0.34	0.56	0.45	0.36	0.25	0.31
Madhya Pradesh	0.25	0.11	0.18	0.25	0.11	0.19
Maharashtra	0.27	0.3	0.29	0.24	0.21	0.23
Manipur	0.19	0.21	0.21	0.18	0.2	0.2
Meghalaya	0.01	0.18	0.1	0.09	0.23	0.17
Mizoram	0.22	0.32	0.28	0.16	0.3	0.24
Nagaland	0.24	0.24	0.25	0.13	0.26	0.21
Odisha	0.18	0.19	0.19	0.15	0.21	0.19
Punjab	0.33	0.22	0.28	0.33	0.2	0.28
Rajasthan	0.25	0.1	0.17	0.16	0.16	0.17
Sikkim	0.22	0.22	0.22	0.2	0.4	0.32
Tamil Nadu	0.31	0.19	0.25	0.3	0.19	0.26
Tripura	0.24	0.12	0.18	0.16	0.11	0.14
Uttarakhand	0.16	0.12	0.14	0.23	0.31	0.28
Uttar Pradesh	0.13	0.08	0.1	0.28	0.08	0.19
West Bengal	0.25	0.12	0.18	0.35	0.1	0.23
A and N Islands	0.4	0.32	0.35	0.29	0.37	0.32
Chandigarh	0.67	0.47	0.58	0.82	0.6	0.73
D and N Haveli	0.24	0.03	0.12	0.24	0.11	0.18
Daman and Diu	0.25	0.24	0.25	0.24	0.19	0.22
Delhi	0.82	0.37	0.58	0.82	0.28	0.55
Lakshadweep	0.29	0.32	0.3	0.3	0.89	0.62
Puducherry	0.35	0.56	0.47	0.35	0.54	0.47

FIRST TIER: 0.30 and above

SECOND TIER: 0.20 to 0.29

THIRD TIER: 0.19 and below

Andhra Pradesh, Mizoram, Lakshadweep, A and N Island, Himachal Pradesh and Gujarat among which Kerala, Delhi, Andhra Pradesh, Himachal Pradesh and Gujarat have significantly improved in social infrastructure. In period 2002-03 the states which are the highest in infrastructure index are Goa, Delhi, Chandigarh, Puducherry, Kerala, A and N Island and Andhra Pradesh. In period 2009-10 the states which are the highest in infrastructure index are Chandigarh, Lakshadweep, Delhi, Puducherry, Goa, A and N Island, Sikkim, Kerala and Karnataka. Comparatively in both the period states which are newly occupied in this tier are Sikkim and Karnataka showing the improvement in the overall index. Delhi being the capital of India is the second largest in terms of GSDP. Being a financial hub the service sector growth itself contributes to the 70 percent of the GDP. Delhi is also well known for the banking, media and tourism sector. Delhi has the highest number of road density and which connects to the major part of India via National highways. Haryana and Punjab are flourished since the green revolution has increased the productivity in wheat and agriculture. The transport system is well developed and well connected to the various cities of India. The Bhatinda railways junction is one of the largest in Asia. These both states are well integrated with the transportation system. Chandigarh is the capital of both the states Haryana and Punjab the city is more flourished in transportation and is the highest in vehicles per capita in India. Kerala is the best in social infrastructure because of the literacy ratio is highest in India. The importance of education in Kerala has increased the demand for better educational infrastructure. The Goa states is well known for the tourism and thus enhanced the need for the infrastructure. Puducherry contributes to the major road density among the Tamil Nadu state.

Second-tier–In period 2002-03 for physical infrastructure development index are Lakshadweep, Gujarat, Andhra Pradesh, Maharashtra, Karnataka, Daman and Diu, Rajasthan, West Bengal, Madhya Pradesh, Himachal Pradesh, Nagaland, Tripura, D and N Haveli, Sikkim, Assam, Mizoram, Chhattisgarh and Jammu and Kashmir. In period 2009-10 for physical infrastructure development index are Lakshadweep, Goa, A and N Island, Gujarat, Uttar Pradesh, Karnataka, Andhra Pradesh, Assam, Himachal Pradesh, Madhya Pradesh, Daman and Diu, Maharashtra, D and N Haveli, Uttarakhand,

Chhattisgarh, Jammu and Kashmir and Sikkim among which Uttar Pradesh and Uttarakhand have improved physical infrastructure. In period 2002-03 for social infrastructure development index are Himachal Pradesh, Delhi, Nagaland, Andhra Pradesh, Kerala, Meghalaya, Haryana, Odisha, Maharashtra, Punjab and Manipur. . In period 2009-10 for social infrastructure development index are Maharashtra, Karnataka, Nagaland, Daman and Diu, Punjab, Sikkim and Manipur. In period 2002-03 for infrastructure index are Lakshadweep, Gujarat, Maharashtra, Mizoram, Himachal Pradesh, Karnataka, Punjab, Nagaland, Tamil Nadu, Daman and Diu, Sikkim, Haryana and Manipur. In period 2009-10 Himachal Pradesh, Uttarakhand, Andhra Pradesh, Punjab, Haryana, Tamil Nadu, Arunachal Pradesh, Gujarat, Mizoram, Maharashtra, West Bengal, Daman and Diu, Nagaland and Manipur. The states which have slightly improved from 2002-03 in 2009-10 are Uttarakhand, Arunachal Pradesh and West Bengal. In this tier the Gujarat and Maharashtra rather being better in the GSDP contribute to not so good in infrastructure. These states have adequate amount of industries like textile, sugar industries but main bottleneck is lack of infrastructure mainly in terms of electricity. The Uttarakhand is known for the tourism sector is developing in infrastructure. Kolkata metro was the first underground railways in India. The west Bengal state contributes around 24 percent in primary sector more than 18 percent in industries and manufacturing sector and largest contribution in service sector. The infrastructure has to be developed and maintenance is quite low.

Third-tier – In period 2002-03 the States/UT which are the lowest in physical infrastructure development index are Manipur, Odisha, Bihar, Uttarakhand, Uttar Pradesh, Arunachal Pradesh, Jharkhand and Meghalaya. In period 2009-10 the States/UT which are the lowest in physical infrastructure development index are Bihar, Manipur, Rajasthan, Tripura, Mizoram, Odisha, Nagaland, Meghalaya, Arunachal Pradesh and Jharkhand. In period 2002-03, for the States/UT which are the lowest in social infrastructure development index are Tamil Nadu, Gujarat, Daman and Diu, Rajasthan, Jammu and Kashmir, Chhattisgarh, Tripura, Madhya Pradesh, D and N Haveli, West Bengal, Assam, Uttar Pradesh, Bihar and Jharkhand. In period 2009-10 the States/UT which are the lowest in social infrastructure development index are Tamil Nadu, Odisha,

Meghalaya, Arunachal Pradesh, Assam, Haryana, Jammu and Kashmir, Uttarakhand, Tripura, West Bengal, Madhya Pradesh, Rajasthan, Bihar, Uttar Pradesh, Chhattisgarh, Jharkhand and D and N Haveli. In Period 2002-03 the States/UT which are the lowest in infrastructure index are Odisha, Assam, Madhya Pradesh, West Bengal, Tripura, Jammu and Kashmir, Rajasthan, Chhattisgarh, Uttarakhand, Bihar, D and N Haveli, Arunachal Pradesh, Uttar Pradesh, Meghalaya and Jharkhand. In Period 2009-10 the States/UT which are the lowest in infrastructure index are Jammu and Kashmir, Odisha, Madhya Pradesh, Uttar Pradesh, Chhattisgarh, Assam, D and N Haveli, Meghalaya, Rajasthan, Tripura, Bihar and Jharkhand. In this tier all the BIMARU states have lower infrastructure index indicating that these states still have lack of infrastructure facilities in both the years.

We can summarize from the Table 2 that comparatively in both years infrastructure index and their ranks are assign on basis of the infrastructure index of States/UT. The states which have improved their ranks are Lakshadweep, Tamil Nadu, Sikkim, Haryana, West Bengal, Jammu and Kashmir, Uttarakhand, D and N Haveli, Arunachal Pradesh, Uttar Pradesh and Meghalaya. The states which ranks are not changed at all are Puducherry, A and N Island, Chhattisgarh and Jharkhand. The states in which ranks have declined are Goa, Delhi, Kerala, Andhra Pradesh, Gujarat, Maharashtra, Mizoram, Nagaland, Daman and Diu, Manipur, Odisha, Assam, Madhya Pradesh, Tripura, Rajasthan and Bihar.

3.1 Infrastructure Growth:

To understand the relationship between infrastructure and growth we will use infrastructure index and PCNSDP of all states for the both the year 2002-03 and 2009-10. Firstly, we can analyse this from both data sets using the correlation for both the years. The correlation between PCNSDP and Infrastructure index is 0.75 for 2002-03. The correlation between PCNSDP and Infrastructure index is 0.89 for 2009-10. The plot indicates the positive relationship between infrastructure index and PCNSDP of Indian States and Union Territories for both the years.

Table 2: State-wise infrastructure index and their ranks

STATES	INFRAINDEX (2002-03)	Rank	INFRAINDEX (2009-10)	Rank
Goa	0.63	1	0.46	5
Delhi	0.58	2	0.55	3
Chandigarh	0.58	3	0.73	1
Puducherry	0.47	4	0.47	4
Kerala	0.45	5	0.31	8
A and N Islands	0.35	6	0.32	6
Andhra Pradesh	0.31	7	0.28	12
Lakshadweep	0.30	8	0.62	2
Gujarat	0.30	9	0.25	17
Maharashtra	0.29	10	0.23	19
Mizoram	0.28	11	0.24	18
Himachal Pradesh	0.28	12	0.28	10
Karnataka	0.28	13	0.30	9
Punjab	0.28	14	0.28	13
Nagaland	0.25	15	0.21	22
Tamil Nadu	0.25	16	0.26	15
Daman and Diu	0.25	17	0.22	21
Sikkim	0.22	18	0.32	7
Haryana	0.22	19	0.27	14
Manipur	0.21	20	0.20	23
Odisha	0.19	21	0.19	25
Assam	0.18	22	0.18	29
Madhya Pradesh	0.18	23	0.19	26
West Bengal	0.18	24	0.23	20
Tripura	0.18	25	0.14	33
Jammu and Kashmir	0.17	26	0.19	24
Rajasthan	0.17	27	0.17	32
Chhattisgarh	0.14	28	0.18	28
Uttarakhand	0.14	29	0.28	11
Bihar	0.13	30	0.14	34
D and N Haveli	0.12	31	0.18	30
Arunachal Pradesh	0.12	32	0.25	16
Uttar Pradesh	0.10	33	0.19	27
Meghalaya	0.10	34	0.17	31
Jharkhand	0.05	35	0.06	35

Figure 1:2002-03

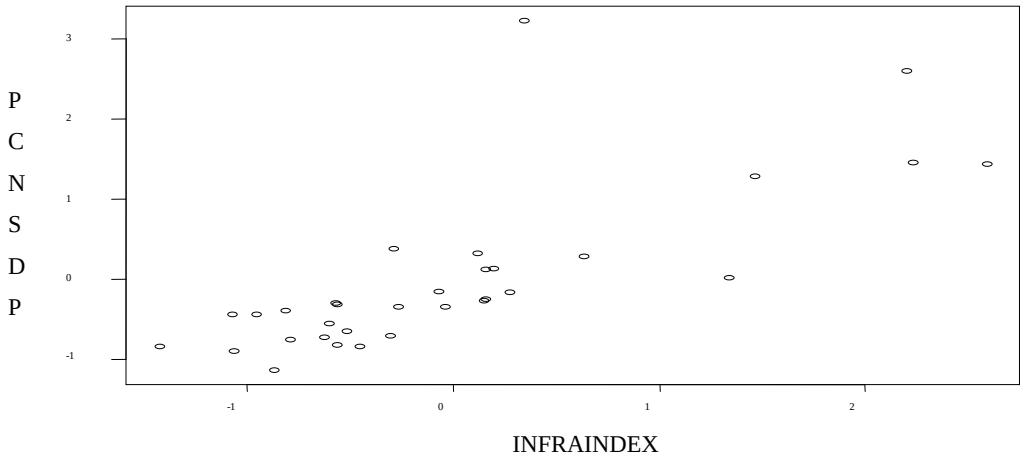

Figure 2:2009-10

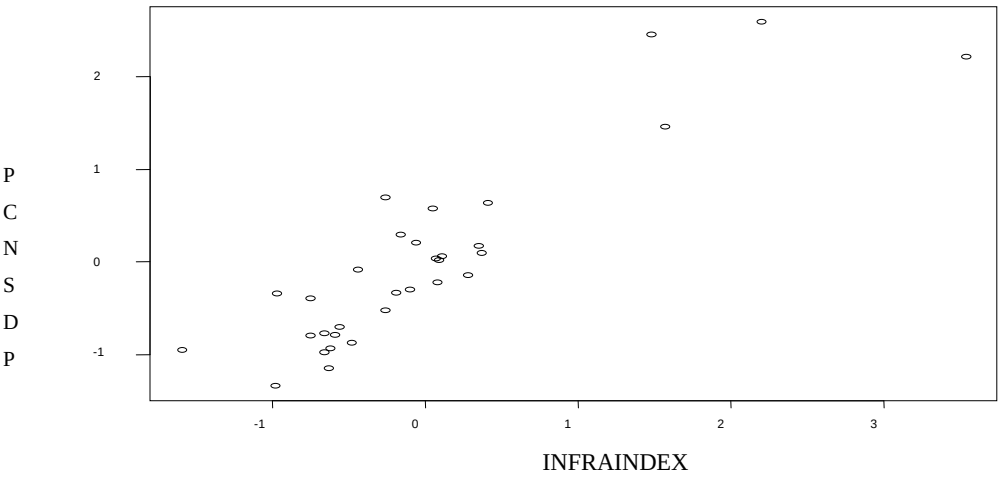

Table 3: Regression Results

Call: 2002-03	Call: 2009-10
lm(formula = PCNSDP ~ INFRAINDEX - 1,data=data)	lm(formula = PCNSDP~ INFRAINDEX - 1, data = data)
Residuals:	Residuals:
Min 1Q Median 3Q Max	Min 1Q Median 3Q Max
-0.9894 -0.3655 -0.1210 0.1932 2.9697	-0.9285 -0.2854 -0.1339 0.2816 1.1403
Coefficients:	Coefficients:
Estimate Std. Error t value Pr(>|t|)	Estimate Std. Error t value Pr(>|t|)
INFRA INDEX 0.7532 0.1181 6.375 4.24e-07 ***	INFRA INDEX 0.8904 0.08174 10.89 4e-12 ***
Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1	Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.6578 on 31 degrees of freedom	Residual standard error: 0.4551 on 31 degrees of freedom
Multiple R-squared: 0.5673, Adjusted R-squared: 0.5533	Multiple R-squared: 0.7929, Adjusted R-squared: 0.7862
F-statistic: 40.64 on 1 and 31 DF, p-value: 4.244e-07	F-statistic: 118.7 on 1 and 31 DF, p-value: 3.997e-12

For further analysis, we use OLS regression using r software which is represented in Table 3. For 2002 the coefficient of the coefficient of the independent variable (INFRAINDEX) is 0.7532. The increase in 1% of infrastructure index increases the PCNSDP by 75%. The t values of the coefficient are 6.375 and are significant. The p-value is statistically significant which less than 0.05 is. The Adjusted R-squared value is 0.5533 indicates the model is reliable because it also takes into account the sample size. The residual standard error is 0.6538 which explains the variability in predicted values of PCNSDP and actual PCNSDP. For2009-10the coefficient of the independent variable (INFRAINDEX) is 0.89043. The increase in 1% of infrastructure index increases the PCNSDP by 89%. The t values of the INFRAINDEX are 10.89and are significant. The p-value are statistically significant which is less than 0.05. The Adjusted R-squared values are 0.7862indicates the model is reliable because it also takes into account the sample

size. The residual standard error is 0.4551which explains the variability in predicted values of PCNSDP and actual PCNSDP.

4. CONCLUSIONS:

There is enormous scope of further research in analysing the availability of infrastructural facilities. The paper has the various infrastructural facilities are compared for both the period 2002-03 and 2009-10. The infrastructure index is being constructed including physical infrastructure index as well as social infrastructure index. Depending on infrastructure index for both years we can conclude that there exists inter- state disparity in India. We also analyse the INFRAINDEX with the PCNSDP of States/UT. Result shows a positive and significant relationship between the growth and infrastructure index.

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