Infrastructure, Growth and Poverty: Interlinkages

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Date: 21 July 2015

DECLARATION

I hereby declare that the dissertation entitled **"Infrastructure, growth and Poverty: Interlinkages"** submitted by me in partial fulfillment for the award of the degree of **MASTER OF PHILOSOPHY** is a bonafide work and that it has not been submitted so far in part or in full, for any degree or diploma of this university or any other university.

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It is recommended that the dissertation may be placed before the examiners for evaluation.

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Abstract

Imbalances in infrastructure could be primary reason for lopsided development in India. This dissertation tries to measure infrastructure level at the state level since 1990s, its development over time and then analyze the first statement empirically. This is done by creating four infrastructure indices- Physical, Financial, and Social- capturing different types of infrastructure and also a Total Infrastructure Index, using Principal Component Analysis for 17 major states of India. Further, correlation analysis shows a significant association between infrastructure indices and poverty. Panel regression analysis shows that not only infrastructure development reduces poverty, but also that improvement in social infrastructure has the maximum impact on poverty reduction. Infrastructure growth impacts poverty via higher growth and improved access to resources. This shows that there are inter-linkages between infrastructure, growth and poverty. Acknowledging this interdependency, simultaneous equation model is used and the results are similar to that of panel regression showing that infrastructure has a strong positive relationship with poverty reduction. Urbanization levels have been associated with lower levels of poverty in the states, showing that the states have higher urbanization levels have lower poverty levels.

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Abbreviations

- GDP-Gross Domestic Product
- GSDP-Gross State Domestic Product
- CSO-Centre Statistics Office
- IMF-International Monetary Fund
- PPP- Public Private Partnership
- NPPP- National Public Private Partnership policy
- GVA- Gross Value Added
- FDI- Foreign Direct Investment
- WPI- Whole Sale Price Index
- RBI – Reserve Bank of India
- NITI- National Institute for Transforming India
- PCI- Per Capita Income
- IDI- Infrastructure Development Index
- IMR- Infant Mortality Rate
- SOC- Social Overhead Capital
- MPCE- Monthly Per capita Expenditure
- RCT- Randomized Control Trial
- GCI- Global Competitiveness Index
- NUHM- National Urban Health Mission
- GIA- Gross Irrigated Area
- GCA- Gross Cropped Area
- PCA- Principal Component Analysis
- CV- Coefficient of Variation
- GER- Gross Enrollment Ratio
- NSS- National Sample Survey
- PLB- Poverty Line Basket
- IR- Item Rate
- O&M- Operation and Maintenance
- NTDPC- National Transport Development Policy Committee
- UP- Uttar Pradesh
- WB- West Bengal

I. Introduction and Literature Review

1.1 Introduction

The meaning of word Infrastructure is something which lies below or comes before (infra) the "structure". Another word sounding familiar is superstructure and often confused with it. The confusion is interesting too as "superstructure" is something built over and above the structure. The contrast should also be seen in the sense of "means" and "ends" too. Superstructure in some senses is the end product or aim of economic development, the infrastructure is the essential foundation on which economic growth can be obtained. Thus, broadly speaking infrastructure can be everything used in the process of development and growth as well. The origin of the word goes to world war two as a term mainly use in relation to military to mean underlying structures in the early days of Marshall Plan, in place of "Social Overhead Capital", to avoid confusions with the hospitals, schools and similar welfare kind of facilities. Since then the term has been widely used by economists but does not have a precise definition till date. The sense in which, it is used has changed widely over the years. Different scholars use this term in different meaning, without much difference in the basic idea that they provide the foundation over which the structure of the economy is built. Consequently, there have been efforts to encompass a variety of activities within the term infrastructure, to differentiate between different components of infrastructure (social, physical, financial etc.) and to measure the contribution of infrastructure in the economy, or investigate how different economies are affected by infrastructural facilities.

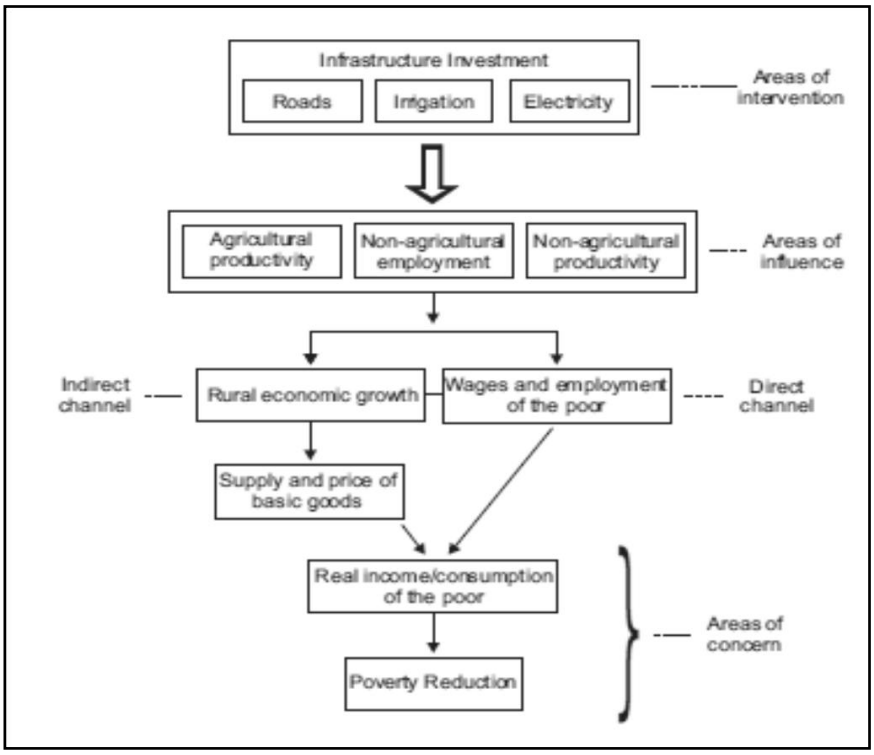
"Infrastructure" is a broad concept that encompasses many dimensions of the civilization but the most dominant and common one is the physical features such as roads, bridges, ports etc. However, equally significant for the well-being of people are social infrastructure services. The benefits from the physical type of infrastructure may or may not trickle down to poor people through generations of growth, but it is the social infrastructure that may make a direct contribution in raising the well-being of poor people.

Poverty is one of the biggest problems, the world faces today. Poverty eradication has been always a major objective of policy makers, especially in the developing countries. The first step to solve a problem is to have in-depth knowledge about the issue. For deciding efficient

poverty eradication policies it is very important to understand the dynamics of poverty and related issues. There has been substantive discussion and debate in the literature on the determinants of poverty. The history of poverty alleviation programmes is long and rich as well. In recent times, mainstream idea in development theory has been on the effects of growth on poverty. It is believed that higher economic growth leads to poverty reduction via increasing the incomes of poor. This idea is commonly known as "Trickle Down" approach, meaning higher economic growth benefits the rich first and when the rich starts using their gains, poor too receive some benefits. Although Trickle Down theory has been propagated and accepted by many prominent scholars, it has its share of criticism too. Another dominant idea in poverty literature is that of 'pro-poor' growth. The idea of pro-poor growth is to focus directly on the poor, so that they could actively participate in economic activities and also get the direct benefits (Kakwani and Pernia, 2000). The most desired component of growth process is its inclusiveness. Growth should be inclusive rather than discriminatory. The least growth should provide is basic minimum needs for all to live a decent life.

In the dynamics of poverty, infrastructure plays an important role. There are mainly two ways to study the impact of infrastructure on poverty. Firstly, the impact of infrastructure is studied in macroeconomic sense, mainly using the production function. Secondly, the impact of infrastructure is also seen in microeconomic sense, both at the firm and household level. Another way to establish the link between infrastructure and growth is to study the growth enhancing effects of infrastructure. Infrastructure, among numerous other factors is considered to be a major facilitator of growth; hence it is necessary to understand this dynamics. Two influential schools of thought emerged during the 1990s connecting infrastructure with poverty. During this time, developing countries realized that physical infrastructure is important for poverty reduction, however there were many in the international development community who were skeptical of giving assistance for infrastructure development (DFID, 2002). The critics argued that benefits from infrastructure investment are over hyped, have little direct relevance to poverty reduction. Their further emphasis is on the institutional framework of developing countries. Developing countries are generally characterized by weak institutions and governance which leads to corruption. Corruption, especially, in deciding public investment many times diverts the benefits from poor to already well off section of the society. However, this also means, if governance and institutional frameworks are strengthened, the linkage between infrastructure and reduction of poverty can become stronger and relevant too.

Figure 01: Impact of Infrastructure on Poverty



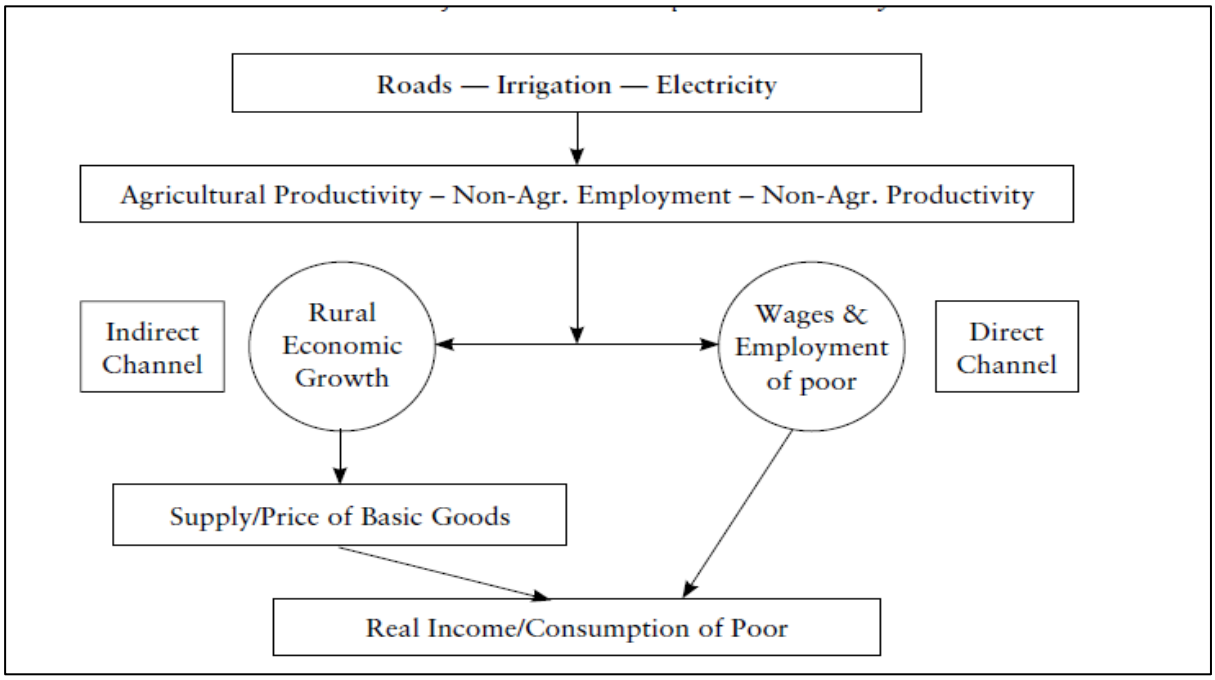
Sources: Ifzal Ali and Ernesto M. Pernia (2003)

In the poverty alleviation debate India has a unique position because here the focus is both on, eradication of poverty and inclusive growth. Infrastructural bottlenecks have seen as a major obstacle towards these goals. Post liberalization, the importance of private capital has increased many folds, so there has been considerable focus on infrastructure as a precondition for attracting the same. Also, private capital is considered to be very important factor for economic growth. With this backdrop, it is mandatory to estimate the link between infrastructure and poverty in India, both at the national and regional level; and assess infrastructure's role in poverty reduction over the years. Moreover, it would be a serious error of judgment to study this links in too simplistic manner. To assume that the association between infrastructure and poverty is uni-dimensional, will be incorrect; rather the association is expected to be multi-directional. It is also believed that it is different for different types of infrastructure – physical, financial or social – and also for regions at different levels of development.

The channels of inter-linkage between infrastructure, growth and poverty may be debatable; however there is empirical evidence and literature regarding the direct and indirect relationship between these significant macroeconomic variables. There are two types of link

"direct" and "indirect". The indirect link via growth is believed to be the stronger and relevant one (Figure 01). It is believed that infrastructure has growth enhancing effects, which provide poor people with additional resources to fight the vicious circle of poverty. Infrastructure's links to growth works in various complex ways and also at various levels, some of the most common links are efficiency improvements. One simple way to see this improvement is to understand the gains from private participation in infrastructure which positively impacts last users. However, this general principle should not be uniformly applied everywhere. The rate of growth good enough to reduce poverty differs with space and time. The poverty reducing impact of growth varies widely within the country as well. Various parameters play important role in this link, some commonly understood one are, demographic, geographical, environmental, economic etc.factors. The marginal gains on growth from adding to the existing infrastructure stock, is higher in developing countries than the developed ones.

Figure 02: Relationship between Roads, irrigation and Electricity and income levels of poor



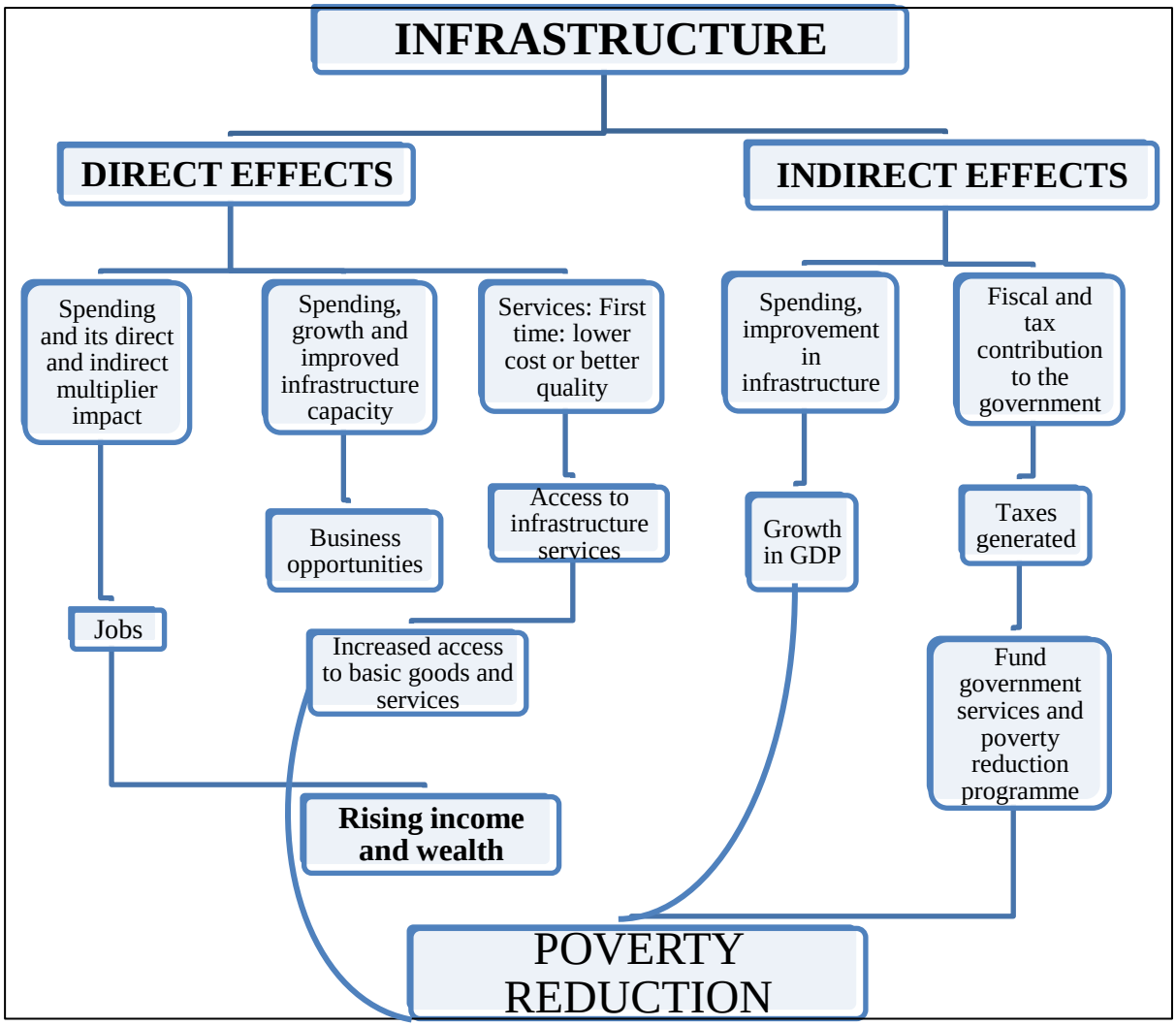
Source: Ifzal Ali and Ernesto M. Pernia (2003)

The direct impact (Figure 01) of improving infrastructure facilities is also instrumental in poverty eradication. Improvement can be done by either investing in infrastructure related areas or working on infrastructure reforms. Infrastructure like roads, bridge, dams, schools etc. enables poor to better access of markets, health and education facilities. Most important

of all, these directly impact the income generating probabilities. It also improves the quality of employment for poor. The second order growth effects of investment in this sector, via provision of improved and reliable services, are the largest and affect the overall economy. It is widely accepted that infrastructure services can contribute to poverty reduction via growth by following paths (Figure 3):

- It generates new types of demand in the economy, which provides opportunities to all economic actors to its advantage.
- Infrastructural works are also direct source of employment, which can be used as counter- cyclical policies during bad phases in the economy.
- Social infrastructure like schools and hospitals creates human capital.
- It also facilitates entrepreneurial activities by decreasing the input cost and increasing profit.

Figure 03: Impact of infrastructure on Poverty (Direct and Indirect effects)



Source: International Finance Corporation; "Poverty Literature Review"

International Finance Corporation (World Bank Group) in their poverty literature review explains the role of infrastructure on poverty reduction via growth. One of their report mentions that the impact of infrastructure may not be just directly via growth and there may be numerous other channels through which poverty rates may be impacted, however exactly by how much may vary from country to country or region to region. A very important aspect of infrastructural improvement is analyzing the linkages of the sectors. Using the input-output table, the backward and forward linkage can be calculated. The sectors with high network effects or linkages have greater impact on the economy. When analyzing types of infrastructure, the literature indicates that investments that have significant network effects will have more social and economic benefits. Specifically, investments in energy and telecom infrastructure affect any economy in positive direction. On the other hand, the impact of physical infrastructure like road and ports varies with and within economies. In developing countries, transport investments such as roads (Figure 02) and ports are shown to have a strong impact on growth while the same sector's impact in developed countries comes in the form of improvement in quality rather than quantity. This happens because with the level of development different things gain importance. So, in the developed countries technology takes more important role than the level and kind of infrastructure.

In the same study, the impact of infrastructure on poverty directly has been explained via following channels:

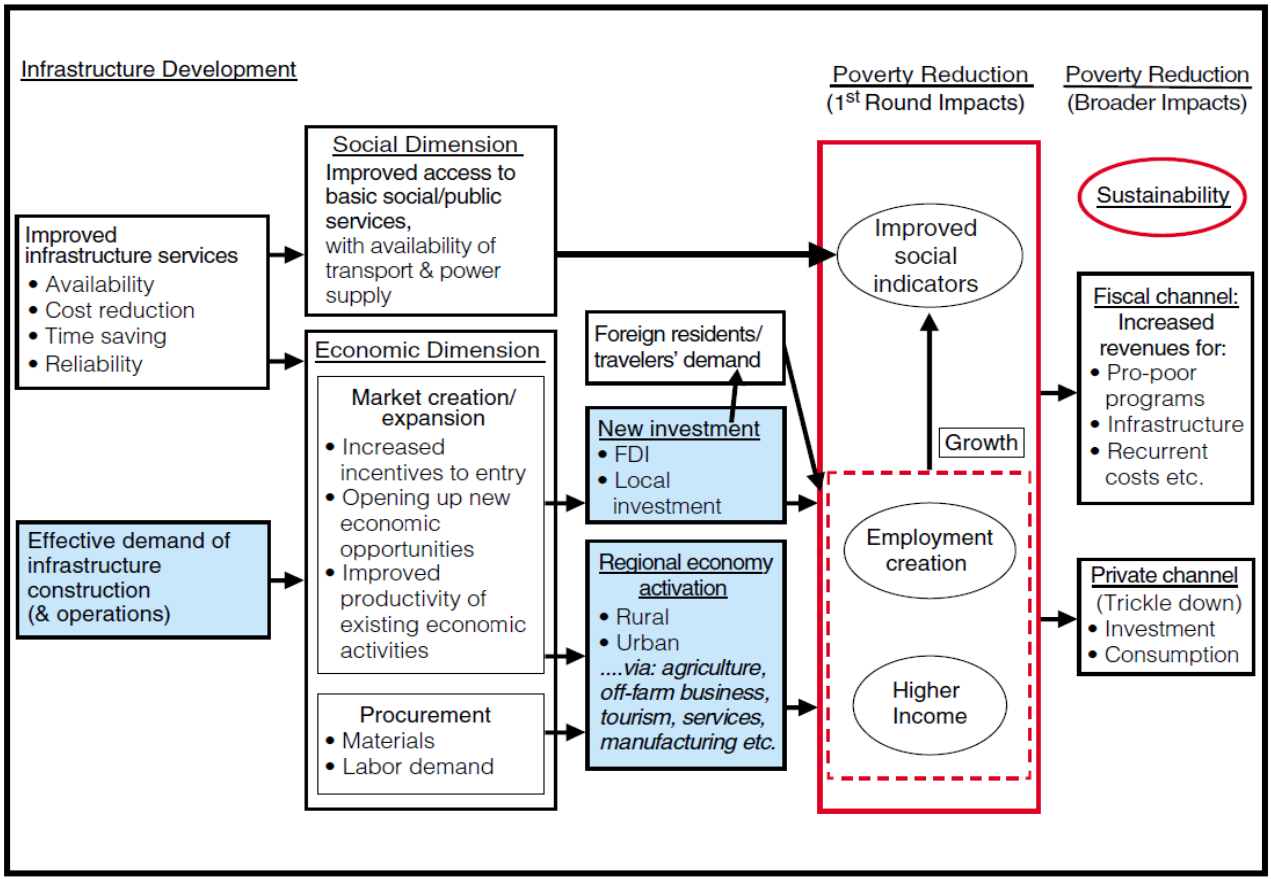
- Providing affordable and quality access: Infrastructure ensures access to a person which is helpful in many ways including creation of new opportunities, saving of time etc.. A study on the impact of household electrification in South Africa shows that female employment increased, due to more time available to them from house work, which in turn encouraged the setting up of micro enterprise" (IFC: The World Bank).
- Evidence of poverty impacts varies by sector: Different infrastructure sector may have differential impact on poverty For example; rural feeder roads help provideaccess to the market, basic education and healthfacilities, which may improve the overall productivity of the poor households. (IFC: The World Bank).

In a similar study by GRIPS Development forum, the poverty reducing impact of infrastructure development has been explained by various means including:

- Effective demand of infrastructure construction which creates additional income by generating jobs.
- Improved infrastructure services also foster market creation mainly by increase in investment. This increase in investment is done via attracting FDI and private capital.
- On the other hand it has significant impact on social indicators as well. Better social infrastructure significantly improves the living conditions of poor.

The above discussed linkages between infrastructure, growth and poverty can be summarized by explaining three broad categories of interdependences between them. The first linkage (Figure 04) is "Investment-inducement effect", which means that improvement in infrastructure helps in increasing the rate of investment. Not only this, it would have positive spillover effect on the economy via strong backward linkages. Moreover, it also helps in gaining FDI which could induce demand effect from foreigners as well. In the final round, demand from foreigners also helps in creation and development of new sectors such as hotels, tourism etc.

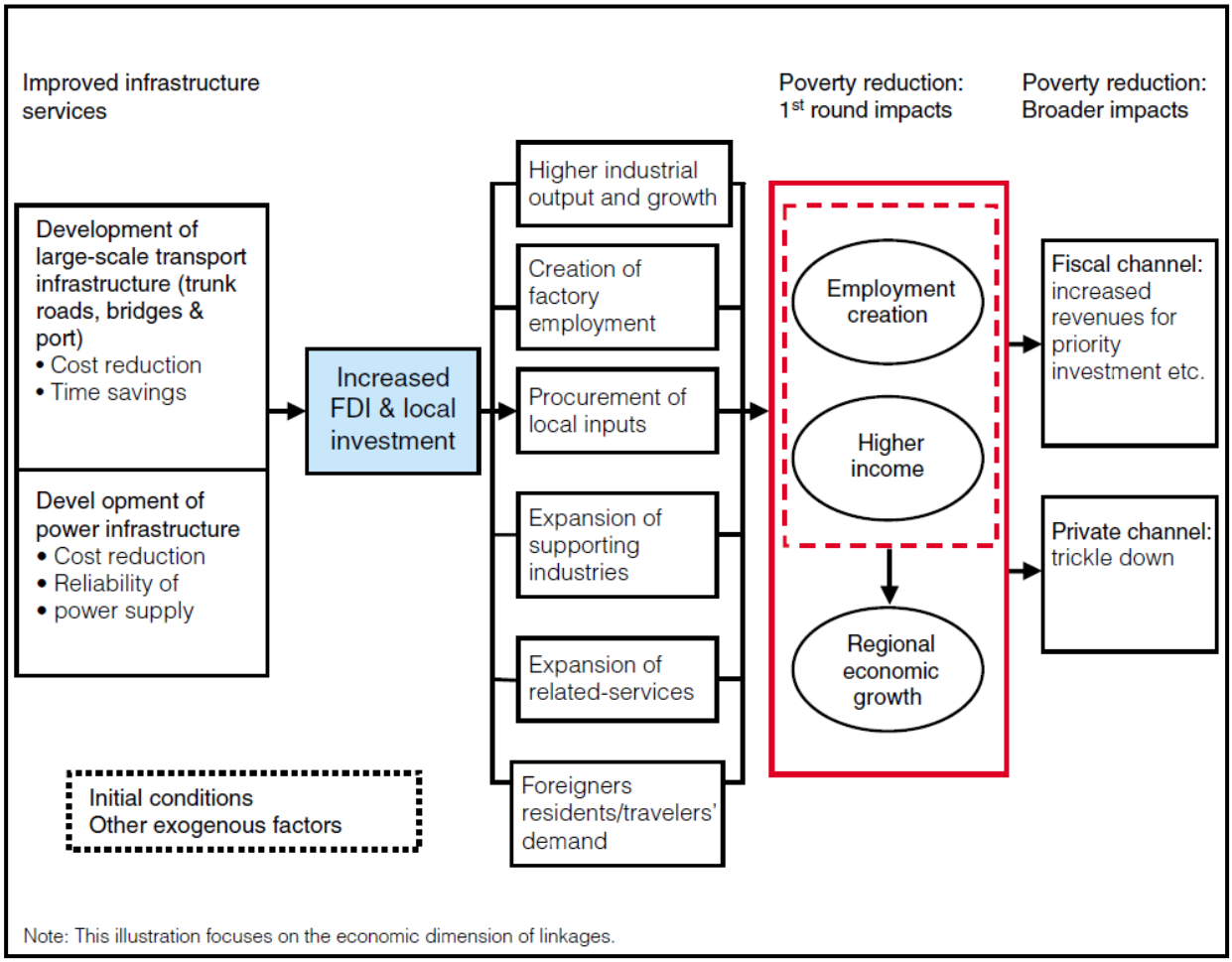
Figure 04: Growth and Poverty Inter-linkages via Infrastructure (Round 1)



Source: Linking Economic Growth and poverty reduction, GRIPS Development Forum

Second linkage (Figure 05) is the "regional economy activation" which means that the improvement in infrastructure facilities can bring new life to some regions by providing new economic opportunities to those areas. For example, access to new market and information could generate new jobs and sources of income in under developed areas. It can also improve the efficiency of the existing sources of employment, for example introduction of new technology can improve the productivity in agriculture by many folds. Furthermore, it also improves the rate of rural-urban migration as well as the degree of connectedness, which could promote new sources of income generation.

Figure 05: Growth and Poverty Inter-linkages via Infrastructure (Round 2)

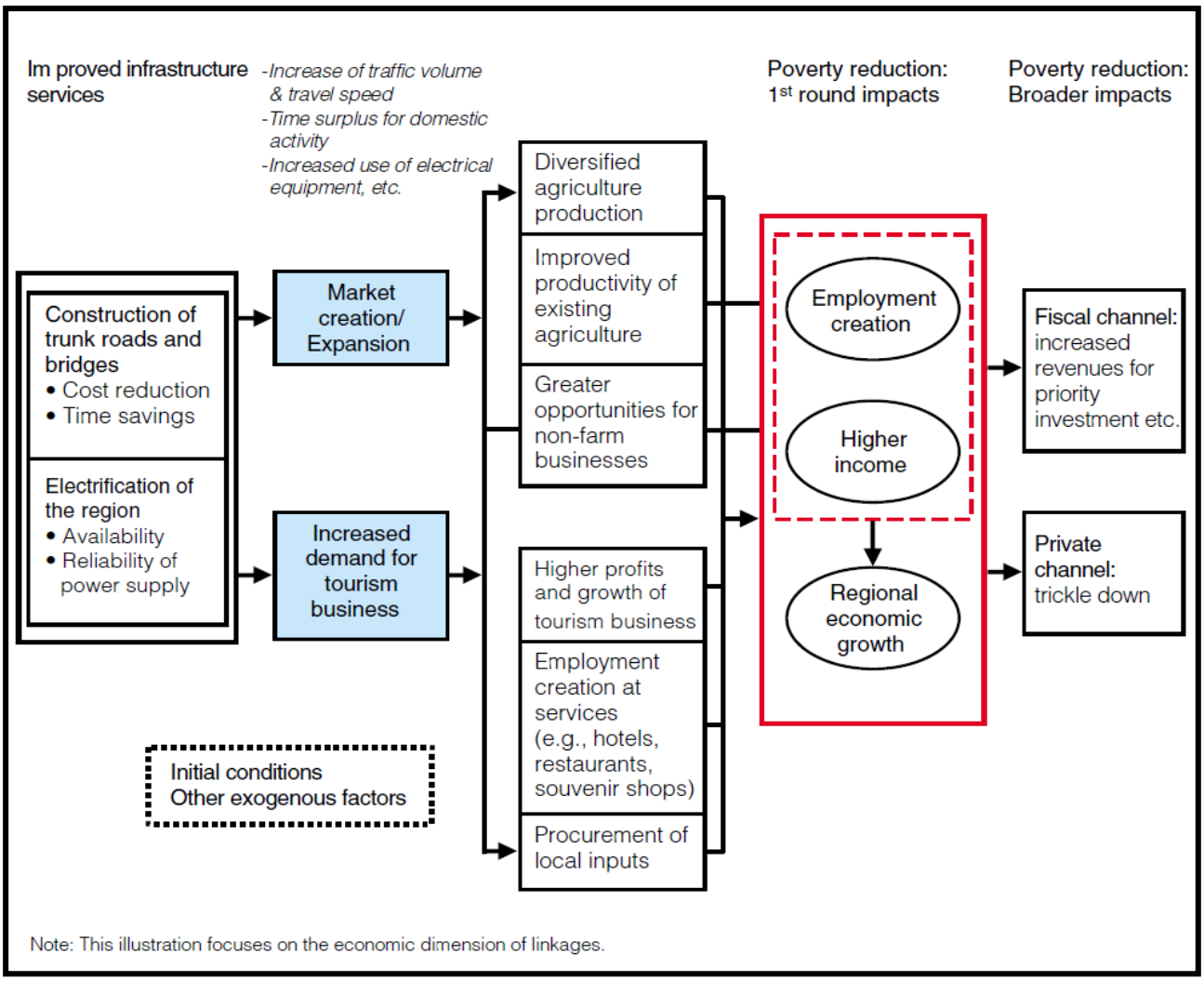


Source: Linking Economic Growth and poverty reduction, GRIPS Development Forum

Third link (Figure 06) is "Effective demand" effect which is about the direct job creation during the period of infrastructure creation. For example, construction works could generate jobs and income during the construction period and also in the time of operation and

maintenance- directly and indirectly. While the quantity of income generated and weather it is good enough to break the cycle of poverty is always questionable. But without doubt it increases the level of income, which improves the life of poor people.

Figure 06: Growth and Poverty Inter-linkages via Infrastructure (Round 3)



Source: Linking Economic Growth and poverty reduction, GRIPS Development Forum

Although the above discussed links generally have empirical validity, in some cases existing infrastructure may fail to serve poor. Devas (1991) suggests the following reasons which may lead to the failure:-

- Inadequacy in the level of infrastructure provisions in terms of what is required and what is being provided.

- The relatively high cost of using the resources, which means either that the poor cannot afford to pay high prices and thus cannot use what is offered, or a substantial subsidy is required which brings imbalance in government budgeting.
- Failure to address the fundamental obstacles like technological know-how, illiteracy, lack of communication, fear from officers, lack of communication etc. which the poor face in gaining access to basic infrastructure.
- Adoption of policy and governance framework which discriminates against poor.

In context of present study; to implement and operationalize infrastructure programmes for poverty reduction in India in a broader framework, we must look in to different kinds of infrastructural facilities – physical, financial and social – and also try to find out the nature of the relationship between them, also across different regions of the nation. For this some important issues are following: First of all it is very important to estimate the impact of different kinds of infrastructure on poverty. The second issue is to also study the nature of related variables like growth and urbanization, which are channels through which infrastructure affects poverty.

Urbanization in recent time has been one important variable in the poverty reduction debate across the world. Poverty reduction outcomes can generally be considered as the residual of urbanization. There is no agreed view point on the role of urbanization on poverty reduction. However, there is no doubt that the cities of today are also the centers of best infrastructure. In today's world the main difference between rural and urban area is that of infrastructure related facilities. The level of urbanization is one critical factor, which plays an important role in this debate. If the level of urbanization is below the critical level then further increase in urbanization helps in poverty reduction. On the other hand, if the level is above critical, then further growth rate of urbanization can have adverse impact on the standard of living of people. The basic understanding of factors which helps in urbanization is also very important to understand its impact on growth and poverty. There are three main causes of urbanization: natural increase in urban population, rural area reclassified in to urban area and rural-urban migration. Natural increase and re-classification are considered to be less relevant variable for urbanization, mainly in the developing countries. The key factor in these countries is rural-urban migration. The most important work on rural-urban migration can be dated back to Harris and Todaro (1970). Economic literature finds direct as well as indirect impact of

urbanization on poverty. Various urbanization channels recognized to have income increasing impacts are followings - the migration process to equilibrate wage differentials between rural and urban areas; an improvement in technology and labor skills which leads to gain in productivity; and the positive effects of urbanization on economic growth to increase per capita income.

Devaranjan et al. (1996) framework relating urbanization and its impact; can be modified to study its impact on infrastructure as well. In the original framework a representative agent choosing to maximize consumption is assumed. The production function used is Cobb Douglas. This model explains the relationship between growth rate and government spending. Total spending is divided in to 'Productive' and Unproductive'. It is also supposed that the different kind of spending has different impact on growth. This model can be modified in three following ways:

- By introducing a new variable representing the process of urbanization.
- By differentiating between rural and urban infrastructure. The budget constraint is also modified for the role of government, which substitute expenditure between rural and urban area.
- To capture the long run economic growths rate a composite of efficiency enhancing term as the product of technological level and urbanization is introduced to production function.

This modified model of economic growth can be used to study the welfare improvement in terms of consumption based on income and infrastructure. It can be concluded that urbanization directly affects basic infrastructure that can improve the standard of living in urban as well as rural areas especially for poor people. Infrastructure enhancing provisions complement the urbanization process up to a point only. Here the level of urbanization is also very important as the model shows that lower the level of urbanization higher will be the impact of education and health infrastructure on improving the standard of living of people. The model also shows that increase in urbanization will decrease the number of poor people, with some limitation related to the level of urbanization already achieved.

1.2 Literature review

There have been many studies underlying the relationship between infrastructure and economic growth. But there are relatively few studies about the inter-linkages of infrastructure, growth and poverty. This is especially true for India, as few studies done are for other countries. In spite of poverty in India being one of the most debated topics in academia there have been very few studies on India on the impact of infrastructure on poverty.

One of the earliest discussions on the topic of infrastructure and economic development was started by **Hirschman (1958)**, in his seminal work while debating about different kind of development strategies; he advocated investment in Social Overhead Capital (SOC). According to him investment in Social Overhead Capital (SOC) is important both because of its direct impact on GDP and also many indirect impacts such as increase in rate of investment. These ideas were supported and further propagated by **Rostow (1960)**, **Paul Rosenstein- Rondan (1943)** and **R. Nurkse (1953)** in their various theories, in different manner.

Out of some work done on inter-linkages of infrastructure and poverty, a considerable effort has been devoted at assessing the macroeconomic impacts of infrastructure development on poverty reduction. The most popular approaches include the estimation of an aggregate production function (or its dual, the cost function), empirical growth regressions, panel regressions, computable general equilibrium. Infrastructure is variously measured in terms of physical stocks, spending flows, or capital stocks. **Estache (2006)**, **Romp and DeHaan (2007)** and **Straub (2007)** offer comprehensive surveys of this literature. Admittedly, most of these studies are based on the experience of developed economies.

The numerous studies that are available on the subject can be classified into 3 categories. The first one could be named as Macroeconomic studies, which includes the research on absolute impact of infrastructure on macroeconomic (production-related) indicators like GDP, poverty, income etc.. The second one could be classified as Microeconomic studies which includes

research on the impact of infrastructure on firm, households and other such smaller units. The third which is a recent development in the economic literature is the increasing use of randomized evaluation to demonstrate impact as well as focus on the dynamic and probabilistic nature of poverty. This derives from the realization that that policy analyses based on static poverty can yield substantial inefficiencies in policy interventions (Jalan and Ravallion, 1998). On the similar grounds the review of literature is also classified in to Macroeconomic, Microeconomic and Randomized Control Trial.

1.2.1. Macroeconomic Evidence

Aschauer (1989) opened the debate on the macro-economic impact of infrastructure when he found in his seminal work that the elasticity of national GDP with respect to infrastructure is high in the United States, roughly 0.4 for total public capital and 0.24 for core infrastructure. These numbers were too large and hence labeled unrealistic by a lot of researchers. There is a lot of subsequent research available, to analyze the similar research questions. Subsequent studies by **Munnell (1990),** and **Nadiri** and **Mamuneas (1994)**, using different methodologies, confirms these results at the national level. However, some researchers, including **Garcia Mila** and **Mcguire(1992)** and **Morrison** and **Schwartz(1996)**, find this elasticity to be lower, and sometimes insignificant at the decentralized level (Eberts,1990 and Hulten and Schwab,1991). **Munnell (1990)**, for example, found the elasticity to be around 0.15 at the US metropolitan level, which is much lower to what was calculated by **Aschauer (1989)**.

Romp and **DeHaan (2005)**, while reviewing the literature on the similar topic, notes that 32 out of 39 studies of OECD countries found a positive effect of infrastructure on various macroeconomic variables such as output, efficiency, productivity, private investment and employment. For the remaining seven studies, three had inconclusive results and four showed negligible impact of infrastructure. For the similar analysis done for 12 developing countries, nine had significant positive impact of infrastructure; three had no impact of infrastructure. **Calderon** and **Serven (2004)** report that 16 out of 17 studies of medium income countries find a positive impact as do 21 out of 29 studies of high income countries.

Biehl (1980) worked on regional disparities within different European countries. In his analysis he found that with inclusion of infrastructure as independent variable and per capita

income as dependent variable, the adjusted Coefficient of Determination (R^2) varied from 0.4 to 0.5, and infrastructure variable was significant at 5 per cent levels. On the basis of this regression analysis, it was concluded that regional disparities in development levels (measured by PCI) could be explained by variation in levels of public infrastructure.

Munnell (1992) finds the feedback effect from national output to public capital; he also finds large impact of aggregate public capital on private sector output and productivity. **Easterly** and **Rebelo (1993)** examined the empirical relationship between 'transport and communication' facilities and GDP for various developing countries and found that elasticity of GDP with respect to transport and communication was 0.16 and investment in these services offered an implied rate of return of 63per cent (Rate of return is equal to Ratio of discounted value of rise in GDP and discounted value of investment in infrastructure). **Canning** and **Fay (1993)** enquiring on similar hypothesis but using only transportation facilities as the explanatory variable found the elasticity to be 0.07, which was much lower in comparison to that of **Easterly** and **Rebelo (1993)** . **Bergman** and **Marom (1993)** studied the impact of physical infrastructure on GDP growth for Israel and found the elasticity to be between 0.31 and 0.44, which is moderately high number. The rate of return in the same analysis varied from 5 percent to 70 percent.

Dalenberg and **Partridge (1995)** using the data for 28 metropolitan areas for U.S. over a 15 year period to determine the impacts of government spending, taxes and public infrastructure on total employment and disaggregated employment, concludes that the taxes have negative impact but educational expenditure have positive impact on total employment. They also found spill-over effect of infrastructure on the nearby areas and for the same reason they conclude that it is very difficult to measure the actual impact of infrastructure.

Cain (1997) examined the link between infrastructure investment and economic development of USA. He found that infrastructure investments generates both direct and indirect effects, his research also suggested that investments in infrastructure are profitable; and boosts private economic activity too. **Mikelbank** and **Jackson (1999)** using the data sets of Ohio in USA concludes that investment in infrastructure has been highest in areas of greatest distress and this pattern has inequality reducing impact.

Dutta (2001) used the data from thirty countries and found a causal relationship between improvement in telecommunications infrastructure and economic growth. The results suggest that evidence for causality from levels of telecommunication infrastructure to economic activity is stronger in the developing countries than in the developed countries. **Zhang** and **Fan (2004)** tested for causal relationship between infrastructural stock and productivity in rural India. The results show that that infrastructure development in the country can improve productivity and is highly significant as well. **Ogun (2010)** in his paper studying the impact of infrastructure on poverty found that infrastructure improvements lead to poverty reduction. Out of various kind of infrastructure he concluded that the impact of social infrastructure on poverty is higher than that of physical infrastructure.

Neil (1996) used the neo-classical growth theory and pointed out that the rate of investment in infrastructure that would maximize steady-state per capita consumption depends on the elasticity of output with respect to infrastructure.The study is based on the data from the United Statesand concludes that the increase in output that can be expected from increased investment in public capital is very uncertain.

Garcia-Mila and **McGuire (1990)** tried to measure the contribution of publicly provided inputs to state economies by specifying a regional production function that, in addition to labor and private capital, includes two publicly provided inputs- highways and education. A panel data set consisting of annual observations on 48 countries from 1969 to 1983 was used to estimate input elasticity coefficients, allowing for differences over time and across states. It was found that both the public inputs had significantly positive effect on output.

Shah (1970) attempted to relate the level of Per Capita Income of Indian states with their level of infrastructural facilities and found a strong and statistically significant correlation exists between these variables. **Gulati (1977)** used 32 variables to construct composite indices of development for 336 districts of various India States. The components significant in explaining the inter-district variations in development are surfaced road length, electricity and irrigation intensity factor.

Tewari (1984) studied the inter-regional disparities in levels of development in Indian states and according to him inadequacy of existing infrastructural facilities seems to be the major obstacle in the path of progress of developing states. In his study he examines the inter-relationship between infrastructure and development and tries to identify the role of the

former in the later through analysis of state level data at two time points - 1970-71 and 1980-81 and finds a statistically significant positive direct relationship between infrastructure and development.

Binswanger, Khandkur, and Rosenzweig (1989) used cross-district Indian data and find that the major effect of roads in the development of rural India. He concludes that road network improves agriculture by reducing the transaction cost and also improves marketing and distribution opportunities. **Elhance and Lakshmanan (1988)**, on the other hand, using physical as well as social infrastructural indicators found production cost reductions in manufacturing result from increasing infrastructure investments.

Nagar and **Basu (2002)** estimated the value of Infrastructural Development Index (IDI) for 17 major Indian states for the period 1990-91 to 1996-97. The telecommunication services, transportation facility and availability of energy/power services were found to be the most dominant among the chosen infrastructure services.

Patra and **Acharya (2011)** examined the spatial disparities in infrastructural facilities across 16 major states in India and in turn analyses its impact on regional economic growth. They also linked infrastructure to poverty. The paper suggests that there is a positive relationship between Infrastructure Development Index & Per Capita Net State Domestic Product and negative relationship between Infrastructure Development Index & Poverty.

Mitra, Varoudakis and **Veganzones (2002)** examined the impact of infrastructure on the total factor productivity and technical efficiency of manufacturing industries in Indian States. The results indicate that differences in infrastructure endowments explain the differences in industrial performance of various Indian states. In addition they were able to identify the industries where total factor productivity and technical efficiency, competitiveness and export capacity depend particularly on infrastructure. This finding is of particular importance for India, which faces serious infrastructure related problems and strongly supports the view that a lack of infrastructure can hamper growth in developing countries like India.

Rodrikand **Subramanian (2005)** while analyzing the take-off year for India post-independence, acknowledge 1980 as the year when productivity raised many fold. They also

accepts possible productivity boosting role of public infrastructure investments done during the initial five year plans.

Murty and **Soumya (2007)** has analyzed the likely macroeconomic effects of changes in public investment in infrastructure in India by constructing a model containing real, fiscal, monetary and external sectors of the economy. They found crowding in of private investment because of increase in public investment in infrastructure. Thus, public sector investment in infrastructure has the potential to provide the much needed push to the Indian economy by increasing the rate of investment.

Mathur (2006) studies the effect of economic reforms on regional development in India. By analyzing trends in growth of per capita state domestic product, poverty, and infrastructure development, he explains the variation in regional development in India. **Kaushiva (2007)**using the sample of Indian states has studied the disparities in growth of GSDP, poverty rates, investment rates, human capital, and infrastructure development and found that despite numerous policies the development has been very lopsided. States like Bihar, Madhya-Pradesh, Rajasthan, and Uttar-Pradesh have experienced comparatively lower growth rates, high concentration of poverty, and a low human development index.

The paper by**Dev (2008)**analyzes the direction of change in inter-state and intrastate disparities based on growth rate of GSDP, per capita GSDP, number of underweight children, infant mortality rate, and net enrolment rate. The comparison is done whether the disparity between states on these indicators have increased or decreased in the post-reform period as compared to the pre-reform period. He concluded that regional disparities have increased in the post-reform period. Another important observation was that there was a positive relationship between higher level of infrastructure, per capita income, and capital flows to the state.

Ghosh and **De (2000)** in an attempt to test the relationship between infrastructure and regional economic development in the Indian States, used OLS regression method using data from 1961-62 to 1994-95 period. For this purpose they formulated physical, financial and social infrastructure development index using the principal component analysis and found that the rising trend in the regional disparity in development can be attributed to the regional inequality in various infrastructure.

Arunkumarand **Upendranadh (1993)** studied the difference in industrial performance of major Indian states. They used Deprivation index for six infrastructural indicators from various states and combines them to derive a composite indicator of infrastructural development using Principal Component Analysis. They then rank the 15 major states under study of on the basis of this combined index and found that the rankings are almost consistent with the general observation regarding the industrial process of these states.

1.2.2. Microeconomic Evidence

According to **Hansen (1965),** infrastructure is important for growth, however the impact of infrastructure is based on the region in which the infrastructure facility is being provided. He classified the regions into three types- congested, lagging and intermediate areas. Congested areas are the one where already there is already sufficient infrastructure available, and are high growth areas but also have problems such as and in such areas, the marginal social cost of creating new infrastructure would be higher than the marginal social benefit from the new infrastructure. Even the regions that are lagging behind in terms of development may not see huge impact of infrastructure and it is the regions that have intermediate levels of development where maximum benefit from infrastructure could be realized.

Shah (1970) in his study found that the per capita income of Indian states have a strong correlation with the level of infrastructure (the study was based on the data after the independence).**Looney and Fredricksen (1981)** studied the impact of infrastructure on GDP in Mexico for different regions (intermediate and lagging) in Mexico in year 1970. Different areas respond better to different kind of infrastructure like in intermediate developed regions, road, electricity, telephone were important and for other regions which were less developed, infrastructure facilities like hospitals and primary schools. This is in support of the general view that infrastructure development does help in economic development. The results are similar to the results in Hansen's paper.

Alagh (1987) emphasize that infrastructural planning in India must focus not only on greater availability of infrastructure but also improvement in their efficiency. **Gayithri (1997)** using the district level data in Karnataka concluded that the industrial development in the district was highly related to the infrastructure availability. **Haughwout (2000)** in his paper found

that investment in infrastructure in cities have benefits not only in those cities but also in adjoining areas.

Amin (2004) has based the analysis in Gujarat state. The paper analyses the impact of infrastructure on the distribution of small scale industries in Gujarat and find that regions within Gujarat with better infrastructure facilities have higher levels of industrialization. **Gulati (2009)** while studying improved performance of agriculture in Gujarat post 2000 found that this could be attributed to innovative practices of government, use of private capital and improvement in irrigation facilities especially canal irrigation. Among these, irrigation infrastructure is found to be a very crucial factor in aiding agricultural growth.

1.2.3. Randomized Control Trial

In the last decade, Randomized Control Trail (RCT) has been gaining popularity and is being used in more and more areas. The use of RCT has provided a completely fresh dimension to project evaluation. Experimental designs, also known as randomization, are generally considered the most robust of the evaluation methodologies. RCT involve randomly allocating the intervention among eligible beneficiaries. Randomly allocating the intervention automatically creates comparable groups- the one with the intervention is called the treatment group and the other is called the control group. These groups are usually comparable to each other as they are randomly chosen and hence there is no sample selection bias. The allocation to control/ treatment group is random and hence the comparison on any count between groups is better.

However, in practice it is not always possible to conduct an experiment and hence finding a perfect control and treatment group is not possible. In such cases, it is done using Quasi-experimental or non-random methods. These may be as perfect as experimental design but help create comparison groups. The statistical methodologies used are matching methods, double difference methods, instrumental variables methods, and reflexive comparisons. Quasi-experimental designs are easier to implement and as they don’t need fresh experiments and use existing data sources. They can be used in cases where it is not possible to conduct natural experiments and are much simpler. However, the disadvantage of these methods is that they are statistically less robust and they the problem of selection bias is not completely eliminated in this case.

Although, the use of RCT has increased, still there are few papers evaluating the impact on poverty. **Estache (2010)** is review of literature on impact evaluation related to infrastructure-both related to RCT and others. The review takes stock of lessons of numerous impact evaluations in energy, water and sanitation based on both randomized experiments and others. The paper points out that the studies on infrastructure have been few and mores so based on randomized experiment methodology and there is a need to use this technique further for the impact evaluation of infrastructure on various variables of interest.

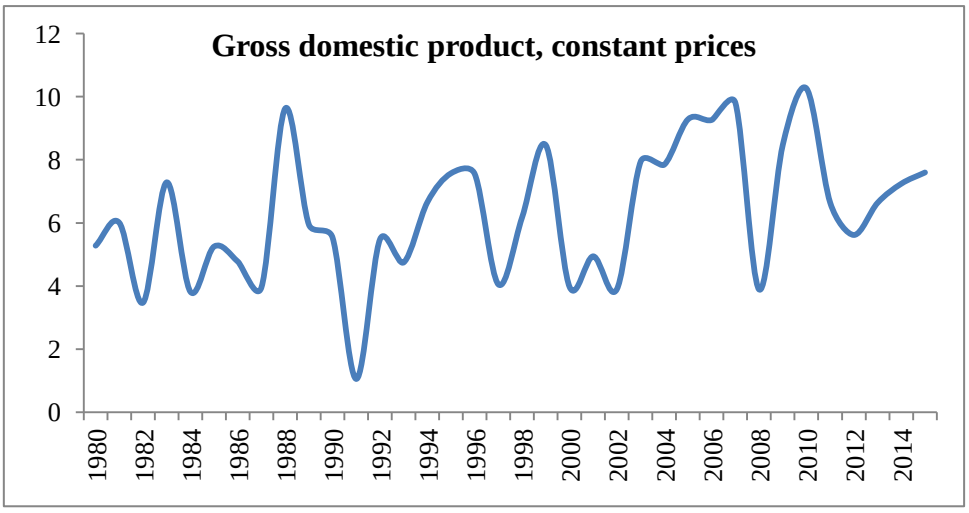
Several broad generalizations can be deduced from the literature. First, there is a consensus that infrastructure generally matters for growth. Nevertheless, the findings remain enormously wide-ranging, particularly in relation to the magnitude of the effect, with studies reporting returns to infrastructure very different to each other. Second, the literature has been plagued by numerous methodological issues that have often lead to a doubt on the robustness of the results. Estimating the impact of infrastructure on growth is complicated as the relationship between these variables is complex and there are network effects, endogenity problem, and quality of data is also questionable at a much disaggregated level. Third there is a huge gap in the literature in terms of studies which evaluate the role of infrastructure in eliminating or reducing poverty. More so, such studies are practically non-existent in context of Indian studies. It is here that this study fills in this gap in the literature.

II. India-Now and then

2. 1 Growth in India

India has seen a major structural break in its growth performance after economic reform in the early nineties. In early 1990s time period as a response to the Balance of Payments crisis, the most important reforms of the economy were undertaken. Since independence, the country has come a long way from a growing at Hindu rate of growth to becoming the fastest growing major economy in the world. The average growth rate of the economy has increased from 1990s to late 2000s. The graph below (Figure 07) clearly shows the increase in average growth rate from 1980s to 2014.

Figure 07: GDP of India



Source: International Monetary Fund

However, one of the major criticisms of the post reform growth process is that the benefits of growth have notbeen borne by one and all and there has been an increase in regional inequality in the country. Higher growth has not equally benefited every region of the country, which has led to further higher differences in level of per capita income between the regions.

A number of studies have found similar results with the regional inequalities increasing in 1990s, including Ahluwalia, 2000 and 2002; Nagaraj, Varoudakis and Veganzous, 1998; and Rao, Shand and Kalirajan, 1999. The table below from the paper "Regional growth and disparity in India: a comparison of pre and post-reform decades" by B.B. Bhattacharya and S.Sakthivelshows that the disparity between states has increased by showing that variance in growth rates among states is higher in 1980s as compared to 1990s.[1]

Table 01: Growth Rate of SDP at Constant Prices (percent per annum)

States	**1980- 90**	**1990-00**
Andhra Pradesh	4.81	5.12
Assam	3.91	2.47
Bihar	5.2	3.46
Goa	5.71	8.23
Gujarat	5.71	8.28
Haryana	6.68	6.71
Himachal Pradesh	6.1	6.91
Karnataka	6.1	7.07
Kerala	4.5	6.0
Madhya Pradesh	5.18	5.45
Maharashtra	5.98	6.8
Orissa	5.85	3.6
Punjab	5.14	4.63
Rajasthan	7.17	6.46
Tamil Nadu	6.35	6.65
Uttar Pradesh	5.88	4.33
West Bengal	5.2	7.24
All India	5.6	6.03
Coefficient of Variation	**0.14**	**0.29**

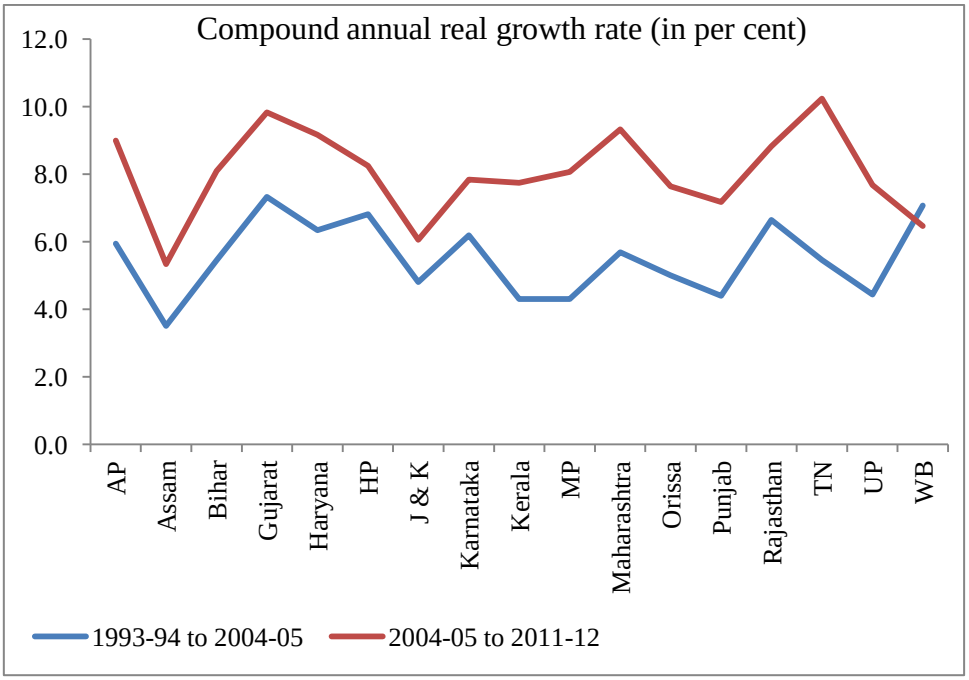
The convergence theorem (Barro, 1991) suggests that when the growth rate of an economy accelerates, initially some regions with better resources would grow faster than others.

[1]Bhattacharya, B., S. Sakthivel (2004): Regional Growth and Disparity in India: Comparison of Pre- and Post-Reform Decades": Economic and Political Weekly, Vol 39, No.10, March 06 - March 12, 2004, accessible at http://www.iegindia.org/upload/publication/Workpap/wp244.pdf

However after certain level of development, when the law of diminishing marginal returns set in, and growth rates would converge, due to differential marginal productivity of capital (higher in poorer regions and lower in richer regions), and this in turn would bridge the gaps in the levels of income across regions.

Figure 8(below) plots the compound average annual growth rates of states in the two time periods under study, i.e. 1993-94 to 2004-05 and 2004-05 to 2011-12. It is important to note that theaverage annual growth rate of all states (expect West Bengal) has been higher during the second time period (2004-05 to 2011-12) as compared to the growth in the first (1993-94 to 2004-05).[2] Another important observation is that the growth rate of all states has been quite varied in both time periods. Third point is that the trend of growth lines is somewhat similar in the sense that the states with higher growth in first phase mostly has higher growth rate in second time phase as well.

Figure08: Growth rate of GSDP at constant (2004-05) prices



The time period 2004-05 to 2011-12 has also seen the growth rates of states which were lagging like Bihar, Orissa also picking up. However, the pick-up has still been much lower for convergence to happen between states. Chowdhury (2014) also finds that lagging regions of the country have started growing at a faster rate during the decade of 2000 compared to the

[2] The appendix 3 of the paper has the detailed tables of the GSDP and its growth rates both at the current and constant prices.

first decade of economic reform. However regional inequality has still increased over the period despite some of the poorer states registering higher growth rates post 2003-04.

2.2 Poverty in India

The Planning Commission is the nodal agency in the Government of India for estimation of poverty in India. It estimates the incidence of poverty at the national and state level separately for rural and urban area. The incidence of poverty is measured by the poverty ratio[3], which is the number of poor to the total population expressed as percentage. It is also commonly known as head count ratio. The poverty ratio is calculated on the basis of independently determined poverty line quantified in terms of per capita consumption expenditure over a month and the class distribution of persons obtained from the thick rounds of large sample surveys of consumer expenditure data of National Sample Survey Office (NSSO).

Since the Working Group of the Planning Commission decided the methodology of poverty estimation in 1962, it has been a topic of debatefor the academicians, experts, policy planners, etc. over the years. To update the poverty lines according to changing times, the Planning Commission has constituted Task Force/Expert Group from time to time to review the methodology. These include the Task Force under the chairmanship of Dr. Y. K. Alagh in 1977; the Expert Groups under the chairmanship of Prof. D.T. Lakdawala in 1989 and Prof. S.D. Tendulkar in 2005. The methodology of every subsequent committee has been based on the idea of improving the methodology, while keeping in mind two main constraints- firstly subsequent poverty lines should be comparable and secondly it should also reflect the condition of people presently.It became really challenging to maintain a balance between these two constraints. The poverty numbers became more and more controversial in 90s, post India adopted economic reforms. The official numbers published by the Government of India, which showed acceleration in poverty reduction from 36 per cent of the population in 1993/94 to 26 per cent in 1999/00, have been criticized for being very unrealistic. The statistical debate related to the measurement of poverty lines evolve around followingrelevant issue- choice of base year, use of implicit prices calculated from NSSO survey, construction of price indices, discrepancy between survey and national accounts, the effect of questionnaire design etc. (Deaton and Kozel, 2001).

[3] There are other measures of poverty like poverty gap ratio etc.. as well, however Planning Commission gives poverty ratios

Poverty ratio in India has declined from 1993-94 to 2011-12 with the decrease being observed in all states, however the decline neither has been uniform across states nor steady across time. It has been observed that the decline in poverty rates in almost all major states was higher in the sub- period 2004-05 to 2011-12.

A World Bank (Poverty and Equity Global Practice Group) paper identifies the rapid decline in poverty in India between 2005 and 2012[4]. There are various other studies which identified similar trends of poverty rates in India and also the causes of reduction in poverty rates.

Sundaram and Tendulkar (2009) point out in their analysis that the poverty rates in India declined during 1990s on all different possible measures of poverty; for example the head count ratio, the poverty-gap Index, the squared poverty gap or the absolute number of poor[5]. The average annual reaction in poverty in 1990s was higher than that recorded during the ten years period preceding 1993-94[6].

Dang and Lanjouw (2015)[7] assess the sharp poverty rate decline between 2004-05 and 2011-12 and found that not only the poverty rates have declined but also the susceptibility of people falling below poverty line again has also declined significantly. Poverty estimates as per the Tendulkar committee methodology shows that no matter how we segregate the data (social, religious or economic groups), poverty has declined sharply for the time period 1993- 94 and 2011-12 with a significant acceleration during the faster-growth period of 2004-05 to 2011-12[8], although this has been attributed to rural distress and movement of women, by many economists.

The graph below (figure 09) shows the poverty rate decline in various states in these 2 phases. The graph clearly shows the fall in poverty rates in all the states and also a bigger decline in poverty rates, however the rate of poverty decline has varied among states. There can be numerous reasons for the differences, out of which we try and explore 2 of them, growth and infrastructure.The recognition that economic growth alone is not sufficient to bring down

[4]Carlos Felipe Balcázar, Sonal Desai, Rinku Murgai and Ambar Narayan, "Why Did Poverty Decline in India?" Accessible at http://www-wds.worldbank.org/servlet/ WDS ContentServer/WDSP/ IB/2016/03/15/090224b084201cb7/10/Rendered/PDF/Why0did0povert0composition0exercise.pdf

[5]Poverty Decline in India in the 1990's: A Reality and Not an Artifact K. Sundaram and Suresh D. Tendulkar, accessible at http://policydialogue.org/files/publications/Ch_14_Sundaram_Tendulkar.pdf

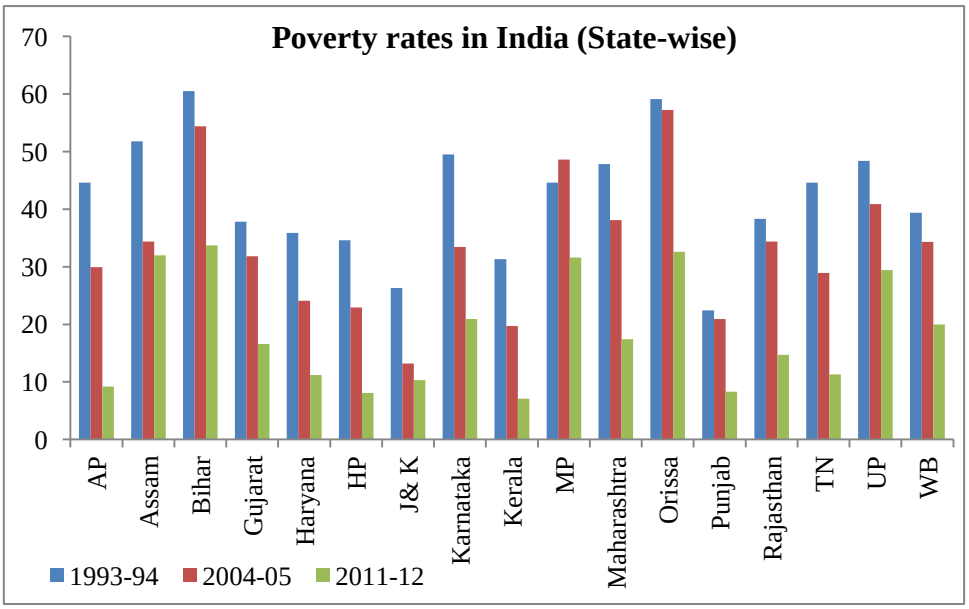
[6]Poverty in India in the 1990s: Revised Results for All-India and 15 Major States for 1993-94, K. Sundaram and Suresh D. Tendulkar, Economic and Political Weekly, Vol. 38, No. 46 (Nov. 15-21, 2003), pp. 4865-4872.

[7] Poverty Dynamics in India between 2004 and 2012: Insights from Longitudinal Analysis Using Synthetic Panel Data, Hai-Anh H. Dang and Peter F. Lanjouw

[8] Poverty by Social, Religious & Economic Groups in India and Its Largest States 1993-94 to 2011-12, ArvindPanagriya and Vishal More

incidence of poverty has led to measures that can make a direct impact on the income of the poor. For instance, employment guarantee programs, child nutrition programs, improved access to primary health and education services in rural areas have been designed to provide certain minimum essential services and minimum income levels to the rural poor. The next section addresses the question of whether the infrastructure improvement played a role in reducing poverty in states and the states with better provision of infrastructure have been able to reduce poverty by greater amount.

Figure 09: Poverty ratios in India (State-wise)



Note: *The poverty rates of the states are based on Tendulkar Committee Report. Poverty rates for UP, MP, Bihar also includes Uttarakhand, Chhattisgarh, and Jharkhandrespectively.*
Source: *Planning Commission*

2.3 Infrastructure in India

India has long history of infrastructure development, historically saying, it can perhaps be said that infrastructure development in India came to be explicitly recognized as an important State responsibility as early as the regime of EmperorSher Shah (1540-1545), when a multitude of infrastructure projects on irrigation and roads were started, this includes still today famous the famous Grand Trunk Road linking the East and West extremities of the country. Another significant moment in the history of infrastructure development came

during the British Raj, when the Indian Railway got started in 1853. The important role of infrastructure in the economic development of the nation was also acknowledged by the National Planning Committee (1938) and the Bombay Plan (1944).These efforts provided the necessary base and motivation for action on infrastructure under the subsequent Plans in post-independent India when it largely remained a responsibility of the State, till economic reforms were adopted. The major policy shift on infrastructure occurred in the 1990s when, along with other wide ranging economic reforms, the infrastructure sector was also opened up to private and foreign participation in view of its large financing needs. The implementation of the National Highway Development Project, coupled with the Prime Minister's Gram Sadak Yojana (The Prime Minister's Rural Roads Plan) marked a similar milestone in the, the 21st century. Lately some popular state led infrastructure projects are- Metro Projects, Neemuch solar power plant, Yamuna Expressway, GIFT city, Banihal-Quazigund tunnel, The Chennai Mofussil Bus Terminus, Mumbai Eastern Freeway. But the notion of infrastructure development has always been biased towards 'Physical Infrastructure', until recent most effort, both by the state and private enterprises, to improve infrastructure focused towards physical infrastructure but neglected Social infrastructure.

World Economic Forum publishes the Global Competitiveness Index (GCI) Report[9] annually since 2005 where they have defined 12 pillars of competitiveness in which **Infrastructures a pillar.** They have 3 categories of pillars – Basic requirements, Efficiency enhancer's, Innovation and sophistication factors and most importantly, **infrastructure is a part of basic requirements** showing the importance of the infrastructure factor for the competitiveness and hence growth of the country. The weight attached to different pillars varies for different set of countries and for developing or less developed countries (with per capita GDP less than $2000) which are still at factor driven stage of growth, the basic requirements are given a weight of 60per cent.

According to Global Competitiveness Report 2015-16, India ranks at 55th position, 16 places higher than the report for 2014-15, when India was at 71th position out of 144 countries analyzed."Infrastructure" covers all modes of transportation, as well as telecommunication, sanitation, and irrigation infrastructures. In terms of infrastructure, India's rank is 81however, within the infrastructure category; its position varies from almost being the worst performing in mobile subscription to a good performing airline sector. Despite mobile telephony being

[9]www.weforum.org/gcr

almost ubiquitous, India is one of the world's least digitally connected countries. Broadband Internet, if available at all, remains the privilege of a very few. Transport and electricity infrastructure are in need of upgrading (115thrank).In 2005, India has a score of 3.50 for infrastructure and ranked 62 out of 125 countries and till 2014-15, the score of infrastructure had increased only to 3.7 and was ranked 90this still lower than BRICS and many neighboring countries, showing the pressing need for infrastructure development in our country. The last one year witnessed some improvement in infrastructure development, with the country moving up to 81st position.

Table 02: Infrastructure Status of India (2014-15)

Indicator	Value	Rank
Quality of overall infrastructure	3.7	90
Quality of roads	3.8	76
Quality of railroad infrastructure	4.2	27
Quality of port infrastructure	4.0	76
Quality of air transport infrastructure	4.3	71
Available airline seat km/week, millions*	3448	12
Quality of electricity supply	3.4	103
Mobile telephone subscriptions/100 pop.*	70.8	121
Fixed telephone lines/100 pop.*	2.3	118
Source: Global Competitiveness Report 2014-15 **Note:** Values are on a 1-to-7 scale unless otherwise annotated with an asterisk (*)		

Infrastructure development is one of the biggest problems that country is facing today. Infrastructure services act as an input to other sectors of the economy. Congested and inefficient infrastructure increases transportation cost and lower competitiveness in the economy. Transport infrastructure in India is inadequate even for meeting the existing demand. Roads are congested and of poor quality. As a result, for passengers, as well as freight traffic, road services are very costly in terms of lost time, wasted fuel, additional pollution and wear and tear of vehicles. Similarly, railways and port infrastructure has been stretched to limits. The railways and port sector are not in position to meet current demand for their services. For instance, several power plants are unable to secure sufficient and timely

supply of coal partly because of inadequate capacity in these sectors. For similar reasons, steel plants are also facing problems in ensuring timely supply of iron ore. In fact, efficient transportation of basic goods has emerged as serious challenge for the economy. Even to keep pace with the current growth rate of 7-8 per cent, the economy needs much more extensive infrastructure.

The magnitude of the problem is simply confounding. For instance, assuming unit elasticity for traffic growth a growth rate of 7 per cent means that the traffic will expand by a factor 4 during the next 20 years. Similarly, the demand for the transportation of coal, iron ore, steel and cement will increase at least in equal measures. Unless road and railways infrastructure is expanded considerably, we could be looking at really messy situation. Most of our demand for petroleum product is met through imports. Therefore, it is crucial to expand ports handling capacity. If the recent controversy over allocation of coal mines is anything to go by, it is very unlikely that domestic production will be able to meet the national demand for coal. Therefore, a significant fraction of demand will have to be met through imports, putting additional burden on port infrastructure. Thus, it is essential that the capacity of roads, ports, airports and water ways be expanded drastically and without further delay.

2.4 Urbanization in India

Urbanization is one of the most important indicators of development in today's world. In a sense urbanization is even synonymous to development. It would also not be wrong to say that urban areas have highest concentration of all kind of infrastructure - **physical, financial and social**. The importance of urbanization in economic planning in India can be understood from the fact that all the five year plans since independence has focused on urban development, even when the focus areas changes with every plan .

In India, the definition of an urban center has remained unchanged since 1961 there by facilitating comparison of census data over time (Sivaramakrishnan, Kundu and Singh 2005, pp. 7-8). For the purposes of Census operations, an area is classified as an urban unit if the place is declared by the state government under a statute as a municipality, corporation, cantonment board, or notified town area committee etc.. In addition, all other places which simultaneously satisfy or are expected to satisfy the following criteria are classified as urban:

a minimum population of 5,000, at least 75 per cent of the male working population engaged in non-agricultural economic pursuits, and a density of population of at least 400 per square kilometer (1,000 per square mile). Any area that does not fit the definition of urban is considered rural.

In India the increase in urban population can be attributed to mainly four factors. These four factors and their contribution is following: - natural growth of population (accounted 59.4 percent in 1991-01); emergence of new cities (accounted 6.2 percent in 1991-01); rural to urban migration (accounted 21 percent in 1991-01); and reclassification of rural areas as urban (accounted 13 percent in 1991-01) (Kundu, 2006).

As per the census numbers, India's population stood at 1.21 billion in 2011. The share of India's population living in urban areas increased from 27.81 percent to 31.16 percent in the inter-censal period 2001-2011. Comparison over the two periods 1991-2001 and 2001-2011, indicates that the rate of growth of population of India has slowed down. Over the inter-censal period 1991-2001, the population increased by 21.5 percent (18.1 percent in rural and 31.5 percent in urban). In the inter-censal period 2001-11, India's population increased by 17.6 percent (12.2 percent in rural and 31.8 percent in urban). The decline in overall growth of population is mainly because of decline in the growth rate of population in rural areas. In terms of absolute numbers the population increased from 1.029 billion to 1.21 billion.

In the context of this study the most significant outcome is the fact that every state has witnessed positive growth rate in urbanization in period 1993-94 to 2011-12. Kerala shows the highest growth rate followed by Tamil Nadu and Haryana. Assam, Bihar, Uttar Pradesh, Rajasthan shows the least growth in urbanization. This clearly shows that there is high correlation between growth and urbanization.

Table03: Major Urban Development Programmes

PLAN PERIOD	MAJOR URBAN DEVELOPMENT PROGRAMMES
First Plan (1951-56)	Main importance was given for construction of institution building, houses for government employees and weaker section of the people under the Centre subsidized scheme.
Second Plan (1956-61)	1. Industrial Housing Scheme was broadened to include all workers. 2. Preparation of Master Plans (e.g., Delhi Development Authority (DDA)) for important towns by setting up the Town & Country

	Planning Legislations.
Third Plan (1961-66)	1. Through urban planning and land policy measures (such as, the control of urban land values through public acquisition) imbalance and asymmetry were sought to be removed in the development of large, medium, and small industries, and between rural and urban areas. 2. The State capitals of Gandhi Nagar and Bhubaneswar were developed and Master Plans for important cities were prepared.
Fourth Plan (1969-74)	1. To provide fund for housing and urban development programs, Housing & Urban Development Corporation (HUDCO) was established. 2. The creation of smaller towns and plan for the spatial location of economic activity were envisaged for decongestion of population in the large cities. 3. To provide a minimum level of services, like, water supply, drainage, sewerage, street pavements in 11 cities with a population of 8 lakhs, an environmental or urban slum improvement scheme was commenced in the Central Sector.
Fifth Plan (1974-79)	1. To prevent concentration of urban land holding and to use them for construction of houses for the middle and low income group, the Urban Land (Ceiling & Regulation) Act was set up and was passed in 1976. 2. In order to ease the increasing pressure on urbanization a Task Force was set up by giving particular emphasis on a comprehensive and regional approach by considering the problem in metropolitan cities.
Sixth Plan (1980-85)	1. To encourage setting up the new industries, commercial and professional establishments in small, medium and intermediate towns, positive inducements were suggested. 2. The major importance was on integrated provision of basic services for the poor. The Integrated Development of Small and Medium Towns (IDSMT) was launched in towns with population below one lakh for provision of roads, pavements, minor civic works, markets,

	shopping complex, bus stands, etc..
Seventh Plan (1985-90)	1.To expand the base of housing finance, the National Housing Bank was set up 2. To promote commercial production of innovative building materials, Building Material Technology Promotion Council (BMTPC) and a network of Building Centers were set up. 3. For the first time, this Plan also considered the problem of the urban poor and Urban Basic Services for the Poor (UBSP), Global Shelter Strategy (GSS), and National Housing Policy (NHP) were announced in 1988.
Eighth Plan (1992-97)	1. The Constitution (74th) Amendment Act, 1992 was made with a view to improve governance at the grass roots by stressing upon decentralization and creation of democratic governance structure; devolution of funds and responsibilities was ensured for fulfilling the needs and aspirations of urban residents. 2. For the first time, this Plan identified the role and importance of urban sector for the national economy and recognized the significance of the following issues: i. Poor suffered due to huge gap between demand and supply of infrastructural services. ii. Housing shortage caused by the unabated growth of urbanization. iii.Higher level of incidence of urban poverty and marginal employment.
Ninth Plan (1997-02)	1. The SwarnaJayantiShahariRozgarYojana (SJSRY) to provide gainful employment to the urban unemployed or underemployed poor by encouraging the setting up of self-employment ventures or provision of wage employment. 2. The Urban Self Employment Programme (USEP). The Urban Wage Employment Programme (UWEP). 3. Nehru RozgarYojana (NRY) to provide employment to the urban unemployed and underemployed poor. 4. Urban Basic Services for the Poor (UBSP) to achieve the social sector goals. 5. Prime Minister's Integrated Urban Poverty Eradication Programme (PM IUPEP) for Class II urban agglomerations development of urban

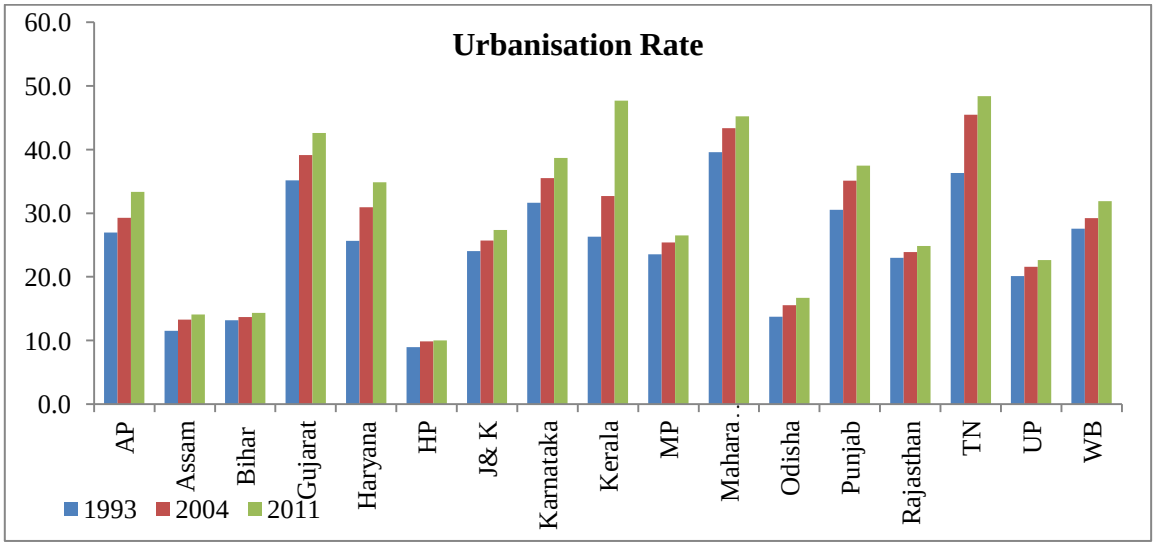
	poor. 6. Other basic service provision included Urban Water Supply and Sanitation.
Tenth Plan (2002-07)	1. Strengthening urban governance by judicious devolution of functions and funds to the elected bodies and ULBs. 2. Land Policy and Housing: The repeal of the Urban Land (Ceiling and Regulation) Act, 1976 was a significant step towards reform in the urban land market. 3. Mapping, urban indicators and data from the urban sector: Town and Country Planning Organization (TCPO) wereestablished for urban mapping based on aerial photography. 4. Extending Plan Assistance for infrastructure through various programmes, such as, Accelerated Urban Water Supply Programme (AUWSP), IDSMT, Mega city Scheme, etc.. 5. Urban poverty alleviation and slum improvement. 6. Improvement of civic amenities in urban areas through improvement in urban water supply, urban sanitation, and urban transport.
Eleventh Plan (2007-12)	1. Jawaharlal Nehru National Urban Renewal Mission (JNNURM). 2. Urban Reform Incentive Fund (URIF) 3. Mega city scheme Integrated Development of Small and Medium towns (IDSMT) 4. Pooled Finance Development Fund (PFDF) 5. Development of satellite cities/counter Magnet cities 6. E-governance in municipalities National Urban Information System (NUIS). 7. National Capital Region Planning Board (NCRPB). 7. Strengthening urban local bodies through capacity building and better financial management. 8. Increasing the efficiency and productivity of cities by deregulation and development of land. 9. Dismantling public sector monopoly over urban infrastructure and creating conducive atmosphere for the private sector to invest.

	10. Establishing autonomous regulatory framework to oversee the functioning of the public and private sector. Using technology and innovation in a big way. 11. SwarnaJayantiShahriRozgarYojana (SJSRY). 12. Reducing incidence of poverty. 13. Accelerated Urban Water Supply Programme (AUWSP). 14. Improvement of urban basic services which includes water supply and solid waste management, others.
Twelfth Plan (2012-17)	1. Rapid Mass Transport (RMT) for better transportation system. 2. Reform of the urban water sector. 3. Efficient use of urban land. 4. Long term strategic urban planning with the overall regional planning perspective. 5. The environmental sustainability of urban development. 6. Investment in new urban infrastructure assets and maintenance of assets. 7. Need to strengthen urban governance 8. To strengthen the 'soft infrastructure' 9. Improvements of urban utilities such as water and sewerage NUHM (National Urban Health Mission) for better urban public health.

Source:SabyasachiTripathi (2013)

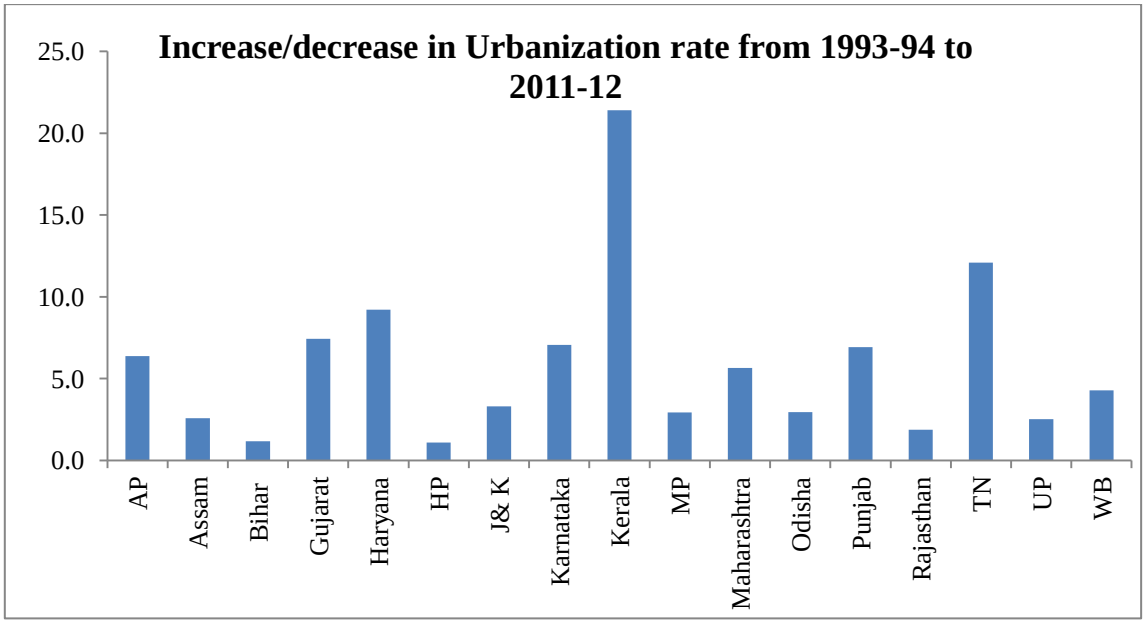
Urbanization has taken place in India along the development of the country. As the graphs below (figure 10 and 11) shows that the Urbanization rate for all the states have increased gradually from 1993-94 to 2011-12. Tamil Nadu is the most urbanized state in 2011-12, followed closely by Kerala and Maharashtra. Tamil Nadu and Maharashtrahad high urbanization rates to start with as well in 1993-94, however Kerala did not and it has shown the highest increase in urbanization over this time period (Figure 11). Tamil Nadu has also shown great improvement in urbanization rates over this time. On the other hand, states like Bihar, Himachal Pradesh, Rajasthan, M.P. and Orissa have seen very low improvement in rates of urbanization. These states have low urbanization rates in 2011-12. Himachal Pradesh is a state with the least urbanization rate; this may be due to the state being of hilly terrain or due to being a small state. It also has shown hardly any increase in urbanization rates in more than last 20 years.

Figure 10: Rate of Urbanization



Source: Census of India (1991, 2001, 2011)

Figure 11: Change in rate of Urbanization



III. Research objective, data sources and methodology

3.1 Research Objective

The extensive literature review aided in establishing the requirement and scope of this thesis. As discussed earlier there are various studies on the impact of infrastructure on growth but a great deal of work has not been done on studying the impact of infrastructure on poverty reduction (especially in Indian context). There is need to study the same with the latest possible data. It is equally important to study the impact of different kind of infrastructure on poverty reduction.

The primary aim of this thesis is to carry out a detailed enquiry about the various impact of infrastructure on the well-being (represented by poverty) of people in major Indian states. **The hypothesis is that the difference in the well-being of people across Indian states can be explained by differences in the level of infrastructure across states.** Based on the above stated hypothesis, following are the research objectives:

- The **first research objective** is to create Infrastructure Index. To capture various dimensions of infrastructure, four kinds of infrastructure index has been created. Physical, Financial, Social and Total Infrastructure Index.
- The **second research objective** is to analyses the level and growth of infrastructure in various Indian states between 1991 and 2011.
- The **third research objective** is to empirically check the impact of all four kinds of infrastructure on the well-being of people (poverty).
- The **fourth research objective** is to empirically evaluate the link between urbanization, infrastructure and well-being of people (poverty).

With these specific objectives, there are some specific issues being examined here. Those issues can be put forward as propositions:

- There exists considerable variation across regions in terms of availability of infrastructure facilities

- There exists considerable variations across regions in terms of economic development levels and poverty levels too
- Levels of economic development and poverty level depends on the level of infrastructure
- Different types of infrastructure have different effects on economic development and poverty
- Infrastructure facilities are major variables in explaining inter-regional variation in levels of economic development
- There is high degree of positive association between urbanization and infrastructure

The thesis will proceed accordingly to analyze the entire three research objective in a systematic way. The above issues were sought to be examined in the context of Indian experience. This would let us arrive at conclusion regarding the role of infrastructure in shaping growth and poverty at regional level.

The thesis will proceed accordingly to analyze the entire three research objective in a systematic way. The 18 Indian states studied under this thesis are- Andhra Pradesh, Assam, Bihar (includes Jharkhand), Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh (includes Chhattisgarh), Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh (includes Uttarakhand) and West Bengal.

3.2 Methodology

3.2.1. Infrastructure Index

The creation of an index is primarily an aggregation exercise. Index primarily represents combination of many variables. So, to create index there are various aggregation methodology available. The method used in this study to aggregate different variables is PRINCIPAL COMPONENT ANALYSIS. In this section principal component analysis and some other related methodology will be explained.

Four infrastructure indexes calculated are PHYSICAL, FINANCIAL, SOCIAL AND TOTAL. Each index is here to capture one specific dimension of development/infrastructure. This can be done using multivariate technique of Factor Analysis. Even under Factor analysis there are various methods, namely-

- The Centroid Method
- The Principal Component Analysis, and
- The Maximum Likelihood Method

The Centroid method and The Maximum Likelihood Method is explained very briefly here. More detailed description of The Principal Component Analysis will be done.

The Centroid Method is not very popular among researchers these days. This methodology was popular in the first half of the twentieth century. This technique maximizes the sum of loadings or weights that factor attaches to individual variables, disregarding signs. The benefit of using it is its convenient and simplicity to use. But it lacks explanatory power, mainly because it disregards the signs of the factor loadings.

The Maximum Likelihood Method is statistically the most efficient methodology, it consists of obtaining a set of Factor Loadings such that each factor explains maximum possible of the Population Correlation Matrix. Although this method tries to maximize the relationship between sample data and population, it is very difficult to use. It involves relatively difficult mathematics, higher algebra and matrix algebra and its interpretation is also very difficult. Thus it is generally not used very often by the researchers.

The most commonly and frequently used method of Factor Analysis these days is Principal Component Analysis. In this method the sum of squared Loadings of each factor is

maximized. This is done with the objective that the factor obtained from the Principal Component Method explains the maximum possible variance in the data matrix. However, this method of maximizing the factor variable correlation is simply another way of assigning higher weight age to variable that move in one/uniform direction and relatively lower weights to those variables that move in different direction. But this done without any prior justification for doing so. However it is still the best possible thing to do, as this is considered to be better than giving weights on the basis of individual value-judgment, which are bound to be biased and defeats the whole purpose of fair research. Beforeusing this method, it is necessary to make the data matrix scale free, since any linear scale transformation would affect the weights attached to the variables and will change the composite factor score of each observation. One easy way of doing so is to divide the data matrix by its mean to get a scale free transformed data matrix. It is widely used by the researchers, but is seriously criticized for its interpretation. The single variable created out of many variables using this technique, is an artificial variable which sumps up all the variable used in the construction of this variable. That is why it becomes very difficult to pin point which out of many variables is the most important one.

Another Method of compositing is to have a composite factor in a way that it has equal correlation with every variable- implying that the variables are equally important. Another variant of this method is the "Unequal Correlation Method" where the weights are obtained in a way that the composite factor has unequal correlation with the variables. If variables that are more disperse across space (or time) are thought to be more important, then the weighting scheme should be such that the correlation of the variable with the "factor" varies directly with the coefficient of variation of the variables. On the other hand, if it is felt that higher representation should be given to those variables that have lower dispersion over space then the correlation should vary inversely with CV of the variables. This second, approach would, however, be against the notion obtained from the experience of regional development and therefore has limited validity.

Empirical studies examining the relationship between growth and infrastructure face challenge of defining infrastructure concretely. Different studies have used different approaches, like some use the harmonious definition or World Bank definition of infrastructure for creating an index; while others use individual indicators of physical, social or financial infrastructure etc.. In this study, we have created 4 infrastructure indices, namely financial, physical, social and total using Principal Component Analysis (PCA) technique.

PCA is a technique used to obtain an artificial variable from the observed variables; it is used as a variable reduction technique.[10]

The paper studies the interregional variation in infrastructure development within India and its role in explaining the variation in economic growth and reduction in poverty in Indian states. Hence, the indicators were chosen keeping in mind the harmonious definition, however with a limitation that the state-wise time series data had to be available. Hence the indicators chosen were road length per sq. km, rail length per sq. km, per capita electricity consumption, gross irrigated area as a percentage of gross cropped area in the physical category; banking offices per sq. km, credit-deposit ratio, state's own tax revenue to GDP ratio in financial category and infant mortality, educational institutions per sq. km, Gross Enrolment Ration in Upper Primary Classes in the social category. The time period taken for this study is 1991-2013, that is the time after economic reforms were undertaken in India. Major 17 states have been chosen for this analysis, the complete list of which is attached in the appendix.[11]

3.2.1.1. Infrastructure indicators

As discussed before Infrastructure is clearly multi-dimensional in nature. There can be various classifications of infrastructure, most appropriate for the present study is PHYSICAL, SOCIAL and FINANCIAL. Physical infrastructure is the most common type, most of us understand infrastructure as physical one only. This basically encompasses the tangible things, which are also known as 'Hard Infrastructure'. The most important aspect of this kind of infrastructure is road, rail, electricity and agriculture. Agriculture in India is highly affected by irrigation, which in turn is also affected by electricity. Social and Financial infrastructure are generally related to intangible things. Social infrastructure mainly is related to health and education, which are also Merit goods. Financial infrastructure brings in monetary side of the economy. These are together also known as 'Soft Infrastructure'. Out of the various indicators of Physical, Financial and Social infrastructure, the following categories of infrastructure were chosen for their relevance and availability of data:

[10]It is useful when there is data on a number of variables (possibly a large number of variables), and there is a possibility of some redundancy in those variables, maybe because they are measuring the same construct. Because of this, it may be possible to reduce the observed variables into a smaller number of principal components (artificial variables), that will account for most of the variance in the observed variables.

[11]Technically 20 states are being studied as Bihar also includes Jharkhand after the state was bifurcated, Madhya Pradesh also includes Chhattisgarh after the state was bifurcated and Uttar Pradesh also includes Uttarakhand after the state was bifurcated.

PHYSICAL INFRASTRUCTUREINDICATORS

1) Road length per square km
2) Rail length per square km
3) Gross Irrigated Area as a percentage of Gross Cropped Area
4) Per-capita electricity consumption

SOCIALINFRASTRUCTUREINDICATORS

1) Infant mortality[12]
2) Gross Enrolment Ratio in upper primary classes[13]
3) Educational institutions per square km[14]

FINANCIAL INFRASTRUCTURE INDICATORS

1) Credit-Deposit Ratio
2) Banking offices per square km
3) State's own tax revenue to GDP ratio

Using PCA in the data for physical, social, financial indicators from 1991-2013, factor loadings are calculated and then used as weights to construct the above mentioned infrastructure indices.

Infrastructure Index = Factor loading of Infrastructure category 1 * (Infrastructure category 1) + Factor loading of Infrastructure category 2 * (Infrastructure category 2) + ……. + Factor loading of Infrastructure category 'n' * (Infrastructure category 'n')

3.2.1.2. States in the study

Major states were chosen for this thesis and the smaller states and North Eastern States were not covered due to problem of comparability with other states and also due to lack of availabilityofdata for all the indicators.

[12] The infant mortality rate is the number of deaths under one year of age occurring among the live births in a given geographical area during a given year, per 1,000 live births occurring among the population of the given geographical area during the same year. (OECD Glossary of Statistical terms)
[13] Upper primary refers to class VI to VIII.
[14] Educational institutions refer to no of educational institutions excluding pre-primary schools, i.e. primary,middle and high schools.

- Andhra Pradesh
- Assam
- Bihar
- Gujarat
- Haryana
- Himachal Pradesh
- Jammu & Kashmir
- Karnataka
- Kerala
- Madhya Pradesh
- Maharashtra
- Odisha
- Punjab
- Rajasthan
- Tamil Nadu
- Uttar Pradesh
- West Bengal

In total along with these 17 states were used for the study, it is important to note that the states which were bifurcated in between this time period which includes Bihar, Madhya Pradesh and Uttar Pradesh are also taken care of by adding the value of indicators appropriately for the bifurcated states. For example, the value of GSDP of Bihar state also includes GSDP of Jharkhand after the state was bifurcated to ensure comparability of the states across time.The indicators of infrastructure in Bihar before the bifurcation of the state in 2001 cannot be compared with the bifurcated state after 2001. Hence, the indicators of Bihar and Jharkhand have been added so that the infrastructure index of Bihar can be compared across time.Similarly, the data for Madhya Pradesh also includes Chhattisgarh after the state was bifurcated and Uttar Pradesh also includes Uttarakhand after the state was bifurcated. This is to ensure comparability within these states across time.

3.2.2. Regression Analysis

To study the impact of infrastructure on poverty, Gross State Domestic Product of the state is used as a control variable. The time period of the study is 1991-92 to 2013-14. However, the poverty data is available from the Quinquennial rounds of NSS only; hence the data is available for the year 1993-94, 1999-2000, 2004-05 and 2011-12. The Quinquennial round of 1999-2000 is not used as it is not comparable to other rounds. The data for infrastructure indices and GSDP is also used for these 3 years for the panel regression.

There are 2 techniques to analyze the panel data- i.e. Fixed Effects model and Random Effects model. Fixed-effects (FE) model is used when the interest is to analyze the impact of variables that vary over time. FE explores the relationship between predictor and outcome variables within an entity (country, person, company, etc.). Each entity has its own individual characteristics that may or may not influence the predictor variables (for example, being a male or female could influence the opinion toward certain issue; or the political system of a particular country could have some effect on trade or GDP; or the business practices of a company may influence its stock price).

The equation for the fixed effects model becomes:

$Yit = \beta 1 Xit + \alpha i + uit$

Where

- αi ($i=1 \ldots n$) is the unknown intercept for each entity (n entity-specific intercepts).
- Y is the dependent variable (DV) where i = entity and t = time.
- X_{it} represents one independent variable (IV),
- $\beta 1$ is the coefficient for that IV,
- u_{it} is the error term

The rationale behind Random Effects (RE) model is that, unlike the fixed effects model, the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model. If there is a reason to believe that differences across entities have some influence on your dependent variable then you should use random effects. An advantage of random effects is that you can include time invariant variables (i.e. gender). In the fixed effects model these variables are absorbed by the intercept. Random

effects assume that the entity's error term is not correlated with the predictors which allows for time-invariant variables to play a role as explanatory variables.

The random effects model is:

$Yit= \beta Xit+\alpha+uit+\varepsilon it$

Where

εit - Within-entity error

uit - Between-entity error

To decide between fixed or random effects Haussmann test is used where the null hypothesis is that the preferred model is random effects vs. the alternative the fixed effects (see Green, 2008, chapter 9). It basically tests whether the unique errors (u_i) are correlated with the regressors; the null hypothesis is they are not.

Infrastructure, growth and poverty are interlinkedvariables. As discussed in the literature review, the most significant way in which infrastructure impacts poverty is via highergrowth. In this regard the relationship between growth and infrastructure become vital. The direction of causation between these variables is debatable one. It is believed that both re-enforces each other but whether growth increases infrastructure or infrastructure increase growth is still not clearly established. Economic models capturing such relationship often suffer from the problem of endogenity. Econometric study of such relationship is done using techniques which solves the problem of endogenity. One often used technique to solve this problem is "SIMULTANEOUS EQUATION MODELS". In simultaneous equation models unlike single equation models in which a dependent variable (y) is function of independent variable (x), the dependent variable (y) itself become independent variable in some other equation. In single equation model the cause-and-effect relationship, if any, runs from X's to Y. But in many situations, for example a simultaneous equation model, such a unidirectional cause-and-effect relationship is not meaningful. This occurs if Y is determined by X's and some of the X's are in turn determined by Y's. In short, there is two ways or simultaneous relationship between Y's and X's which makes the distinction between a dependent and independent variable dubious one. It is better in this situation to lump together set of variables that can be determined simultaneously by the remaining set of variables. In such models there is more than one equation- one for each endogenous variable. For example, in this study there will be

three simultaneous equations (an example of the format as given below) for representing infrastructure, growth and poverty.

$$Y1 = f(X1, X2, \ldots.)$$
$$X1 = f(Y1, X2, \ldots.)$$
$$X2 = f(X1, Y1, \ldots..)$$

3.3. Data sources

The data used in the study has been taken from various sources which are listed below

- Ministry of Statistics and Programme Implementation
- Ministry of Railways
- Ministry of Road Transport and Highways
- Central Electricity Authority
- Land Use Statistics, Ministry of Agriculture & Farmers Welfare
- Selected Education Statistics, Ministry of Human Resource Development
- Directorate of Economics & Statistics, Ministry of Agriculture
- Reserve Bank of India
- Census 2011, Office of the Registrar General & Census Commissioner
- Census 2001, Office of the Registrar General & Census Commissioner
- Census 1991, Office of the Registrar General & Census Commissioner
- Open Government Data (OGD) Platform India
- NITI Aayog (erstwhile planning Commission)
- Economic Surveys, various volumes (1991-92 to 2015-16)
- State Economic Surveys (various years)
- Indian Public Finance Statistics
- Select Health Statistics
- Sample Registration Statistical Reports (various years)
- Press Information Bureau
- Himachal Pradesh Human Development Report
- Jammu and Kashmir Human Development Report
- State Development Reports (Planning Commission)
- Education in India, 1990-1991;Volume I and Volume II
- Himachal Pradesh Planning Department Data

- Budget Documents of various state governments
- World Economic Forum

IV. Results

This section has been divided into 6 sub-sections. The first one presents the growth pattern of all the infrastructurecategories and that of the infrastructure indices that are constructed using PCA. The second sub-section details out the trends of the 3 infrastructure indicators, the third one explains the interstate disparity in states in terms of infrastructure status. The fourthsubsectiongives the results of correlation analysis of poverty rate with individual infrastructure indices, total infrastructure index, GSDP, urbanization rates. The next one (fifth subsection) gives the results of panel regressions including poverty rates, infrastructure indices, urbanization rates, GSDP variables. The sixth subsection gives the results of simultaneous equation model.

4.1 Growth of infrastructure indicators

The statusofinfrastructure varies widelyamong states and across time as well (the detail infrastructure index is given in Appendix).The level of infrastructure is different across states for all the infrastructure categories, and an important point to note is that all the states have seen some development in infrastructure during 1991-92 to 2013-14, however the pace of development in infrastructure has been quite varied. The infrastructure level among states was varied in 1990s and with different pace of development over last 2 and half decades, the states have different infrastructure levels in recent time as well. Some of the salient features of the status of infrastructure in the countryare:

1) **Per capita electricity consumption:**Punjab had the highest per capita electricity consumption in 1991-92 among all the states, and it had the highest level of per capita electricity consumption in 2013-14 as well.However, because of the high consumption levels in 1991-92, it has the lowest growth in electricity consumption during this time period.On the other hand, Assam had the lowest levels of per-capita electricity consumption in 1991-92, and till date it is the state with lowest per-capita electricity consumption, showing hardly any improvement.
2) **Rail and Road Network:**West Bengal has the densest rail network.Kerala has the best road networkamong all these stateswith highest road length per sq. km in 1991-92 and even in 2013-14. Jammu and Kashmir has theleast spread of rail and road network among all the states considered in this study.

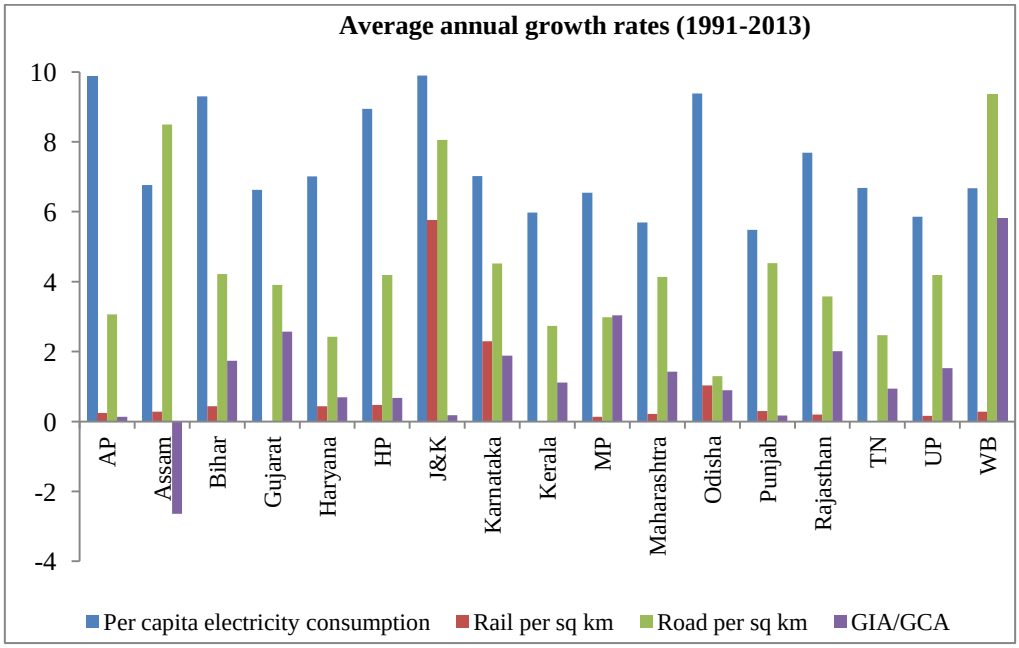
3) **Gross Irrigated Area as a ratio of Gross Cropped Area:**Punjab had about 95 per cent of the total cropped area under irrigation in 1991-92, which stands at 98 per cent in 2013-14. The irrigated area as a ratio of cropped area has consistently been highest in Punjab in all these years and the cropped are in Punjab is now almost fully under irrigation. In contrast, Assam had only about 4 per cent of cropped area under irrigation in 2013, which is even lower than the levels of 1991, showing hardly any presence of irrigation facilities in Assam.
4) **Infant Mortality and Gross Enrolment Ratio:**Kerala fares extremely well in social indicators having lowest infant mortality and one of the highest Gross Enrolment Ratio (GER) among all the states. Infact state of Kerala has for long being hailed as performing exceptionally well in area of social development. Odisha had fared poorly in the improvement in area of decline in infant mortality, as it had the highest infant mortality in 1991, in 2001 and also one of the highest in 2013 as well.HimachalPradesh has highest GER in upper-primary classes since 1991. Jammu& Kashmir and UP has the lowest levels of GER among all the states.
5) **Educational institutions:**Jammu and Kashmir has thelowest number of educational institutions per sq. km.
6) **Own tax revenue to GDP**: Andhra Pradesh has highest Own tax revenue to GDPratio, and on the other hand, Assam has the least. In general South Indian states fared well in this category in comparison to north Indian states.
7) **Banking offices:**Kerala has the highest number of banking offices per sq. km, whereas J& K has the least. In this category also, South- Western states performs better than the North-Eastern states.

The progress of states in terms of infrastructure development depends not only on how well the states have undertaken efforts for infrastructure development, but also on the level of infrastructure in the beginning, the growth rate of the states, urbanization rate in the state etc.. To begin with the analysis, the growth rates of the individual infrastructure categories, including physical, social, and financial are compared and the results are as follows:

(a) Physical infrastructure: All the states have seen some improvement in terms of physical infrastructure. There has been growth in availability/provision of all the categories of physical infrastructure under study which are roads, rail, irrigation, electricity. The maximum growthhas beenin the levels of per capita electricity consumption in all the states. There has been high growth in road per sq. km in all

states as well. Many studies have pointed that road length is one of the most important factors for growth, in this light development in road network is very motivating.Among the 4 indicators of physical infrastructure, **rail length per square km has witnessedleastgrowth** (with an average of 0.7 per cent for all the states).There has been hardly an improvement in rail infrastructure in this time periodin the country (as can be seen clearly in the red bars of the Figure 12). This is not a good sign as railways are an important mode of transport.Irrigation facility measured by Gross Irrigated Area as a ratio of Gross Cropped Area has increased in all states, with the only exception of Assam, where the share of irrigated area as a percentage of cropped are has declined in 2013, as compared to 1991.

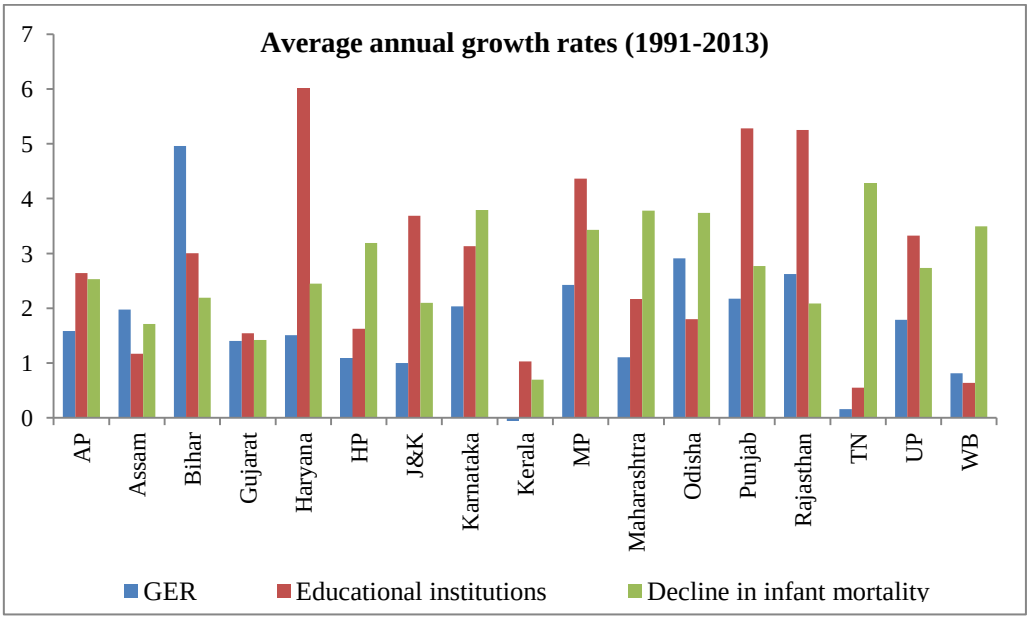
Figure12: Growth in physical infrastructure



(b) Social Infrastructure: The social infrastructure which has been a neglected area in our country has seen some improvement in the time period of 1991-92 to 2013-14. The most important observation is that the growth rates of the social infrastructure have been positive for all the states; i.e. the social infrastructure has improved in all states. States like Bihar, Odisha and UP, the states which did not fare that well in ranking on terms of social indicators in the initial period of the study have also seen much progress in social infrastructure over these 2 decades. **The most striking result is the highest average annual growth rate of GERin Bihar, and that of**

educational institutions in Haryana, which were the states that were lagging behind in areas of social development. The above mentioned result in case of Bihar might be because of low base, which gives higher growth rates; but it also shows the intense effort put in by the states for social development**.** Infant mortality has decreased in all states, with the maximum decline in Tamil Nadu. The least decline in infant mortality has been in Kerala, not because the state has not performed well in social infrastructure development, but because the initial level of infant mortality in the state only was lowest and hence it is reflected as the least improvement rates. The figure 13 below shows positive growth rates for all social infrastructure categories (shown as positive bars in the figure for all the states) during this time period.

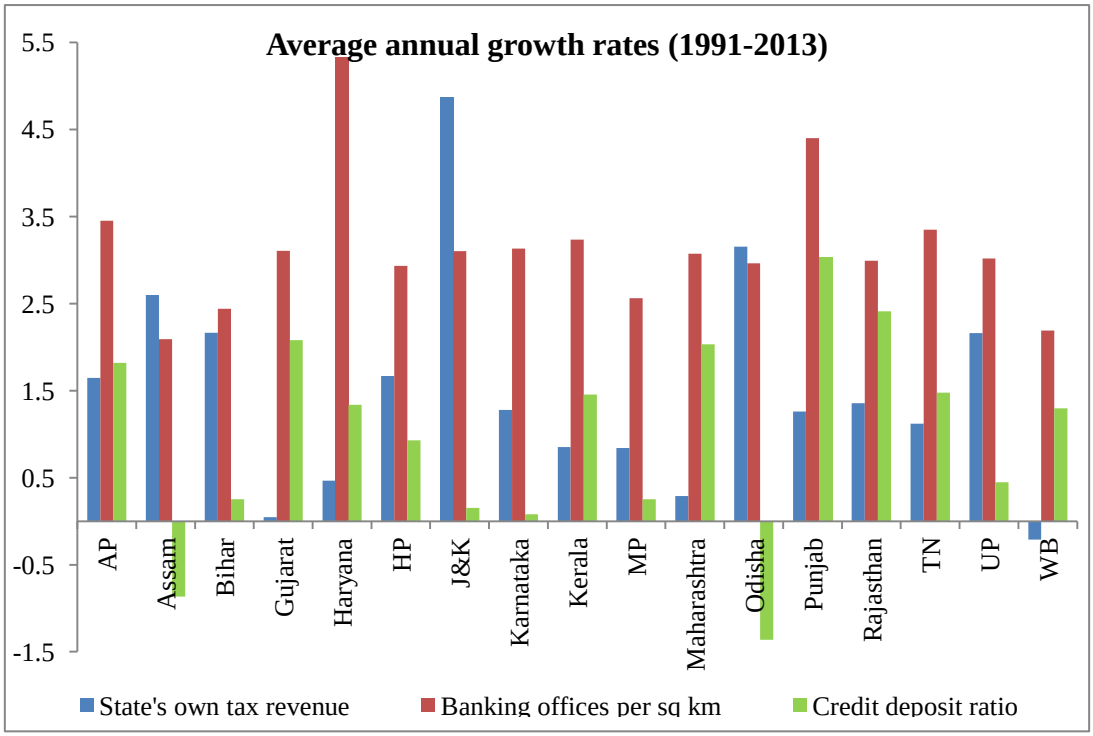
Figure 13: Growth in Social infrastructure



(c) Financial Infrastructure: Financial infrastructure may be considered as a newer area as the spread of financial institutions (except post offices which have not been covered in the study due to non-availability of state-wise data) has been relatively new in the country. The average growth in the financial infrastructure indicators has been less than that of the physical infrastructure categories and social infrastructure categories. Among the financial infrastructure indicators, banking offices per sq. km has seen the maximum increase in almost all the states, with Haryana having the highest increase

over this time period. Credit-deposit ratio[15] has grown over these years with the notable exceptions of Odisha and Assam, where the credit-deposit ratio has decreased over the time period 1991-2013. It was intended to take post office as well in financial infrastructure however its data was not available state wise for this time period, hence it was not taken.

Figure 14: Growth in financial infrastructure



4.2 Infrastructure Indices trends

After studying the growth of individual infrastructure indicators, the infrastructure indices i.e. Physical, Social, Financial and total are constructed using Principal Component Analysis. Using PCA, the infrastructure indices have been generated from 1990-91 to 2013-14. These indicators give a widespread measure of the status of infrastructure in the states. The trends of the infrastructure indices across these years are summarized below:

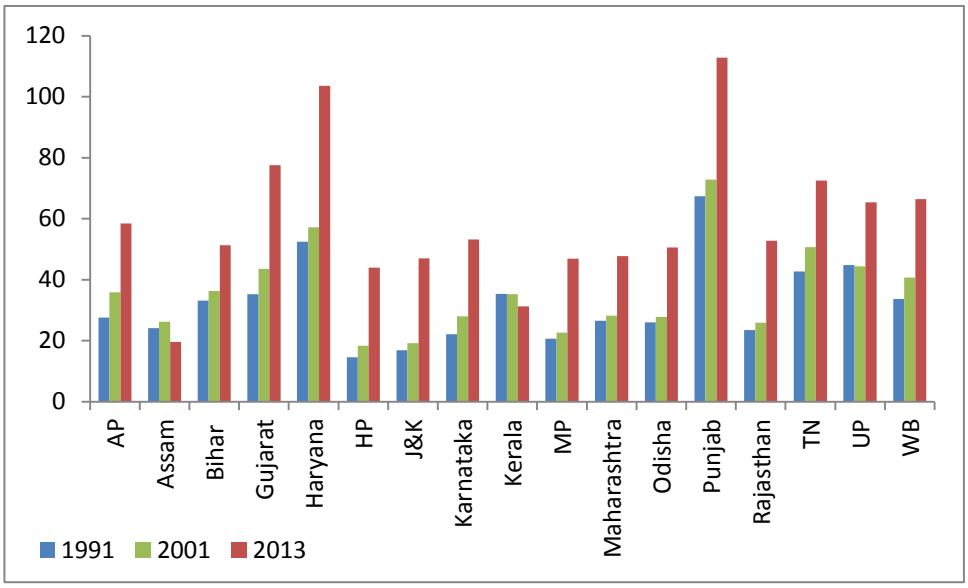
[15] It is the ratio of how much a bank lends out of the deposits it has mobilized. It indicates how much of a bank's core funds are being used for lending, the main banking activity.

(a) Physical Infrastructure

The physical infrastructure index constructed for all the states includes- Gross irrigated area as ratio of gross cropped area, road length per square kilometers, rail length per square kilometers and per capita consumption of electricity, for the years 1991 to 2013shows distinct trends among states.The figure 15(below) clearly shows that the physical infrastructure has improvedinmostly all the states (with red colored bars representing level of infrastructure in 2013-14being higher in all states as opposed to blue and green ones), except for Kerala and Assam.The reason for poor performance for Kerala and Assam can be very different. While Kerala has always prioritized road construction and other forms of infrastructure, however in case of Assam this can be due to neglect of infrastructure development.

States with best physical infrastructure index in 1991 were Punjab, Haryana, and Gujarat (in decreasing order of the index).**Punjab, Haryana and Gujarat witnessed maximum improvement in physical infrastructure during these 2 decades, despite having a high base effect, i.e. having better infrastructure facilities to start with in 1991.**There has a been gradual improvement in the infrastructure in both the decades (as can be seen from figure 15) with the infrastructure levels in 2013 being higher than in 2001 and they in turn being higher than they were in 1991. This result matches with the general perceptionof having the best physical infrastructure. All three states had historical advantage in physical infrastructure and it also shows that the historical bias remained intact post-independence too.Due to high levels in 1991 and combined with high improvement rates,Punjab,Haryana, Gujarat and Tamil Nadu are the states with highest physical infrastructure index, and best infrastructure availability in 2013. Not only this, the infrastructure index in these states is much larger than in states like Himachal Pradesh, J&K, and Assam.

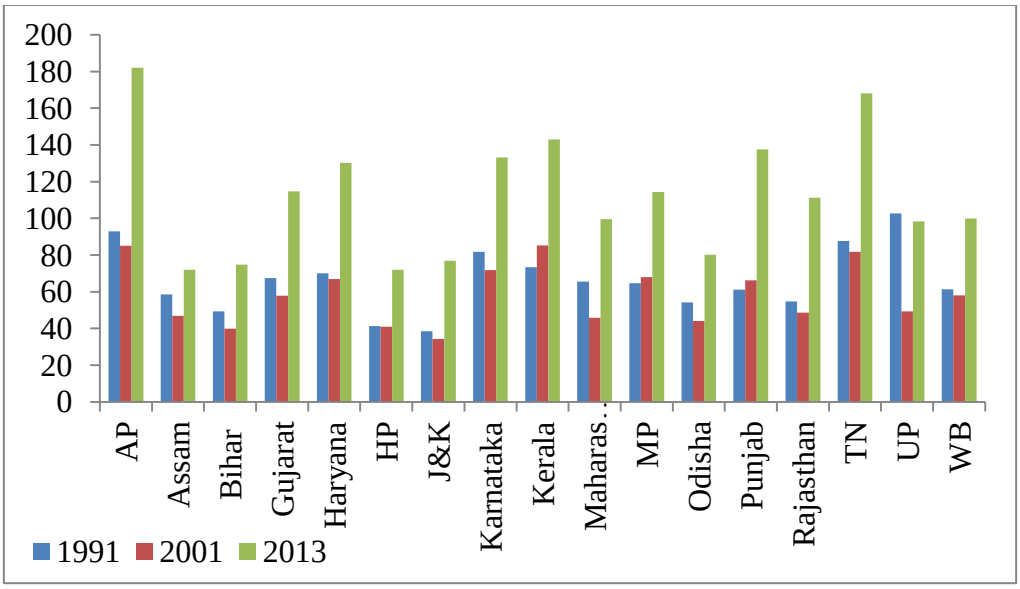
Figure 15: Physical Infrastructure Index levels from 1991-2013



(b) Financial Infrastructure

All states have shown improvement in financial infrastructure which includes- Credit-Deposit ratio, banking offices per square kilometers and states own tax revenue, over the period under study. Four southern states- Andhra Pradesh, Tamil Nadu, Kerala and Karnataka have out-performed rest of India consistently on this indicator of Infrastructure. UttarPradesh, Andhra Pradesh and then Tamil Nadu had best financial infrastructure index in 1991-92. Surprisingly, there are some states for which the financial infrastructure was worse off in 2001 as compared to 1991; however it improved again in 2011. Andhra Pradesh, Tamil Nadu,Punjab witnessed high augmentation in financial infrastructure; on the other hand Bihar and West Bengal are the states with least improvement in financial infrastructure. These results confirm expectations, though surprisingly Uttar Pradesh in 1991-92 was the best performing state. Due to high levels of development in financial infrastructure, Andhra Pradesh, Tamil Nadu and Kerala were the states with best financial infrastructure in 2013-14.

Figure16: Financial Infrastructure Index Levels from 1991-2013

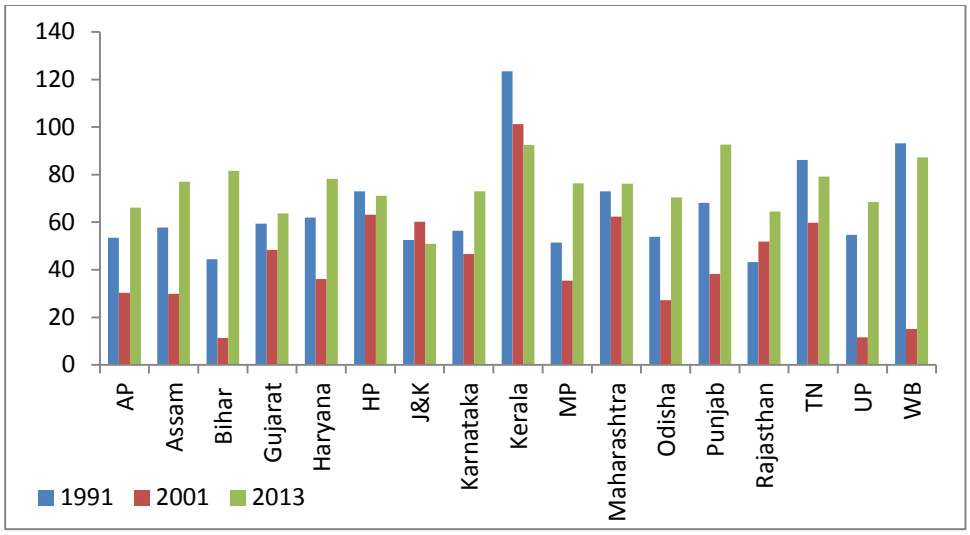


(c) Social Infrastructure

There has been upward mobility in states from 1991-92 to 2013-14in terms of development of social infrastructure index which includeGrossEnrolment Ratio, infant mortality, and educational institutions per sq. km. However, there has been less improvement in social infrastructure as compared to physical or financial infrastructure. And there are states which are worse off in terms of availability of social infrastructure in 2013 as compared to 1991. **There is a noteworthypattern in social infrastructure development, with the social infrastructure becoming little worse-off during 1991-2001; however it started improving after 2001 again.**This peculiar trend can be the effect of LiberalizationPrivatization Globalization (LPG) policies. Post 1991, private investment became more important than ever for states to grow which led states to focus more on physical and financial infrastructure to attract private capital. The trend has been such that social development which includes health education etc. has been neglected and is still not up to the mark in the country. However, over time it has been seen that human capital has been improving.

Kerala is the state with best social infrastructure index followed by Tamil Nadu and West Bengal in 1991. Bihar has shown the highest growth in improvement in social infrastructure, which is much above the growth in all other states, which could be called as catching-up by the worse-off states. Least growthin social infrastructure has been in Kerala; however it is due to high levels of social infrastructure in 1991. Kerala, Tamil Nadu, Punjab and Maharashtra are the states with the best social infrastructure index in 2013 as well.

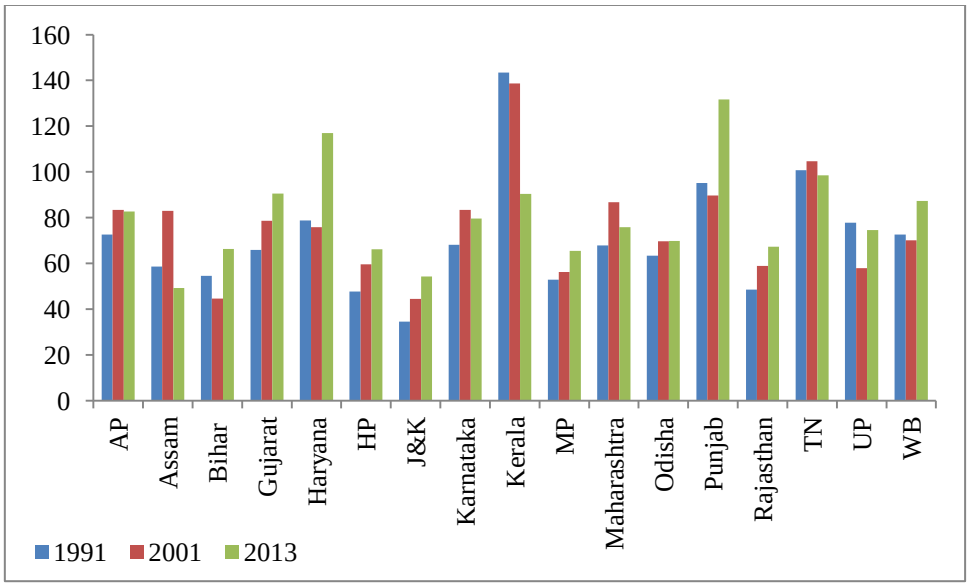
Figure 17: Social Infrastructure Index levels during 1991-2013



(d) Total Infrastructure

The total infrastructure indexhasall the indicators of physical, financial and social infrastructure indices.The graph of the total infrastructure index between the years 1991 and 2013 (Figure 18) shows that the infrastructure index hasincreased between these years, showing improvement in infrastructure in all states. The highest infrastructure index among all the states in 1991-92 as well as in 2013-14 was of that of Keralaand that too by a large margin, pointingtowards the possibility of the total infrastructure index being highly influenced by the social infrastructure indicators.States with best infrastructure in 1991-92 are Kerala followed by Tamil Nadu and Punjab. The best performing states, i.e. states with maximum improvement in total infrastructure during this time period are Haryana, Gujarat, Punjab and Tamil Nadu and hence these states are the best infrastructure in 2013-14 as well.

Figure18: Total Infrastructure Index levels during 1991 to 2013



4.3. Interstate disparity in infrastructure development

The infrastructure indices give a picture of the inter-regional disparity in the country in terms of infrastructure availability. It is important to note that all states have seen improvements in infrastructure; however the pace of infrastructure development has been quite varied in states (as discussed in detail in the previous section (Section 4.2)). The divergence among state in terms of infrastructure provision may have increased or decreased depending on whether the states which were better-off in terms of infrastructure initially (in early 1990s) were the states with higher progress in infrastructure; or whether other states which did not fare that good in infrastructure development in 1993-94 did catch up to other states with higher growth rates as compared to others. To address this question, variance and standard deviation of the infrastructure indices among states is calculated at 3 points which divides the period into almost 3 equal parts. The standard dev is calculated for the years 1991-92, 2001-02 and then for 2013-14. Then the increase or decrease in standard deviationgivesan idea of whether the inter-regional variation in terms of provision of infrastructure has increased or decreased.

The interstate disparity in both physical and financial infrastructure increased (or remained almost same for certain types of infrastructure) going from 1991-92 to 2013-14.Inter-state variation has declined only for social infrastructure indicators- Infant Mortality and Gross Enrolment Ratio in Upper Primary classes (shown in green color in the table below).This is consistent with the results in Section 4.2 where in case of social

indicators, states like Haryana and Bihar (lagging in terms of social development in initial years) were the states which saw maximum improvement and hence the disparity between states in terms of provision of social infrastructure may have declined. Some of the salient features that come out from calculating the standard deviation among states for various infrastructure categories for 1991-92, 2001-02 and 2013-14 are as follows:

1) The infrastructure indicators – Per capita electricity consumption, road lengthper square km and banking offices per square km (shown in red color in the table below) witnessed major increases in variance among states, with per capita electricity consumption having the highest increase in interstate variation.
2) Variance among states for other 4 infrastructure indicators (shown in black in the table below) remained almost same.
3) The variance among states in terms of GER and infant mortality has declined, also pointing towards the unanimous improvement in social infrastructure in all the states.

Table 04: Regional Disparity of Infrastructure

INFRASTRUCTURE CATEGORY	Increase or decrease in variation (1991 to 2013)
PHYSICAL INFRA	
Per capita Electricity Consumption	Increase
Rail route per square km	Almost same
Road length per square km	Increase
GIA/GCA	Almost same
SOCIAL INFRA	
Educational Institutions per square km	Increase
Gross Enrolment Ratio in Upper primary classes	Decrease
Infant mortality	Decrease
FINANCIAL INFRA	
Banking office per square km	Increase
State Own Tax Revenue to GDP ratio	Almost same
Credit-Deposit Ratio	Almost same

Note:* *"Green"color shows positive development, "red" signifies distressing situation,"yellow" shows increase in inter-state variance however not very large and "black"color shows no major change.

Our data analysis showsthe states that had best infrastructure index in 1993-94 were by and large the states which had best infrastructure in 2011-12 (for all infrastructure indices- social infrastructure, physical infrastructure and financial infrastructure- as shown in Table 5). **The best performing states have remained broadly the same, however, the ranking within states have changed.Apart from Physical infrastructure Index, the states at the bottom of the pyramid in terms of infrastructure in 1990s have remained so in 2011-12 as well.** This shows that the need for states which are not performing that well in the dimension of infrastructure development, to catch up is still there.

TABLE 05: BEST PERFORMING STATE (YEAR-WISE)

	TOTAL INFRA INDEX	**SOCIAL INFRA INDEX**	**PHYSICAL INFRA INDEX**	**FINANCIAL INFRA INDEX**
1991-92	Kerala	Kerala	Punjab	Uttar Pradesh
1993-94	Kerala	Kerala	Punjab	Andhra Pradesh
2001-02	Kerala	Kerala	Punjab	Andhra Pradesh
2004-05	Kerala	Kerala	Punjab	Andhra Pradesh
2011-12	Punjab	Kerala	Punjab	Andhra Pradesh
2013-14	Punjab	Kerala	Punjab	Andhra Pradesh

Although the variance in infrastructure levels has increased from 1991 to 2013, it is important to note that there is a distinct pattern for all the indicators where the variance has either remained same, decreased or increased by small amount (for the per capita electricity consumption) in the time period 1991-2001. **It is only after 2001, that the regional variance increased for all indicators except infant mortality and GER. This point towards an important phenomenon that the disparity between states on account of infrastructure has primarily increased during the last decade only.**Theinfrastructure development in the 2000s has been such that it increased the disparity among states in terms of infrastructure availability, except social infrastructure.

The tables 6, 7 and 8 given belowranks all the states according to the infrastructure index, which also shows the states in the top of the pyramid and also at the bottom of the pyramid,mostlycontinue to stay there for all three infrastructure indices, with few movements up and down in terms of ranks. This also shows that the variance between states may have increased or at least not decrease in terms of provision of infrastructure and is consistent with the variance analysis.

TABLE 06: RANKING OF STATES IN SOCIAL INFRASTRUCTURE INDEX

1993-94	2004-05	2011-12
Kerala	Kerala	Kerala
West Bengal	HP	Tamil Nadu
Tamil Nadu	Maharashtra	Maharashtra
Assam	Tamil Nadu	HP
Maharashtra	Karnataka	J & K
HP	Gujarat	Karnataka
Punjab	J & K	Gujarat
Karnataka	MP	Punjab
Haryana	Rajasthan	MP
Gujarat	AP	Rajasthan
Odisha	Haryana	Andhra Pradesh
UP	Punjab	West Bengal
J&K	Odisha	Haryana
AP	Assam	Odisha
Rajasthan	WB	Bihar
MP	UP	Assam
Bihar	Bihar	UP

Table 07: RANKING OF STATES IN PHYSICAL INFRASTRUCTURE INDEX

1993-94	2004-05	2011-12
Punjab	Punjab	Punjab
Haryana	Haryana	Haryana
Gujarat	Tamil Nadu	Gujarat
Tamil Nadu	West Bengal	Tamil Nadu
Andhra Pradesh	UP	Andhra Pradesh
UP	Gujarat	UP
Maharashtra	Bihar	J & K
Odisha	Andhra Pradesh	HP
Karnataka	Kerala	West Bengal
MP	Odisha	Odisha
Rajasthan	Karnataka	Karnataka
West Bengal	Rajasthan	Rajasthan
Kerala	Maharashtra	MP
Bihar	MP	Maharashtra
Jammu & Kashmir	Assam	Bihar
Himachal Pradesh	Jammu & Kashmir	Assam
Assam	Himachal Pradesh	Kerala

TABLE08: RANKING OF STATES IN FINANCIAL INFRASTRUCTURE INDEX

1993-94	2004-05	2011-12
Kerala	Tamil Nadu	Andhra Pradesh
Andhra Pradesh	Andhra Pradesh	Tamil Nadu
Tamil Nadu	Kerala	Kerala
Punjab	Karnataka	Punjab
Karnataka	Haryana	Haryana
West Bengal	Punjab	Karnataka
Haryana	Maharashtra	Maharashtra
Gujarat	West Bengal	Rajasthan
Bihar	Rajasthan	Gujarat
Maharashtra	Gujarat	MP
UP	Odisha	West Bengal
MP	MP	UP
Rajasthan	UP	Odisha
Odisha	Himachal Pradesh	Himachal Pradesh
Himachal Pradesh	Assam	Assam
Assam	Jammu & Kashmir	Jammu & Kashmir
Jammu & Kashmir	Bihar	Bihar

After understanding the infrastructure status of all the states and their performance in terms of infrastructure development in the past 2 decades or so, the next section goes on to examine the relationship of infrastructure development with poverty levels in states and the growth rates of states. The next 3sub-sections deal with examining the link of infrastructure levels with poverty rates in the states using correlation analysis, panel regression analysis and simultaneous equation model.

4.4. Correlation Results

Correlation analysis is a statistical technique to assess the strength of relationship among variables. It involves finding out the correlation coefficient between variables which is a measure of linear association between two variables. Values of the correlation coefficient lie between -1 and +1. A correlation coefficient of +1 indicates that two variables are perfectly related in a positive linear sense; a correlation coefficient of -1 indicates that two variables are perfectly related in a negative linear sense, and a correlation coefficient of 0 indicates that there is no linear relationship between the two variables. This in simple terms would imply the extent of co-movements in the 2 variables with direction decided by the sign of correlation. Correlation and regression analysis are related in the sense that both deal with relationships among variables. The higher the absolute value of the correlation coefficient, the higher is going to be the association between the variables (the negative or positive sign will decide the direction of association).

A simple correlation analysis is done between the poverty rates and infrastructure indices of all the states. The simple correlation results between the variables of interest i.e. Poverty Rate, Total Infrastructure Index, Social Infrastructure Index, Financial Infrastructure Index and Physical Infrastructure Index for the year 1993-94, 2004-05 and 2011-12 shows that poverty is negatively correlated to all these infrastructure indices. (See tables 9, 10 and 11 below)

The table 9 shows that the poverty rate in year 2011-12 is negatively correlated with all the infrastructure indices, showing that the states having better infrastructure status have lower poverty levels. Another important point that comes out of the correlation analysis is that the **correlation coefficient of Social Infrastructure Index is the highest (in absolute amount),** higher than that of Physical and Financial Infrastructure Index. The value of correlation coefficient is -0.60 for social infrastructure. This means that the states with better social infrastructure facilities would be the ones having lower poverty levels. This also points towards the possibility of social infrastructure being a very important contributor in poverty reduction.

Table 09: Correlation Table (2011-12)

	Poverty_2011-12
Poverty_2011-12	1
Total Infrastructure Index	-0.1883
Social Infrastructure Index	-0.5906
Financial Infrastructure Index	-0.5718
Physical Infrastructure Index	-0.478

Similarly, the correlation coefficient between poverty levels in the states for the year 2004-05 and 1993-94 and the infrastructure indices of states shows similar results, with infrastructure indices having negative relation with poverty levels of states with the strongest relation between social infrastructure index and poverty levels of the states (Table 10 and 11).

Table 10: Correlation Table (2004-05)

	Poverty_2004-05
Poverty_2004-05	1
Total Infrastructure Index	-0.0562
Social Infrastructure Index	-0.4227
Financial Infrastructure Index	-0.1783
Physical Infrastructure Index	-0.2456

Table 11: Correlation Table (1993-94)

	Poverty_1993-94
Poverty_1993-94	1
Total Infrastructure Index	-0.1836
Social Infrastructure Index	-0.3735
Financial Infrastructure Index	-0.357
Physical Infrastructure Index	-0.0233

Further, the correlation analysis is carried out is carried out including other variables of interest. The correlation results between the variables Poverty, GSDP, Social Infrastructure

Index, Financial Infrastructure Index, Physical Infrastructure Index and Urbanizationof all these states are presented in the table Table12.

Table 12: Correlation Matrix

	Poverty
Poverty	1
GSDP	-0.422
Social Infra Index	-0.4607
Total Infra Index	-0.3547
Financial Infra Index	-0.4588
Physical Infra Index	-0.4592
Urbanization	-0.4259

As is clearly visible, all the correlation coefficients are negative, indicating that all these variables have a negative correlation with poverty. Increase in any one of these would lead to decline in the poverty level of the state. So, all the infrastructure indices would be associated with lower levels of poverty. Higher urbanization rates in the states would be associated with lower level of poverty. This could imply that the states with higher urbanization would be associated with lower poverty levels. The value of these coefficients is also quite high. The correlation coefficient of GSDP with Poverty is -0.4220, showing strong negative relation of these 2 variables. Further, the coefficient of social, financial and physical infrastructure indices with Poverty are -0.4607, -0.4588 and -0.4592 respectively; pointing towards strong negative relationship between these infrastructure indices and poverty levels in the state. Even here, the coefficient of social infrastructure is a little higher than other kind of infrastructure, which is consistent with the results in previous correlation analysis.In fact, social infrastructure has the largest coefficient, even a little more than GSDP or Urbanization. The states with better infrastructure, higher growth rates or higher urbanization rates would be the one associated with lower poverty levels.

The correlation analysis shows the importance of infrastructure in terms of its strong positive relationship with decline in poverty. However, there are certain limitations of the Correlation

analysis, like there may be certain other variables that can explain why the co-variables are correlated or there may be a more complex association among variables which is not captured in correlation analysis. For a more nuanced understanding, we further did panel regression analysis and simultaneous equation model analysis.

4.5 Results of the panel regression

The data available in the study is a panel data set; hence panel regression is done with all the variables of interest, i.e. infrastructure, poverty, growth, urbanization. The results for the panel data are exactly as per the intuition and similar to the results of correlation analysis, with the 3 infrastructure indices and GSDP, all four having negative relationship with poverty rates of the states. Betterinfrastructure status has been associated with lower poverty rates. The results from the panel data regression for the 17 states under the study and for the time periods 1993-94, 2004-05 and 2011-12 show following results (presented in Table 13 and Table 14):

Table 13: Results of Fixed Effects Regression

Poverty	Coeff.	Std. Err	t	P>t	95% conf	Interval
Social Infra	.085833	.165734	0.52	0.608	-.252640	.4243074
Physical Infra	-.137513	.0751919	-1.83	0.077	-.291075	.0160488
Financial Infra	-.242516	.0901715	-2.69	0.012	-.426671	-.0583617
GSDP_Constant	-.000054	.0000131	-4.19	0.000	-.000081	-.0000281
Constant	67.1955	9.485161	7.08	0.000	47.824	86.56686

Table 14: Results of Random Effects GLS regression

Poverty	Coefficient	Std. Err	Z	P>z	95% Conf.	Interval
Social Infra	-.21340	.1234406	-1.73	0.084	-.4553403	.028538
Physical Infra	-.16361	.0624467	-2.62	0.009	-.2860114	-.041224
Financial Infra	-.12700	.0834494	-1.52	0.128	-.2905582	.036557
GSDP_Constant	-.00003	.0000127	-2.79	0.005	-.0000604	-.000010
Constant	73.76	8.147511	9.05	0.000	57.79532	89.7329

Haussmann fixed test show that the Random effects (RE) regression is more suitable in this panel regression[16]. As the table 14 above shows (the results of RE regression), the Social Infrastructure Index, Physical Infrastructure Index and Financial Infrastructure Index, all three have a negative coefficient and GSDP also has a negative coefficient with respect to poverty rate. All the coefficients are highly significant (with Physical Infra Index, GSDP significant at even 1 per cent and Social Infra Index significant at 10 per cent), with only the coefficient of Financial Infrastructure Index significant at 12.8 per cent. The social infrastructure has the highest coefficient (in absolute number) followed by physical infrastructure index and then financial infrastructure index which shows that the improvement in social infrastructure has been most significant in poverty reduction in the country. One per cent improvement in social infrastructure contributes to poverty rate reduction by 0.21 per cent. Similarly, one per cent improvement in physical infrastructure has been associated with a decline of poverty rate by 0.16 per cent and one per cent improvement in financial infrastructure reduces poverty rate by 0.13 per cent. This is similar to the correlation analysis where the correlation coefficient of Social Infrastructure was higher than that of Physical and Financial Infrastructure.

The co-efficient of GSDP is much smaller than the coefficient of these 3 infrastructure indices (however it is also significant), showing that the role of infrastructure has been higher than the role of growth in reducing poverty. Economic growth may not be sufficient for eradicating poverty and infrastructure may be important to create opportunities for all and hence help them come out of the poverty net.

The social infrastructure index consists of Infant Mortality **(Health)**, Educational institutions per sq km and Gross Enrolment Ratio in upper primary class **(Education)**. The importance of social infrastructure index in reducing poverty shows that there is a need for focusing on education and health; in order to not only promote human development, but also in reducing poverty. This can prove to be more crucial to eradicate poverty from the country. Government has recently launched various initiatives to improve physical infrastructure (roads, railways) and financial infrastructure (bank offices, bank accounts), however much more needs to be done to improve the status of health and education. The focus on social infrastructure needs to be much more for targeting poverty eradication.

Further, the panel regression is done combining the infrastructure indices i.e. with the Total Infrastructure Index which shows similar results. **The sign of the coefficient of the Total**

[16] The result of Haussmann test is in the Appendix

Infrastructure Index and GSDP are both negative and significant. The results of RE model are more suitable as indicated by Haussmann test in this case. [17] The coefficient of the Infrastructure Index is still much greater than the coefficient of GSDP, indicating that it takes much more than growth to eradicate poverty.

Table 15: Fixed effects regression

Poverty	Coefficient	Std. Err.	T	P>t	[95% Conf.	Interval]
GSDP_Constant	-0.161328	0.06995	-2.31	0.02	-0.303830	-0.018826
Total Infra	-0.000074	0.00001	-6.07	0.00	-0.000099	-0.000049
Constant	58.071160	5.14420	11.29	0.00	47.592750	68.549560

Table 16: Random Effect regression

Poverty	Coefficient	Std. Err.	Z	P>z	[95% Conf.	Interval]
GSDP_Constant	-0.20977	0.06461	-3.25	0.00	-0.33641	-0.08313
Total Infra	-0.00005	0.00001	-4.41	0.00	-0.00008	-0.00003
Constant	58.51701	5.55192	10.54	0.00	47.63544	69.39857

Both the panel regressions indicate that infrastructure development has been significant in poverty reduction. Hence it is also an important factor in explaining the different levels of poverty in states and also explains the different levels of poverty decline in this time phase in various states.

Further, as the literature points out that urbanization levels are highly related to poverty rates and high rates of urbanization may aid decline in poverty levels. To check for this hypothesis, the panel regression is done with urbanizationrates of states used as an explanatory variable as well. The results of the panel regression are as follows:

Table 17: Fixed Effects Regression

Poverty	Coeff	Std. Err.	Z	P>z	95% Conf	Interval
Total Infra Index	-0.1532	0.0625	-2.45	0.020	-0.2806	-0.0257
Urbanisation	-0.0001	0.0000	-4.07	0.000	-0.0001	0.0000
GSDP_Constant	-1.0219	0.3372	-3.03	0.005	-1.7097	-0.3341
Constant	81.8509	9.0913	9.000	0.000	63.3090	100.392

[17]The result of Haussmann test is in the Appendix.

Table 18: Random Effects Regression

Poverty	Coefficient	Std. Err.	Z	P>z	95% Conf	Interval
Total Infra Index	-0.1917	0.0668	-2.87	0.0040	-0.3226	-0.060
Urbanisation	0.0000	0.0000	-3.39	0.0010	-0.0001	0.000
GSDP_Constant	-0.3011	0.2537	-1.19	0.2350	-0.7984	0.196
Constant	63.8820	7.1750	8.90	0.0000	49.8193	77.94

The Haussmann test shows that the **result of Fixed Effects (Table 17) is more appropriate in this panel regression.** The impact of Urbanization on poverty levels (from the fixed effects model) is that urbanization has negative relation with poverty levels. Urbanization rates are positively related with decline in poverty levels in the states, meaning the states having higher urbanization rates have lower poverty levels. This implies that urbanization has played a significant and positive role in decline in poverty levels in the state. The result is as per the intuition and with the literature available on the subject as urbanization could mean better access to resources or more jobs etc. which may aid in increasing the opportunities available to people. The available literature on the subject shows that the urbanization is a positive contributor to growth and infrastructure development.

The sign of the coefficient of the variable urbanization is negative (although small in magnitude) and highly significant. The same regression also shows that Total Infrastructure Index and GSDP also have negative relation with poverty levels in the state. The co-efficient for both the variables are negative and highly significant.

The results from this panel regressions conform that infrastructure plays an important role in eradicating poverty. The cross sectional data on states and its analysis shows that infrastructure development have been instrumental in reduction of poverty and the difference in access to infrastructure is an important factor in explaining the difference in poverty levels among states. Further, there is literature which points toward the possibility of existence of a more complexedand indirect relationship between poverty and infrastructure indices. To take this into account, simultaneous model is used and the results are in the next section.

4.6 Simultaneous equation results

The relationship of infrastructure and growth with decline in poverty is not simple and unidirectional. Instead, there are many direct and indirect complicated channels through which all the variables could have an effect on each other. Infact there may be a possibility of multi-directional relationship. To take into account the multidimensional and bidirectional relationship of the indices including Infrastructure Indices, GSDP etc.., the simultaneous equation model is used.

The model in which there is a single dependent variable and one or more explanatory variables then the model is called a single equation model. On the other hand, a system of equations representing a set of relationships among variables or describing the joint dependence of variables is called simultaneous equation. In such models there are more than one equation one of the mutually or jointly dependent or endogenous variables.

Three stage least- squares regression is used for estimation and the model used for estimation is as follows:[18]

$$\boldsymbol{GSDP\_constant} = \boldsymbol{f}(SocialInfraIndex, PhysicalInfraIndex, FinancialInfraIndex, FiscalDeficit,)$$

$$\boldsymbol{Poverty} = \boldsymbol{f}(SocialInfraIndex, PhysicalInfraIndex, FinancialInfraIndex, GSDP_{Constant})$$

$$\boldsymbol{TotalInfraIndex} = \boldsymbol{f}(GSDP_{Constant})$$

Another model (named model 2) with urbanization as an explanatory variable in the equation 2 and 3 of this model is constructed. The result of simultaneous equation model using three-stage least-squares regression is as follows:

[18] This model was decided after various models were tested and checked for identification etc.

Table 19: Simultaneous Equation Model (Part 1)

	Coeff	Std. Err.	Z	P>|z|	95%	Conf. Int.
GSDP_Constant						
Social Infra Index	198.2246	428.8027	0.46	0.644	-642.213	1038.6
Physical Infra Index	29.11133	585.0516	0.05	0.96	-1117.56	1175.7
Financial Infra Index	645.3513	370.5113	1.74	0.082	-80.837	1371.5
Fiscal Deficit	19.75076	2.1109	9.36	0.00	15.613	23.88
Constant	-675.15	36522.61	-0.02	0.985	-72258.1	70907.8

	Coeff.	Std. Err.	z	P>|z|	95%	Conf. Int.
Poverty						
Social Infra Index	-0.064	0.066	-0.97	0.333	-0.193	0.066
Physical Infra Index	-0.167	0.092	-1.83	0.068	-0.347	0.012
Financial Infra Index	-0.264	0.062	-4.29	0.000	-0.385	-0.143
GSDP_Constant	0.000	0.000	0.58	0.561	0.000	0.000
Constant	60.130	5.659	10.63	0.000	49.039	71.221

	Coeff.	Std. Err.	z	P>|z|	95%	Conf. Int.
Total Infra Index						
GSDP_Constant	0.0001	0.000	3.2700	0.001	0.000	0.0002
Constant	69.7634	6.502	10.730	0.000	57.02	82.507

The first table of model 1 which is based on the first simultaneous equation shows the relationship between GSDP_Constant with Social Infrastructure Index, Physical Infrastructure Index, Financial Infrastructure Index and Fiscal Deficit. The coefficients of Infrastructure Indices except Financial Infrastructure Index are not significant; for which the coefficient is positive, large and significant. However, the Fiscal Deficit has a positive and highly significant coefficient.

The second table of the model 1 (Table 19-part 1) corresponding to the second equation of the simultaneous equation model shows the relation of poverty with Social Infrastructure Index, Physical Infrastructure Index, Financial Infrastructure Index and GSDP. The results of the

equation are in sync with the correlation results and the results of panel regression. The coefficients of all the variables are negative, implying that all the infrastructure indices and GDP growth are associated with decline in poverty levels of the state. This implies that the states with higher infrastructure development would be associated with lower levels of poverty. Similarly, higher income and higher growth in state GDP could be able to reduce poverty levels. The equation results show that an increase in GDP or improvement in infrastructure would lead to decline in poverty levels. Hence, the states which have put in effort to improve infrastructure would also experience decline in poverty levels. However, the coefficients of social infrastructure and GDP are not statistically significant.

The third table of the model 1 tests the relationship of Total Infrastructure Index with the GSDP. The coefficient is quite small, however highly significant. This shows that GSDP has a positive impact on total infrastructure. Higher growth aids in development of infrastructure. These results also show that infrastructure, growth, poverty is related in a multi-dimensional sense.

Table 19: Simultaneous Equation Model (Part 2)

	Coeff	Std. Err.	z	P>|z|	[95%	Conf. Int
GSDP_Constant						
Social Infra Index	198.2246	428.80	0.46	0.64	-642.21	1038.663
Physical Infra Index	29.11133	585.05	0.05	0.96	-1117.5	1175.791
Financial Infra Index	645.3513	370.51	1.74	0.08	-80.83	1371.54
Fiscal Deficit	19.75076	2.1109	9.36	0.00	15.613	23.88808
Constant	-675.1525	36522.6	-0.02	0.98	-72258.1	70907.84

	Coefficient	Std. Err	z	P>|z|	95%	Conf. Int
Poverty						
Urbanisation	0.101	0.2212	0.460	0.646	-0.3319	0.535
Social Infra Index	-0.084	0.0827	-1.02	0.306	-0.2468	0.077
Physical Infra Index	-0.191	0.1049	-1.82	0.068	-0.3967	0.014
Financial Infra Index	-0.273	0.0614	-4.45	0.000	-0.3937	-0.153
GSDP_Constant	0.000	0.0000	0.330	0.743	0.0000	0.000

Constant	60.651	5.6994	10.64	0.000	49.4810	71.822

	Coeff	Std. Err	Z	P>|z|	95%	Conf. Int
Total Infra Index						
Urbanization	1.289	0.403	3.200	0.001	0.499	2.0786
GSDP_Constant	0.000	0.000	0.970	0.334	0.000	0.0001
Constant	45.69	9.487	4.820	0.000	27.097	64.285

The model 2 presented in Table 19 (Part 2) shows results which are similar to this. The main findings of that model 2 are similar with the model1 with fiscal deficit having significant positive relationship with GSDP; all infrastructure indices have negative relationship with poverty. However, urbanization has an insignificant coefficient with poverty being dependent variable. This may have happened due to problem of multi collinearity in the model (multi-collinearity between infrastructure indices and urbanization rates) which is also pointed by the last equation of the model where urbanization has a positive impact on Total Infrastructure index.

The results of thepanelregression analysisand simultaneous equation model can be summarized as follows:

Table 20: Summary of Regression Result

Type of regression	Dependent variable	Independent Variables	Coeff	Significance
Random Effects Panel regression	Poverty	Social Infra Index	-.2134	Significant at 10%
		Physical Infra Index	-.1636	Significant at 1%
		Financial Infra Index	-.127	Significant at 15%
		GSDP_Constant	-.000035	Significant at 1%
Random Effects Panel regression	Poverty	GSDP_Constant	-.000059	Significant at 1%
		Total Infra Index	-.06098	Significant at 1%
Fixed Effects Panel regression	Poverty	Total Infra Index	-0.0396	Significant at 10%
		Urbanization	-0.9379	Significant at 5%
		GSDP_Constant	-0.0595	Significant at 1%
Simultaneous equation model (1)	GSDP_Constant	Social Infra Index	45.61	Insignificant
		Physical Infra Index	-38.21	Insignificant
		Financial Infra Index	516.23	Insignificant
		Fiscal Deficit	20.89	Significant at 1%
Simultaneous equation model (1)	Poverty	Social Infra Index	-0.30	Significant at 1%
		Physical Infra Index	-0.19	Significant at 1%
		Financial Infra Index	0.00	Insignificant
		GSDP_Constant	0.00	Significant at 15%
Simultaneous equation model (1)	Total Infra Index	GSDP_Constant	.000182	Significant at 5%
Simultaneous equation model (2)	GSDP_Constant	Social Infra Index	198.224	Insignificant
		Physical Infra Index	29.1113	Insignificant
		Financial Infra Index	645.351	Significant at 10%
		Fiscal Deficit	19.7507	Significant at 1%
Simultaneous equation model (2)	Poverty	Urbanization	0.101	Insignificant
		Social Infra Index	-0.084	Insignificant
		Physical Infra Index	-0.191	Significant at 10%
		Financial Infra Index	-0.273	Significant at 1%
		Fiscal Deficit	0.000	Insignificant

Simultaneous equation model (2)	Total Infra Index	Urbanization	1.289	Significant at 1%
		GSDP_Constant	0.000	Insignificant

Broadly, the results of all these regressions point towards a same direction. Infrastructure indices seem to explain the differential levels of poverty within states. All these regressions show that infrastructure has had a significant impact on poverty levels in states. Growth and Urbanization levels are also seen to have a distinct significant impact on reducing poverty levels.

V. Conclusion

The findings of the study have been conclusive in the direction of infrastructure development playing a significant role in reducing the poverty levels in the states. The detailed results can be summarized as follows.

First, every state has higher level of state domestic product but the differences between states are still very highin terms of levels of income and the inter-regional inequality within states has not decreased.The growth rates of all the states have increased from the phase of 1993-94 to 2004-05 and in the second phase of 2004-05 to 2011-12. However, it is also noteworthy that the growth rates of states which were lagging behind in 1990s have started picking up in recent years, which is a positive sign. However the gap between income levels and growth rates of in states is still there.

Second, India has experienced decline in poverty levels in last 2 and half decades.The decline in poverty rates has been observed in all the states; however the rate of decline and the extent of decline vary among states. The time period of 2004-05 to 2011-12 is associated with higher decline in poverty levels in all states as compared to 1993-94 to 2004-05. Punjab had lowest poverty rate in 1993-94 and Kerala has the lowest poverty rates in 2011-12. The concentration of poor is still very high in Bihar and Odisha.

Third, infrastructure development still remains a concern for India and the development of infrastructure has been at a slow pace. There has been some development in states in allinfrastructure categories- physical, social and financial infrastructure. Some categories of infrastructure like electricity consumption, road, and infant mortality have seen huge improvement whereas categories like railways have seen hardly any improvement.The development of infrastructure has been such that the inter-state disparities in physical and financial infrastructure facilities have increased or remained constant for certain categories of infrastructure; and has declined only for certain categories of infrastructure. This implies that the relative positions of the states have remained mainly unchanged in terms of any definition of development.

Fourth, there has been enormous difference in performance among the states in terms of all the basic indicators of development. Every state except Kerala has shown improvement in Physical infrastructure.Punjab had the best physical infrastructure in 1993-94 and continues to retain the top slot in 2011-12 as well.The reasons for the stagnancy in physical infrastructure

indices vary across these states. Kerala already had good physical infrastructure, so the scope of improvement overtime is less. On the other hand, forstates like Assam and Biharthe reason for less physical infrastructure growth in may be lack of growth in these states. Haryana, Himachal Pradesh andJ&K have shown maximum improvement in the physical infrastructure and these are fast growing states also. This suggests high correlation between growth of GSDP and physical infrastructure.

Similar trends can be found in financial infrastructure too. Every state has shown improvement with Andhra Pradesh, Haryana, Rajasthan and Punjab showing maximum improvement. Bihar and West Bengal showed the least improvement. The improvement in social infrastructure is less than that of physical infrastructure and financial infrastructure. Bihar has shown tremendous improvement in social infrastructure, which is because of high improvement rate of social infrastructure in recent times and low base (less developed social infrastructure in 1990s), is also responsible in achieving high growth rate in Bihar. Kerala has been the best performing state in terms of social development. Social infrastructure facilities have been proved to be highly significant factors in determining the inter-state level of development and poverty reduction. Therefore, there are sufficient symptoms to warrant the fact those differential infrastructure facilities across the states are primarily responsible for the widening of income disparity.

Fifth, the correlation and regression analysis indicate that infrastructure has played an important role in reducing the poverty levels in the country. The correlation coefficient for the Social Infrastructure Index, Physical Infrastructure Index and Financial Infrastructure Index is negative and the coefficient is the highest for the social infrastructure index, implying that the relationship of poverty levels is the strongest with the social infrastructure. The panel regression analysis shows similar results,with higher growth and improvement in infrastructure indices leading to lower poverty levels. The impact of infrastructure is not only negative but highly significant on poverty reduction. Also, what is noteworthy is that the impact of infrastructure development on reduction in poverty levels is much higher than that of growth (the coefficient of growth is much smaller than that of infrastructure). This is in line with the hypothesis that just growth is not enough for poverty reduction and provision of facilities in terms of better infrastructure is crucial for poverty reduction. Apart from this, urbanization levels are also negatively correlated with poverty rates in the state and the panel regression results also show that increase in urbanization leads to decline in poverty rates. The simultaneous equation model results are coherent with these results of panel regression and

correlation analysis; the results show that infrastructure development leads to higher and poverty reduction. Also, higher growth leads to more infrastructure development and increase in urbanization in states lead to decline in poverty levels.

VI. Policy Implications

As is observable from the analysis, infrastructural development is one of the pre-requisite for growth and poverty reduction and also that our country despite making some progress in terms of provision of infrastructure is still lacking behind in basic infrastructure. An equally important point that comes out of the analysis is the huge inter-regional variation in the country with some states not having access to basic amenities like electricity, school etc.. Post-liberalization states were in a hurry to attract private investment which led them to take measures to promote physical infrastructure.[19] Hence, since 1990s states started investing in development of infrastructure; however the gap is still huge. The infrastructure has improved over the last two and half decades however the status in some states is quite worrisome. The answer to these questions is important in light of the direction policy needs to take going forward.

First, the study shows the grim picture of the availability of infrastructure and compares how we fare globally. Hence there is an urgent need for the policy to take this into account and invest in infrastructure development. India is the fastest growing major economy in recent years[20] and in order to continue the momentum and attract further investment, there is a need to improve the infrastructure availability. This is also required on urgent basis to improve India's position as a favored investment destination. Not only physical infrastructure but also social infrastructure could be helpful in attracting investment (because of availability of a more skilled labor force). Another important aspect that the study highlights is that the infrastructure development may not just promote investment, give boost to certain sectors used as an input in building of infrastructure like steel etc. but also in reduction in poverty levels. This should be another reason to invest in infrastructure.

Second, considering the crucial role of social infrastructure in poverty eradication, the focus of the policy needs to be increased on this area. Human capital development which is heavily dependent on social infrastructure is crucial for a country like ours which has a large population of young people. It is only with human capital that the young population would be

[19] For more on this issue see Arvind Subramanian(2012)
[20]IMF world Economic Outlook (April 2016)

a demographic dividend for the country and a liability. This would not only help the economy directly but also indirectly by creating more employment opportunities for the section which had no access to skill employment etc. due to lack of access to education facilities.

Third, the most important questions to address for policy of any country is what infrastructure should be built; in which area should the infrastructure be built in, what infrastructure needs to be focused first and so on. Historically, in India the site of infrastructure projects has mostly been decided by Planning Commission and state planning boards. They have decided on the location of infrastructure projects and kind of infrastructure projects. Technically, there should be a Cost-Benefit analysis for deciding whether to undertake any project or not, however the case of infrastructure needs to be tackled differently. The benefits from the infrastructure projects could be wide ranging- from generating direct demand of labor/employment, material etc. to generating new opportunities and improved access for people leading to higher growth and lower poverty. In certain sense, the benefits of infrastructure are such that they could be classified as social benefits. The impact of infrastructure as has been seen in this study as well is quite complex and may be difficult to quantify. Hence, all these benefits need to be kept in mind and included in the calculations while any kind of cost-benefit analysis is done. However, in reality infrastructure projects have not been based on any such analysis rather they have been based on political considerations. The railway line being set up or electricity connections to villages have been decisions which have been taken with a political consideration mostly and hardly on merit. This could also potentially explain the inter-regional imbalances between states, between urban and rural areas.

Fourth, building of infrastructure requires coordination among states and center and not just this, even that of local bodies or village Panchayats with the state governments. There is a need to emphasize this coordination further in order to assess the needs of areas for infrastructure.

Fifth, there is a need to bridge the inter-regional variation in the country for inclusive growth and poverty reduction. Poverty is still concentrated in certain states including Bihar, Orissa; hence huge investments need to be made in these areas.

Sixth, considering that infrastructure is a kind of social good, in the sense that the benefits of infrastructure are availability to the people as a whole, pricing of infrastructure needs to be

done carefully. Also, different categories of infrastructure are different in nature and may require different pricing methodology.

Seventh, considering the huge infrastructure gap in the country, the monetary requirements for building infrastructure is huge. For example, by the end of the Tenth five year plan, the total infrastructure investment was 5% of the GDP (Planning Commission, 2011). Earlier all such investments were done by government however over time private capital has been used in infrastructure development as well. In fact government targeted the share of private sector in total infrastructure investment as 30% in the Eleventh Five Year Plan. One method of using private funds is Public Private Partnership. Government needs to look into sources of infrastructure financing and invest heavily in infrastructure building in coming years.

VII. CaveatsandWay forward

The analysis in the paper using various techniques shows that infrastructure and income growth has significant impact on poverty levels of the state. The study pointed towards the role of infrastructure in the decrease in poverty levels in the states. The crucial results of the paper is that social infrastructure plays far more important role in reducing poverty as compared to other forms of infrastructure- including physical and financial. Apparently, this infrastructure has been focused on the least with the recognition that is also a part of infrastructure coming quite late. The focus has always been on "Hard" infrastructure; although we still lag behind hugely in this area as well. So, an important implication of the study is that to fulfill our Sustainable Development Goals, one of which is "No Poverty" meaning end poverty in all forms everywhere, we may need to push our efforts to improve social infrastructure. However the study is bound by certain limitations which include:

- The latest data available for all the infrastructure indicators was only till 2013-14; hence the study could not be extended till the latest year (2015-16).
- Latest data of poverty is available for 2011-12, hence the panel regression between infrastructure and poverty cover only the time period till 2011-12. This ignored the trends of change in poverty concentration in states in last 5 years.
- A time series analysis could not be done as the quinquennial and thin rounds of NSS are not comparable.
- The North-eastern states which have high deficit of infrastructure could not be covered in the analysis due to paucity of the data. The data for all the infrastructure variables and for the complete time period was not available for north-eastern states.
- The Census data was available for 1991, 2001 and 2011 and hence the data had to be interpolated for the years 1993-94, 2004-05 and 2011-12 (the years of NSS rounds for which Poverty data is available.
- The urbanization data was available for 1991, 2001 and 2011 (the census years) and hence the data had to be interpolated for the years 19933-94, 2004-05 and 2011-12 (the years of NSS rounds for which Poverty data is available.
- Certain infrastructure categories like telecommunication, postal services could not be taken into the physical and social infrastructure index respectively as the state-wise data for these was not available for the period of study.

- The data for state wise GSDP was not available on a single base for all the time periods. Hence, splicing was done to convert the GSDP data at a uniform base (base year was 2004-05).
- The panel regression and simultaneous equation is a partial equilibrium analysis, however the impact of infrastructure could be economy-wide. Such impacts can be covered in a general equilibrium framework only, which is not taken into account in this study.

The way forward for this analysis is to try and make an index with more indicators covering other areas of infrastructure which has not been covered until now. Also, another crucial step could be to do a general equilibrium analysis to assess the multidimensional impact of infrastructure on poverty.

VII. Appendix

Figure A.1 Infrastructure Level In States

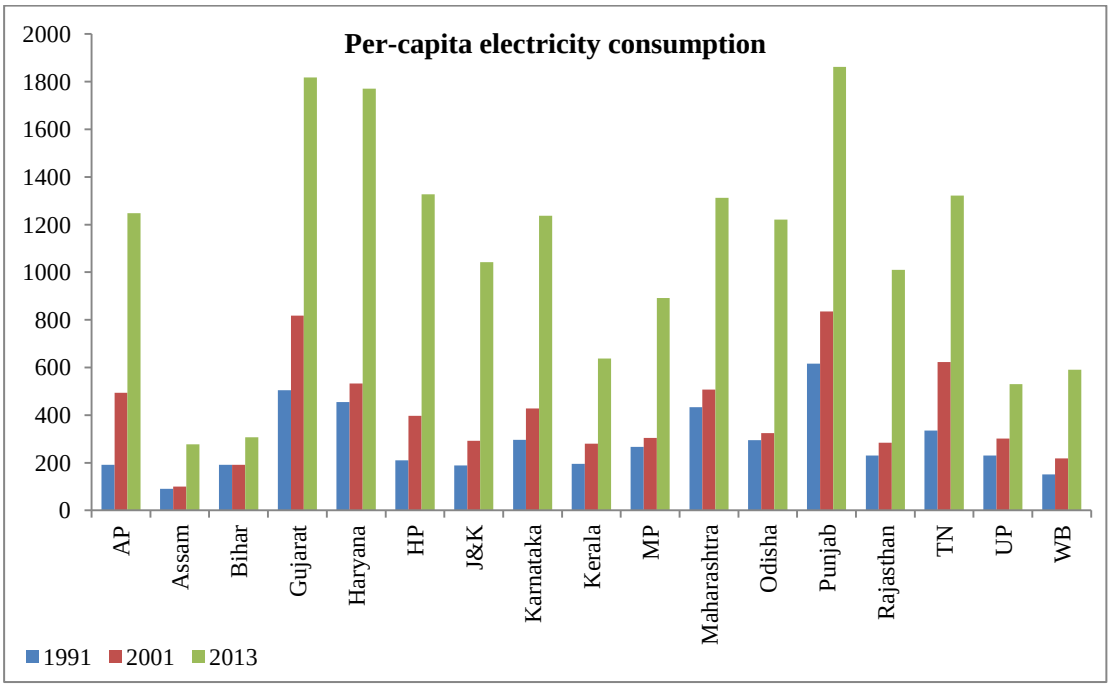


Figure A.2: State Wise Rail Route

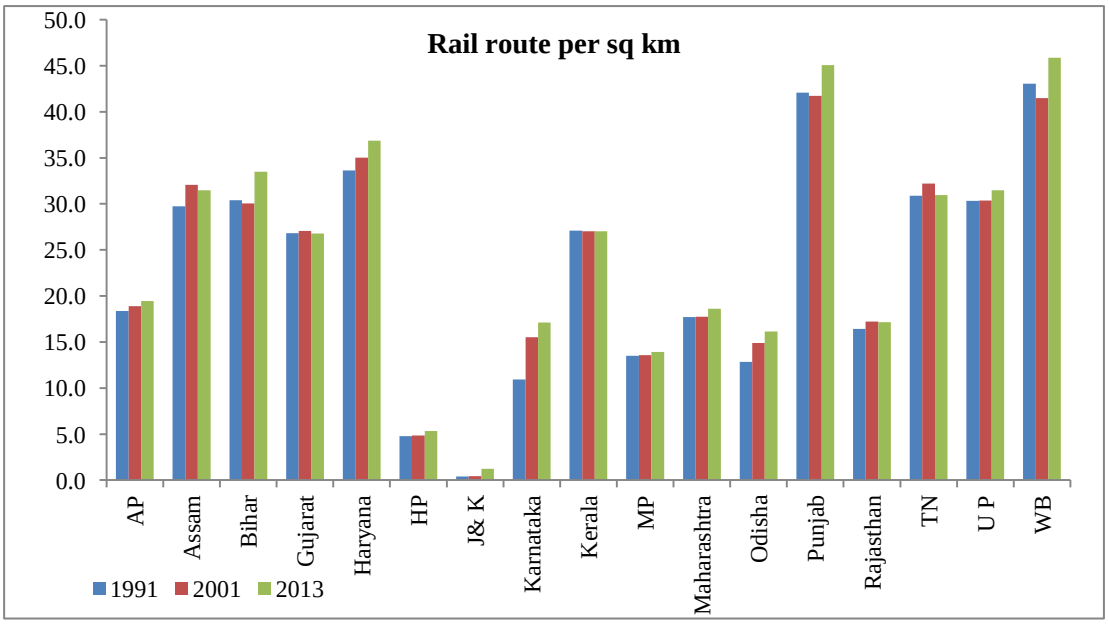


Figure A.3: State Wise Road Length

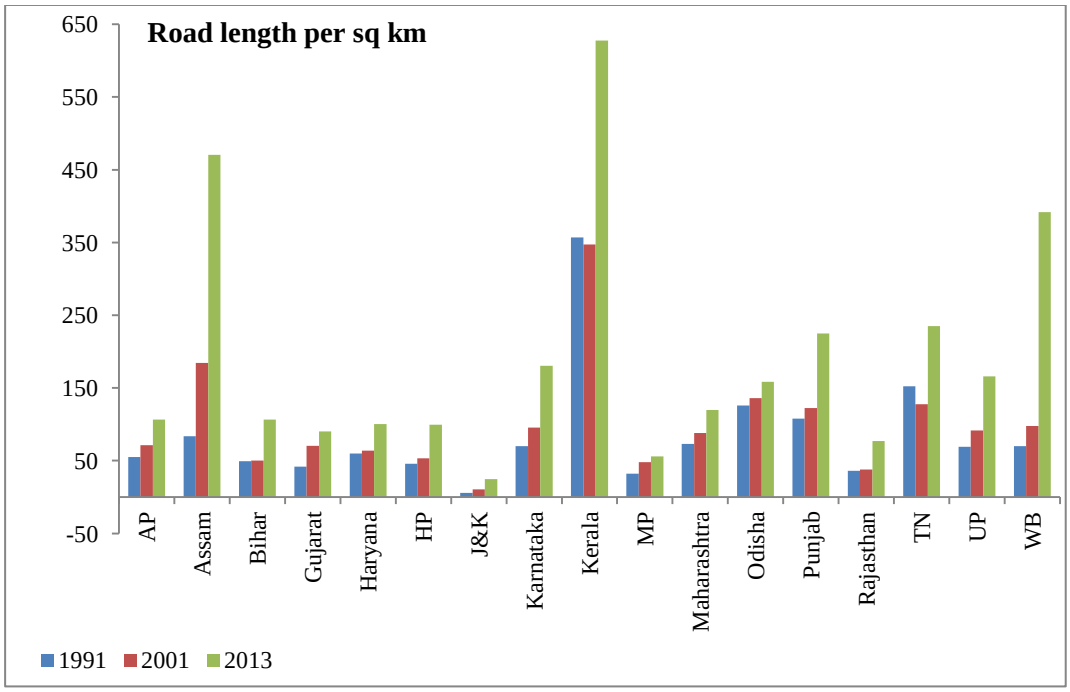


Figure A.4: State Wise Ratio of Gross Irrigated Area by Gross Cropped Area

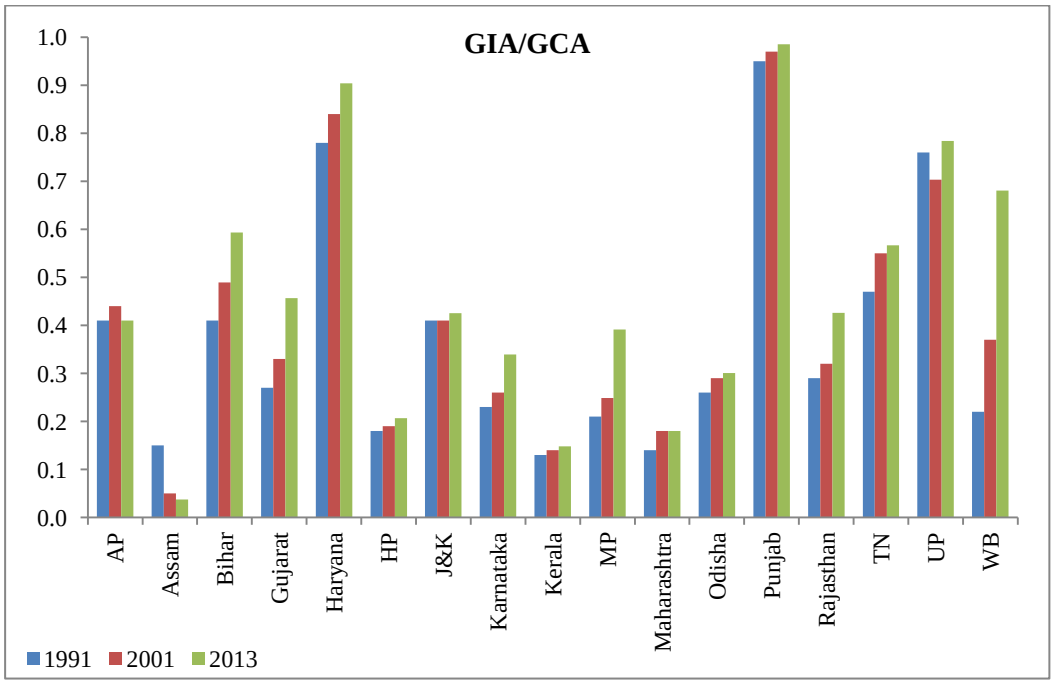


Figure A.5: State Wise Number of Banking Offices

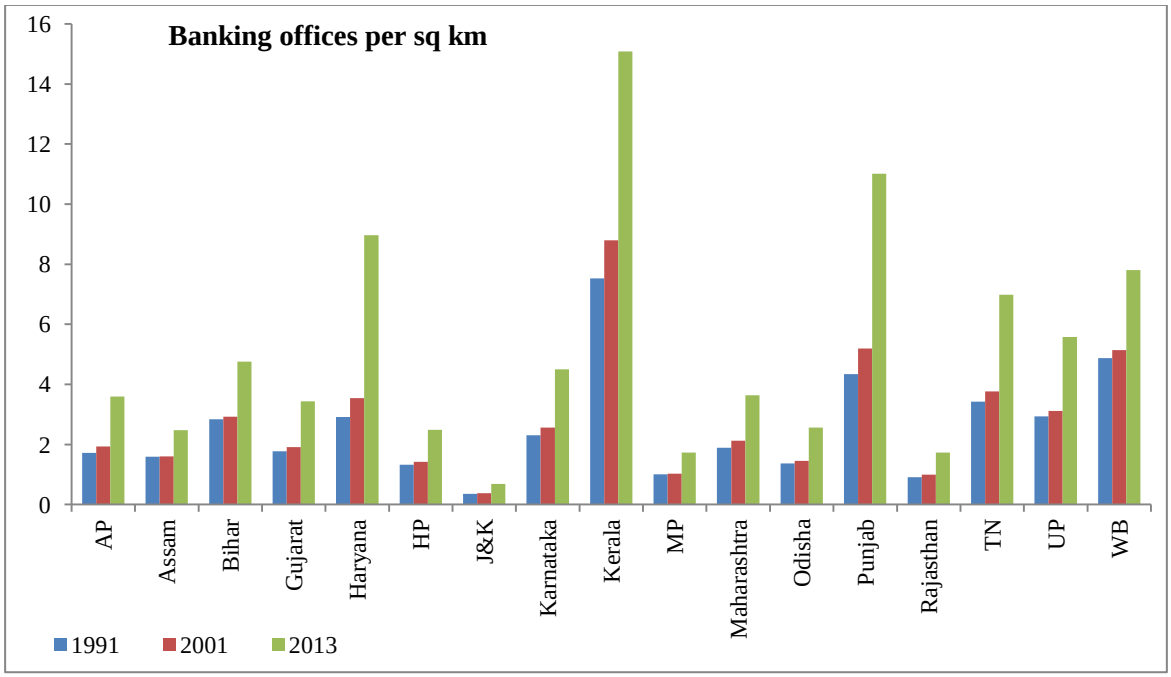


Figure A.6: State Wise Credit- Deposit Ratio

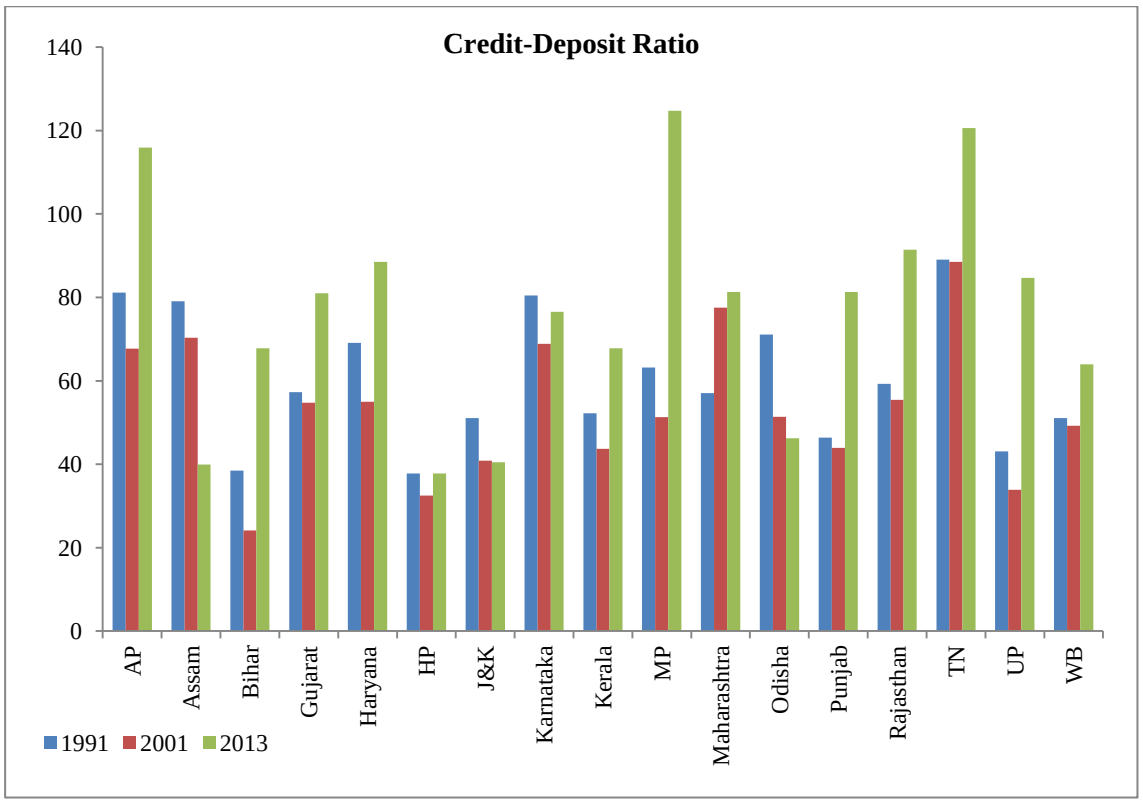


Figure A.7: State Wise Tax to GDP Ratio

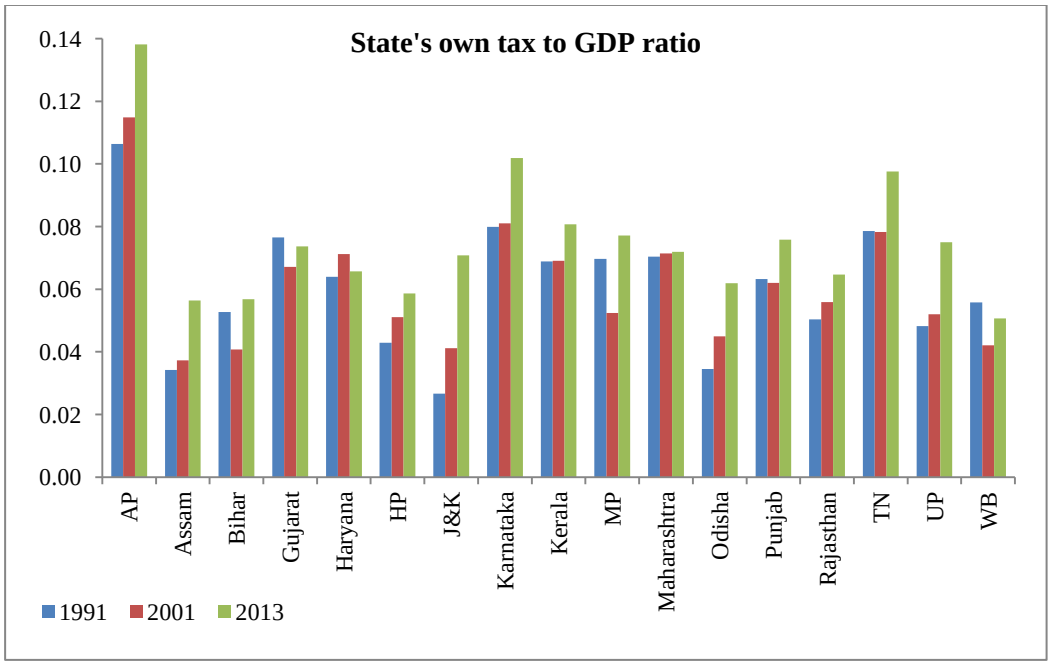


Figure A.8: State Wise Infant Mortality Rate

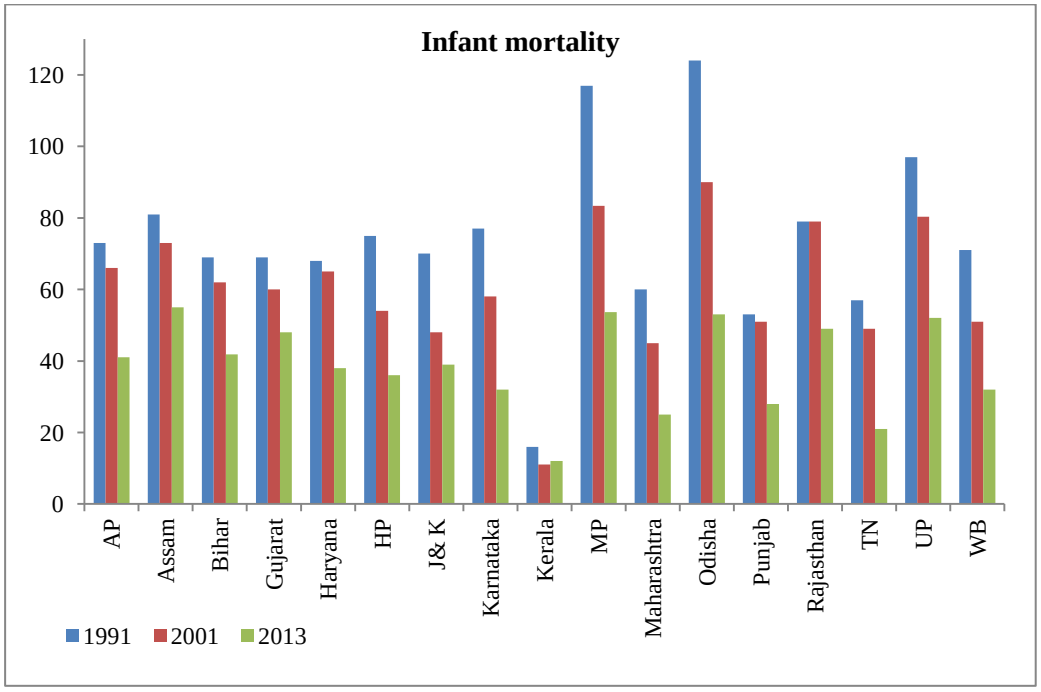


Figure A.9: State Wise Educational Institution

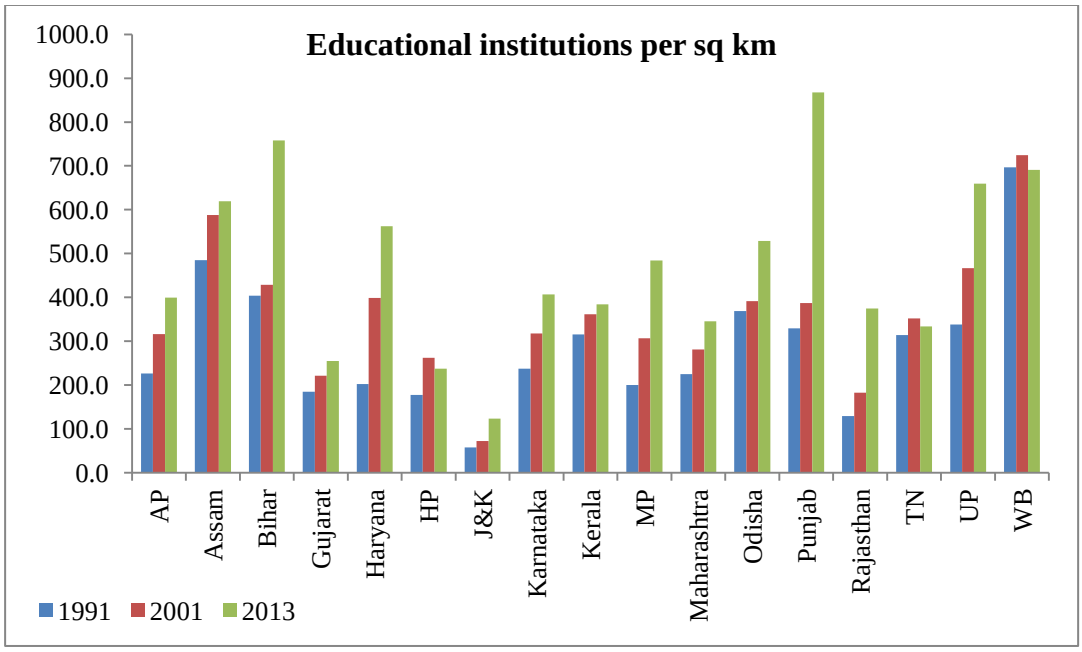


Figure A.10: State Wise Gross Enrollment

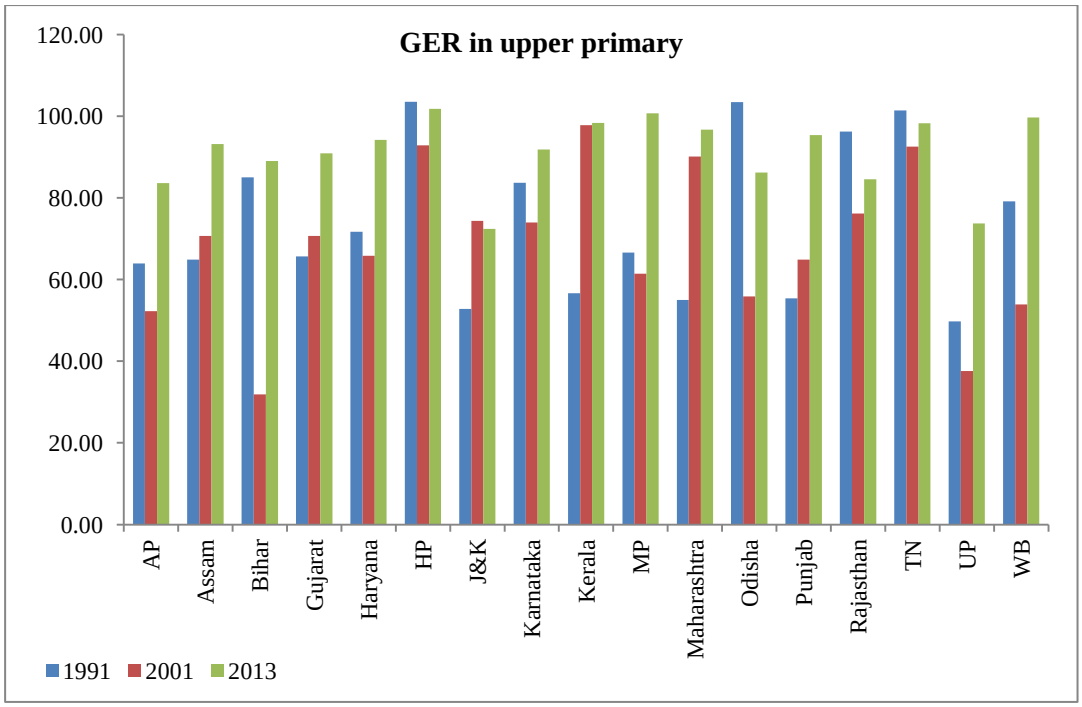


Table A.1:POVERTY RATIO IN STATES (BASED ON MPCE-MRP AS PER TENDULKAR METHODOLOGY)

	1993-94	2004-05	2011-12
Andhra Pradesh	44.6	29.9	9.2
Assam	51.8	34.4	32
Bihar	60.5	54.4	33.7
Gujarat	37.8	31.8	16.6
Haryana	35.9	24.1	11.2
Himachal Pradesh	34.6	22.9	8.1
Jammu &Kashmir	26.3	13.2	10.3
Karnataka	49.5	33.4	20.9
Kerala	31.3	19.7	7.1
Madhya Pradesh	44.6	48.6	31.6
Maharashtra	47.8	38.1	17.4
Orissa	59.1	57.2	32.6
Punjab	22.4	20.9	8.3
Rajasthan	38.3	34.4	14.7
Tamil Nadu	44.6	28.9	11.3
Uttar Pradesh	48.4	40.9	29.4
West Bengal	39.4	34.3	20
Source: Planning Commission			

Table A.2: GROSS STATE DOMESTIC PRODUCT (GSDP) OF THE MAJOR STATES

(A) GSDP AT CURRENT PRICES (in rupee crore)

	1993-94	2004-05	2011-12	2013-14
AP	38497.16	224713	667867	855935
Assam	18575.83	53398	125903	125903
Bihar	31049.79	137539	378887	516436
Gujarat	55723.01	203373	598786	765638
Haryana	25541.72	95795	298688	388917
HP	5731.364	24077	64957	82585
J & K	8296.001	27305	68185	87570
Karnataka	46120.08	166747	455212	614607
Kerala	31231.6	119264	312677	396282
MP	58471.13	160789	449540	620412
Maharashtra	126606.6	415480	1170121	1510132
Orissa	24286.79	77729	220589	272980
Punjab	33153.97	96839	256374	317556
Rajasthan	38134.34	127746	414179	517615
TN	66712.56	219003	667202	854238
UP	96015.8	285627	783354	985643
WB	53882.37	208656	528316	706561

Source: CSO
Note: The base year is 2004-05; the data for 1993-94 has been converted to the same base using the splicing technique.

(B) GROWTH RATE OF GSDP AT CURRENT PRICES (in per cent)

	1993-94 to 2004-05	2004-05 to 2011-12	2011-12 to 2013-14
AP	17.4	16.8	13.2
Assam	10.1	13.0	0.0
Bihar	14.5	15.6	16.7
Gujarat	12.5	16.7	13.1
Haryana	12.8	17.6	14.1

HP	13.9	15.2	12.8
J & K	11.4	14.0	13.3
Karnataka	12.4	15.4	16.2
Kerala	13.0	14.8	12.6
MP	9.6	15.8	17.5
Maharashtra	11.4	15.9	13.6
Orissa	11.2	16.1	11.2
Punjab	10.2	14.9	11.3
Rajasthan	11.6	18.3	11.8
Tamil	11.4	17.3	13.2
UP	10.4	15.5	12.2
WB	13.1	14.2	15.6
Source: CSO *Note: The growth rate represents compound annual growth rate.*			

(C) GSDP IN CONSTANT (2004-05) PRICES (in rupee crore)

	1993-94	**2004-05**	**2011-12**	**2013-14**
AP	119087	224713	410554	453151
Assam	36559	53398	76844	86862
Bihar	76745	137539	237070	282817
Gujarat	93473	203373	392058	452625
Haryana	48734	95795	176917	199657
HP	11657	24077	41908	47255
J & K	16298	27305	41203	45847
Karnataka	86184	166747	282784	321455
Kerala	75071	119264	200958	226208
MP	101217	160789	276759	325357
Maharashtra	226082	415480	775610	896767
Orissa	45444	77729	130113	137468
Punjab	60356	96839	157303	174038
Rajasthan	63001	127746	230859	257432
TN	122069	219003	433238	480618

UP	177256	285627	479284	535436
WB	98469	208656	323417	371795

Source: CSO
Note: The base year is 2004-05; the data for 1993-94 has been converted to the same base using the splicing technique.

Table A.3: GROWTH OF GSDP AT CONSTANT (2004-05) PRICES (in per cent)

	1993-94 to 2004-05	2004-05 to 2011-12	2011-12 to 2013-14
AP	5.9	9.0	5.1
Assam	3.5	5.3	6.3
Bihar	5.4	8.1	9.2
Gujarat	7.3	9.8	7.4
Haryana	6.3	9.2	6.2
HP	6.8	8.2	6.2
J & K	4.8	6.1	5.5
Karnataka	6.2	7.8	6.6
Kerala	4.3	7.7	6.1
MP	4.3	8.1	8.4
Maharashtra	5.7	9.3	7.5
Orissa	5.0	7.6	2.8
Punjab	4.4	7.2	5.2
Rajasthan	6.6	8.8	5.6
TN	5.5	10.2	5.3
UP	4.4	7.7	5.7
WB	7.1	6.5	7.2

Source: CSO

Note: The growth rate represents compound annual growth rate.

Table A.4: INFRASTRUCTURE INDICES

	Financial Infra Index	Physical Infra Index	Social Infra Index	Total Infra Index	State
1991	92.89	27.54	53.47	72.61	Andhra Pradesh

	58.64	24.14	57.74	58.63	Assam
	49.34	33.14	44.43	54.59	Bihar
	67.41	35.27	59.41	65.84	Gujarat
	69.99	52.43	61.91	78.72	Haryana
	41.34	14.58	72.95	47.75	Himachal Pradesh
	38.58	16.90	52.52	34.57	Jammu & Kashmir
	81.72	22.12	56.43	68.09	Karnataka
	73.38	35.34	123.44	143.45	Kerala
	65.63	20.61	51.41	52.83	Madhya Pradesh
	64.72	26.53	73.02	67.86	Maharashtra
	54.29	25.98	53.86	63.33	Odisha
	61.23	67.31	68.15	95.12	Punjab
	54.65	23.52	43.22	48.49	Rajasthan
	87.76	42.69	86.24	100.76	Tamil Nadu
	102.66	44.81	54.63	77.82	Uttar Pradesh
	61.29	33.65	93.24	72.60	West Bengal
1992	78.68	32.49	60.68	83.15	Andhra Pradesh
	37.13	24.78	77.27	66.76	Assam
	50.52	33.20	46.28	54.91	Bihar
	54.65	39.22	64.05	68.67	Gujarat
	60.67	56.93	65.54	78.76	Haryana
	34.56	15.72	73.14	51.73	Himachal Pradesh
	25.76	18.73	52.70	36.81	Jammu & Kashmir
	63.06	26.12	61.58	71.35	Karnataka
	78.22	34.26	124.71	135.16	Kerala
	51.64	22.87	58.74	60.58	Madhya Pradesh
	51.92	28.53	75.19	71.80	Maharashtra
	37.49	27.60	56.82	69.59	Odisha
	60.34	73.82	69.65	89.76	Punjab
	39.96	25.00	49.48	51.50	Rajasthan
	70.26	44.15	91.70	95.02	Tamil Nadu
	46.86	41.46	55.94	61.33	Uttar Pradesh
	60.23	34.42	96.48	78.65	West Bengal
1993	62.88	37.26	51.66	77.55	Andhra Pradesh
	29.81	15.75	81.78	62.30	Assam
	45.28	26.19	47.96	54.63	Bihar
	47.46	49.92	60.43	68.54	Gujarat
	51.17	60.40	63.21	74.75	Haryana
	30.38	20.55	74.65	49.85	Himachal Pradesh
	18.62	25.22	52.79	34.10	Jammu & Kashmir
	57.68	31.15	67.73	77.42	Karnataka

	81.64	26.34	122.10	141.41	Kerala
	41.14	28.87	50.16	58.96	Madhya Pradesh
	44.08	36.66	78.11	72.37	Maharashtra
	30.51	31.44	59.13	69.88	Odisha
	58.30	80.91	70.07	89.27	Punjab
	34.09	27.89	50.65	52.44	Rajasthan
	61.04	45.27	94.11	95.66	Tamil Nadu
	41.65	36.72	58.26	59.52	Uttar Pradesh
	56.31	26.39	101.98	75.79	West Bengal
1994	115.10	33.06	52.17	64.44	Andhra Pradesh
	54.76	24.88	82.05	56.09	Assam
	67.94	33.80	47.90	55.63	Bihar
	82.45	39.94	61.08	59.40	Gujarat
	88.94	53.38	63.55	70.40	Haryana
	52.95	16.05	75.21	39.83	Himachal Pradesh
	36.66	17.79	53.03	27.45	Jammu & Kashmir
	103.31	27.23	72.31	64.59	Karnataka
	111.58	37.27	122.29	94.60	Kerala
	77.47	24.23	51.08	48.04	Madhya Pradesh
	92.67	28.25	78.46	60.63	Maharashtra
	60.46	27.40	59.29	54.14	Odisha
	92.54	72.50	70.43	87.89	Punjab
	67.12	25.40	50.88	44.13	Rajasthan
	116.55	45.18	94.24	83.47	Tamil Nadu
	66.87	42.23	58.66	61.35	Uttar Pradesh
	92.57	37.01	102.18	80.45	West Bengal
1995	109.58	32.19	52.00	64.02	Andhra Pradesh
	53.88	25.30	80.88	56.24	Assam
	71.48	32.45	47.08	55.86	Bihar
	86.78	40.07	66.43	63.10	Gujarat
	88.62	53.74	61.19	72.42	Haryana
	52.60	16.44	78.44	41.89	Himachal Pradesh
	37.24	17.39	52.50	28.42	Jammu & Kashmir
	110.20	26.74	69.22	65.56	Karnataka
	110.42	37.61	125.17	101.44	Kerala
	86.97	24.40	61.17	53.38	Madhya Pradesh
	96.96	29.79	78.61	67.41	Maharashtra
	62.00	28.06	58.26	56.72	Odisha
	88.13	71.04	71.66	89.62	Punjab
	65.60	26.17	51.65	45.35	Rajasthan

	125.51	44.80	97.93	88.41	Tamil Nadu
	65.29	40.52	58.47	62.11	Uttar Pradesh
	90.19	37.10	101.49	81.19	West Bengal
	111.31	32.83	47.96	58.06	Andhra Pradesh
	52.34	25.25	71.98	51.09	Assam
	64.19	33.99	44.36	52.89	Bihar
1996	82.57	42.12	62.52	53.51	Gujarat
	80.81	55.34	57.82	64.53	Haryana
	50.56	17.42	81.08	33.48	Himachal Pradesh
	34.36	18.49	53.00	21.62	Jammu & Kashmir
	108.41	25.85	61.40	56.54	Karnataka
	109.46	37.05	121.69	103.31	Kerala
	86.08	25.04	55.49	45.07	Madhya Pradesh
	92.56	31.03	76.71	58.50	Maharashtra
	61.82	28.93	54.68	56.22	Odisha
	81.61	73.32	65.84	84.27	Punjab
	67.34	27.20	50.54	39.49	Rajasthan
	127.42	46.25	83.91	78.65	Tamil Nadu
	63.45	43.01	51.77	60.10	Uttar Pradesh
	84.04	36.96	89.51	73.41	West Bengal
	78.54	32.28	33.31	59.44	Andhra Pradesh
	32.45	24.74	52.25	42.43	Assam
	45.78	34.50	37.06	46.34	Bihar
	52.34	38.76	39.11	56.19	Gujarat
	55.35	53.96	42.67	66.06	Haryana
	33.99	15.74	51.21	37.70	Himachal Pradesh
	23.62	18.40	32.57	27.00	Jammu & Kashmir
	66.21	25.44	39.70	55.60	Karnataka
1997	88.77	36.23	83.31	123.16	Kerala
	51.30	23.06	36.03	43.22	Madhya Pradesh
	57.20	26.44	49.99	56.61	Maharashtra
	35.52	27.14	41.36	57.63	Odisha
	60.98	69.17	45.38	89.52	Punjab
	40.56	25.33	33.25	39.28	Rajasthan
	76.04	45.59	50.25	76.30	Tamil Nadu
	44.84	43.27	38.68	57.44	Uttar Pradesh
	58.40	36.99	65.78	61.92	West Bengal
1998	75.82	33.47	32.35	87.61	Andhra Pradesh
	33.28	26.39	31.00	49.16	Assam

	44.89	34.16	17.79	41.91	Bihar
	53.59	40.85	47.82	85.50	Gujarat
	60.39	54.44	43.92	80.44	Haryana
	34.47	16.91	59.55	64.90	Himachal Pradesh
	25.70	18.88	54.16	54.27	Jammu & Kashmir
	63.18	26.32	46.21	84.52	Karnataka
	85.31	37.80	93.96	136.08	Kerala
	50.29	24.42	41.35	72.21	Madhya Pradesh
	58.51	28.66	65.82	98.56	Maharashtra
	34.24	28.47	20.61	61.47	Odisha
	60.62	71.07	45.62	93.82	Punjab
	39.97	26.63	42.70	63.36	Rajasthan
	76.24	47.27	62.98	108.92	Tamil Nadu
	45.08	42.57	20.32	50.91	Uttar Pradesh
	56.08	37.26	24.86	53.85	West Bengal
1999	124.38	34.01	30.15	80.02	Andhra Pradesh
	51.63	26.27	10.98	61.83	Assam
	67.40	34.82	43.03	48.89	Bihar
	86.89	46.74	33.39	81.37	Gujarat
	87.93	57.86	56.57	75.91	Haryana
	51.16	17.74	52.22	57.02	Himachal Pradesh
	43.68	19.08	40.71	42.23	Jammu & Kashmir
	100.96	27.29	89.14	78.09	Karnataka
	98.67	37.37	36.51	157.15	Kerala
	85.26	24.50	60.75	61.64	Madhya Pradesh
	105.32	28.81	25.41	89.20	Maharashtra
	55.69	29.55	37.43	69.86	Odisha
	81.49	73.98	53.76	96.84	Punjab
	70.83	28.75	54.68	61.29	Rajasthan
	120.08	48.26	12.50	103.54	Tamil Nadu
	64.47	42.53	11.99	58.09	Uttar Pradesh
	70.84	37.28	11.99	65.84	West Bengal
2000	127.83	33.12	32.45	87.64	Andhra Pradesh
	54.84	25.55	43.95	56.99	Assam
	41.19	33.53	26.25	45.93	Bihar
	92.10	43.37	39.77	87.95	Gujarat
	91.10	54.74	39.23	88.22	Haryana
	51.68	16.73	53.19	53.13	Himachal Pradesh
	51.01	17.48	40.81	44.75	Jammu & Kashmir
	101.29	26.77	44.67	78.44	Karnataka

	94.28	39.14	97.27	127.51	Kerala
	78.32	20.89	34.58	57.24	Madhya Pradesh
	113.22	28.27	51.70	87.31	Maharashtra
	61.36	27.72	33.81	65.49	Odisha
	85.72	69.51	42.19	107.11	Punjab
	76.73	26.36	41.99	62.32	Rajasthan
	121.79	48.53	54.18	107.24	Tamil Nadu
	65.54	41.74	27.20	65.37	Uttar Pradesh
	68.35	39.23	40.37	68.62	West Bengal
2001	85.12	35.91	30.31	83.30	Andhra Pradesh
	46.89	26.24	29.87	83.01	Assam
	39.95	36.27	11.34	44.63	Bihar
	57.86	43.53	48.40	78.63	Gujarat
	66.96	57.15	36.13	75.87	Haryana
	41.00	18.31	63.11	59.56	Himachal Pradesh
	34.33	19.18	60.14	44.43	Jammu & Kashmir
	71.82	28.00	46.57	83.43	Karnataka
	85.17	35.28	101.29	138.67	Kerala
	45.85	22.59	35.46	56.21	Madhya Pradesh
	67.98	28.16	62.31	86.78	Maharashtra
	44.07	27.74	27.18	69.67	Odisha
	66.23	72.80	38.30	89.73	Punjab
	48.63	25.93	51.89	58.87	Rajasthan
	81.84	50.72	59.76	104.58	Tamil Nadu
	49.28	44.35	11.64	57.91	Uttar Pradesh
	57.99	40.67	15.03	70.12	West Bengal
2002	82.61	38.23	36.55	51.23	Andhra Pradesh
	43.91	23.22	17.96	61.20	Assam
	39.19	46.31	6.99	53.26	Bihar
	52.39	47.09	50.95	50.66	Gujarat
	68.19	67.36	37.22	69.57	Haryana
	38.41	22.10	69.50	36.65	Himachal Pradesh
	32.08	25.56	50.41	23.37	Jammu & Kashmir
	68.21	30.46	46.94	50.83	Karnataka
	89.53	31.79	102.86	84.09	Kerala
	49.82	24.60	38.93	37.27	Madhya Pradesh
	62.83	30.97	59.65	48.80	Maharashtra
	45.81	26.10	28.56	48.85	Odisha
	69.88	84.73	33.30	80.45	Punjab
	49.79	28.71	36.82	35.37	Rajasthan

	80.40	54.79	62.86	73.43	Tamil Nadu
	51.71	50.25	13.29	67.68	Uttar Pradesh
	57.57	45.92	20.22	75.01	West Bengal
2003	131.47	35.68	41.32	92.22	Andhra Pradesh
	57.36	27.52	31.24	58.37	Assam
	51.33	38.78	13.23	42.23	Bihar
	83.20	46.91	49.90	86.49	Gujarat
	101.13	64.65	38.78	89.21	Haryana
	64.03	19.55	69.03	67.37	Himachal Pradesh
	61.13	21.74	45.51	51.32	Jammu & Kashmir
	113.02	28.43	51.18	87.70	Karnataka
	107.47	32.48	106.71	110.61	Kerala
	78.16	24.59	39.12	62.02	Madhya Pradesh
	97.94	28.10	63.73	85.42	Maharashtra
	75.40	28.32	29.10	64.32	Odisha
	92.11	77.99	38.50	96.58	Punjab
	86.47	26.92	40.16	64.47	Rajasthan
	130.86	50.41	68.58	111.98	Tamil Nadu
	72.83	49.43	18.02	61.40	Uttar Pradesh
	81.25	48.82	31.42	71.42	West Bengal
2004	95.74	36.82	43.44	85.26	Andhra Pradesh
	46.08	25.01	31.84	98.69	Assam
	43.38	39.47	14.31	69.18	Bihar
	60.47	45.87	50.85	78.68	Gujarat
	75.75	66.01	42.44	98.81	Haryana
	49.23	19.37	73.14	56.40	Himachal Pradesh
	44.48	23.11	49.52	41.65	Jammu & Kashmir
	86.07	29.26	55.23	87.11	Karnataka
	95.25	33.00	97.58	181.07	Kerala
	57.97	26.19	45.61	61.89	Madhya Pradesh
	71.69	27.52	70.70	74.99	Maharashtra
	58.96	29.47	38.27	80.60	Odisha
	74.89	78.50	40.13	114.82	Punjab
	63.39	29.22	45.07	60.26	Rajasthan
	96.50	52.55	70.39	114.14	Tamil Nadu
	56.78	51.05	15.03	89.60	Uttar Pradesh
	65.19	52.23	29.76	122.08	West Bengal
2005	100.61	38.26	44.22	85.25	Andhra Pradesh
	49.87	24.32	28.91	92.80	Assam

	45.90	39.98	14.79	64.15	Bihar
	65.43	45.24	50.48	78.86	Gujarat
	79.88	65.52	40.48	94.64	Haryana
	51.10	20.01	72.31	58.31	Himachal Pradesh
	47.56	23.13	51.04	41.67	Jammu & Kashmir
	89.41	29.71	53.55	85.81	Karnataka
	92.71	34.22	89.92	173.71	Kerala
	62.22	25.81	49.38	61.55	Madhya Pradesh
	70.82	26.74	60.29	72.77	Maharashtra
	62.45	29.57	29.49	76.37	Odisha
	80.67	78.69	41.28	110.24	Punjab
	68.44	29.71	46.19	60.60	Rajasthan
	97.70	54.04	70.31	112.16	Tamil Nadu
	58.92	51.28	13.09	82.24	Uttar Pradesh
	63.86	55.32	30.05	113.81	West Bengal
2006	105.94	40.64	43.92	80.77	Andhra Pradesh
	51.08	23.29	24.02	94.04	Assam
	47.93	41.69	14.72	64.76	Bihar
	70.94	47.40	50.43	75.84	Gujarat
	81.70	67.40	48.18	89.73	Haryana
	50.50	22.09	70.47	57.16	Himachal Pradesh
	50.64	23.64	50.58	37.30	Jammu & Kashmir
	95.67	31.67	54.69	86.95	Karnataka
	99.27	33.79	85.23	180.58	Kerala
	61.61	28.25	51.10	57.54	Madhya Pradesh
	69.19	28.73	71.10	68.88	Maharashtra
	60.68	29.97	35.99	73.53	Odisha
	80.80	81.17	40.77	106.07	Punjab
	69.29	31.38	48.33	57.56	Rajasthan
	101.65	55.91	69.90	108.18	Tamil Nadu
	63.38	53.02	10.12	82.22	Uttar Pradesh
	67.88	54.97	30.43	116.19	West Bengal
2007	166.01	41.93	44.60	81.31	Andhra Pradesh
	69.92	22.90	39.41	100.16	Assam
	64.39	42.37	17.58	64.26	Bihar
	117.56	52.43	50.97	79.85	Gujarat
	105.38	69.51	36.50	88.14	Haryana
	78.19	25.01	71.30	60.43	Himachal Pradesh
	83.69	24.52	51.26	36.37	Jammu & Kashmir
	136.65	33.64	54.50	88.56	Karnataka

	110.81	33.16	93.39	199.05	Kerala
	98.84	29.08	51.76	56.88	Madhya Pradesh
	102.49	30.57	60.95	69.39	Maharashtra
	82.77	34.64	37.64	74.67	Odisha
	104.94	85.26	40.96	106.73	Punjab
	119.43	32.62	48.48	60.62	Rajasthan
	145.74	57.94	74.63	109.90	Tamil Nadu
	84.90	53.94	21.46	80.92	Uttar Pradesh
	82.17	56.41	31.72	119.17	West Bengal
2008	175.13	44.08	39.67	78.51	Andhra Pradesh
	67.30	25.87	16.43	91.13	Assam
	58.62	43.46	10.45	61.08	Bihar
	100.13	55.73	52.49	64.86	Gujarat
	103.07	74.36	28.77	83.40	Haryana
	73.16	26.13	67.08	47.35	Himachal Pradesh
	78.33	29.67	62.54	31.53	Jammu & Kashmir
	124.50	35.85	49.19	77.55	Karnataka
	112.31	36.14	84.96	169.85	Kerala
	91.32	31.27	47.80	49.73	Madhya Pradesh
	106.85	34.11	56.83	70.04	Maharashtra
	79.08	35.92	32.56	66.72	Odisha
	99.33	89.09	40.62	106.05	Punjab
	108.27	34.53	45.92	53.91	Rajasthan
	145.74	59.64	69.11	96.83	Tamil Nadu
	81.13	55.94	13.21	79.80	Uttar Pradesh
	80.74	59.17	24.10	123.65	West Bengal
2009	170.31	56.40	42.40	78.32	Andhra Pradesh
	66.99	18.36	19.17	105.75	Assam
	59.43	46.04	19.66	67.26	Bihar
	99.17	73.67	54.89	72.65	Gujarat
	101.29	94.41	34.75	93.59	Haryana
	75.44	40.59	69.26	58.11	Himachal Pradesh
	78.64	47.44	67.63	36.75	Jammu & Kashmir
	123.76	45.91	51.76	85.99	Karnataka
	111.29	28.29	90.87	206.06	Kerala
	96.98	44.23	49.93	56.65	Madhya Pradesh
	104.86	43.65	59.59	80.04	Maharashtra
	81.67	42.05	35.24	75.46	Odisha
	102.17	109.95	29.14	124.56	Punjab
	112.80	44.67	48.64	59.47	Rajasthan

	139.05	73.32	76.47	108.09	Tamil Nadu
	81.59	60.87	15.66	92.12	Uttar Pradesh
	82.15	57.12	18.89	147.91	West Bengal
2010	178.60	51.82	41.84	109.16	Andhra Pradesh
	67.09	23.99	16.50	27.20	Assam
	64.92	47.10	18.53	41.99	Bihar
	104.58	63.96	52.60	92.44	Gujarat
	121.04	85.31	34.64	100.20	Haryana
	80.57	34.12	67.00	69.36	Himachal Pradesh
	64.42	38.22	66.41	64.56	Jammu & Kashmir
	124.00	40.71	50.39	79.61	Karnataka
	144.86	36.61	88.62	72.63	Kerala
	95.92	35.49	46.09	65.68	Madhya Pradesh
	107.13	38.64	60.90	77.19	Maharashtra
	81.21	38.07	31.05	56.62	Odisha
	138.06	98.88	50.57	113.82	Punjab
	109.73	38.85	45.40	75.13	Rajasthan
	152.56	66.25	75.47	108.66	Tamil Nadu
	89.92	59.63	15.97	56.22	Uttar Pradesh
	96.09	62.13	34.75	57.14	West Bengal
2011	187.41	54.24	44.55	121.08	Andhra Pradesh
	73.56	27.03	21.44	57.97	Assam
	67.99	38.07	23.39	66.31	Bihar
	110.95	66.11	51.94	109.56	Gujarat
	131.57	85.91	37.80	130.98	Haryana
	78.49	44.30	66.06	86.34	Himachal Pradesh
	69.92	48.12	58.99	72.56	Jammu & Kashmir
	129.27	42.44	55.89	100.87	Karnataka
	146.25	23.39	93.65	127.49	Kerala
	99.76	39.57	47.69	81.62	Madhya Pradesh
	115.58	39.36	67.01	100.13	Maharashtra
	81.08	43.59	31.60	81.13	Odisha
	132.09	98.01	49.94	147.77	Punjab
	111.24	41.73	44.74	88.54	Rajasthan
	159.42	64.18	78.02	137.46	Tamil Nadu
	94.55	51.15	21.32	84.56	Uttar Pradesh
	97.40	43.93	40.75	100.65	West Bengal
2012	186.01	55.38	48.13	127.23	Andhra Pradesh
	71.51	21.82	38.24	77.18	Assam

	73.01	50.80	23.64	74.17	Bihar
	119.44	70.13	59.89	119.94	Gujarat
	127.92	95.12	45.96	139.71	Haryana
	76.71	39.48	66.82	88.67	Himachal Pradesh
	77.30	42.58	57.87	74.87	Jammu & Kashmir
	132.58	47.29	56.30	111.88	Karnataka
	149.62	34.17	97.36	149.61	Kerala
	99.32	42.34	52.60	86.88	Madhya Pradesh
	117.33	42.70	68.78	107.31	Maharashtra
	81.31	45.97	39.48	90.40	Odisha
	135.35	106.75	49.65	159.37	Punjab
	118.67	46.83	46.75	96.63	Rajasthan
	166.40	69.89	74.89	146.20	Tamil Nadu
	98.60	63.12	22.77	93.99	Uttar Pradesh
	101.08	64.44	46.07	117.04	West Bengal
2013	182.07	58.44	64.76	82.62	Andhra Pradesh
	72.03	19.56	75.01	49.25	Assam
	74.84	51.34	79.38	66.35	Bihar +Jharkhand
	114.68	77.58	62.59	90.55	Gujarat
	130.20	103.60	76.32	116.92	Haryana
	72.08	43.95	69.97	66.09	Himachal Pradesh
	76.85	47.03	50.20	54.32	Jammu & Kashmir
	133.20	53.20	71.54	79.60	Karnataka
	142.88	31.22	91.27	90.33	Kerala
	99.56	46.90	74.60	65.48	Madhya Pradesh
	114.36	47.75	74.91	75.81	Maharashtra
	80.26	50.57	68.62	69.81	Odisha
	137.63	112.80	90.15	131.63	Punjab
	111.23	52.78	63.16	67.27	Rajasthan
	168.06	72.47	77.84	98.55	Tamil Nadu
	98.24	65.33	66.58	74.53	Uttar Pradesh
	99.95	66.45	85.06	87.23	West Bengal

Table A.5: PANEL REGRESSION RESULTS

Haussmann fixed

	(b)	(B)	(b-B)	Sqrt ((V_b-V_B))
	Fixed	**Random**	**Difference**	**S.E.**
Social	.0858333	-.2134012	.2992345	.1105902
Physical	-.1375136	-.1636181	.0261045	.0418835
Financial	-.2425166	-.1270003	-.1155163	.0341628
GSDP_Constant	-.0000547	-.0000355	-.0000193	3.04e-06

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2 (3) = (b-B)'[(V_b-V_B) ^ (-1)] (b-B)

= 36.78

Prob>chi2 = 0.0000

(V_b-V_B is not positive definite)

Table A6. Correlation results

	Poverty	**Social Infra Index**	**Total Infra Index**	**Physical Infra Index**	**Financial Infra Index**	**Urbanization**
Poverty	1					
Social Infra Index	-0.078	1				
Total Infra Index	-0.503	0.255	1			
Physical Infra Index	-0.460	-2153	0.523	1		
Financial Infra Index	-.6889	0.031	0.714	0.4637	1	
Urbanization	-.4259	0.311	0.545	0.4282	0.5891	1

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