IMPACT OF ECONOMIC AND SOCIAL INFRASTRUCTURE ON INCOME INEQUALITY - EVIDENCE FROM INDIAN STATES

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ABSTRACT: This paper discusses how infrastructure impacts inter-district inequality in India using data for 12 states, that were categorised as leading and lagging for the period 2001-2011. Income data from 388 districts is used to compute state wise Gini coefficients to analyse how infrastructure impacts inequality. Unlike the existing literature which considers either quantity or quality of infrastructure, this study uses an alternate perspective that considers both 'availability' and 'usage' of infrastructure to study how the economic and social variants of infrastructure impact output and inequality in Indian states. The paper finds that only economic infrastructure has a sobering impact on inter-district income inequality in both the leading and lagging states. Social infrastructure was observed to accentuate income inequality in the lagging states. The worsening of social infrastructure in the backwards districts of both categories of states and more prominently in the lagging ones, appears to explain the findings.

KEY WORDS: India; infrastructure index; interstate income inequality; intrastate income inequality; economic infrastructure; social infrastructure; Gini Coefficient; district domestic product; financial depth.

1. INTRODUCTION

There is a broad consensus in the empirical literature that infrastructure enhances growth prospects of a country (Aschauer, 1989; Munnell, 1990; Nadiri and Mamuneas,1994; Hulten and Schwab, 1991; Romp and de Haan, 2007; Calderon and Servén, 2014). Provision of infrastructure can also impact spatial inequality if benefits from it are shared asymmetrically across regions (Estache and Fay, 2010; Calderon and Servén, 2004; 2014; ADB, 2012). There are country specific studies that have found beneficial impacts of different kinds of economic infrastructure on the development of rural areas e.g. road, electricity and irrigation in Bangladesh, China, Peru, Vietnam and South Africa (Mu and Van de Walle, 2007; Zhu and Luo, 2006; Escobal and Ponce, 2008; Dinkelman, 2011). Broadly, provision of physical infrastructure, especially transport and communications, facilitates access to information, increases mobility of labour, spurs nonfarm activities and thus, reduces poverty in the lagging regions of a country. There is also a large body of literature that has considered both physical and human infrastructure identifying their beneficial impact on reducing regional inequality (Fleisher *et al*., 2007; Fan *et al*., 2004; Zheng and Kuroda, 2013). These studies broadly find that though both physical and social infrastructure have positive effects, education plays a more prominent role in lowering inter regional inequality. However, drawing on the experience of France, Italy and Brazil; Estache and Fay (2007) observe that transport and infrastructure is a necessary but not sufficient condition for regional growth. From a Chinese perspective, Fan *et al*. (2011) suggests that identifying the types of infrastructure that have the highest returns in specific regions is one area for detailed research. Further, UNCTAD (2013) notes that empirical evidence on relationships between infrastructure investment and inequality is less conclusive.

Building on the backdrop above, the present study explores how different categories of infrastructure impact intrastate inequality in India. India is a Union of 28 states and 7 union territories and is governed through a Parliamentary system as per the provisions of the Constitution of India. The Parliament consists of two Houses—Rajya Sabha and Lok Sabha with representation from the states and Union Territories. The Constitution provides for a central government for the Union and a state government for each of the 28 states. The Central Government is formed by the party holding the majority of seats in the elections to the Lok Sabha. Government in a state is formed by the party obtaining the majority of seats in the elections to the State Legislative Assembly. The subjects on which the Central and State governments can legislate is provided in the Constitution.

Regions in India are defined in at least three different ways. First, groups of states on a geographical basis like Eastern, Western, Central Northern, Southern and Northeast regions. Second, states having their own legislature. Third, districts within states for the study of intrastate regional performance. We consider states to represent regions for the purpose of balance regional development. The intrastate dynamics is studied through district level indicators of development. Districts serve as an important unit of administration as development policies, programs and schemes are implemented through district level administration. Economic and social indicators data in India is available for the Country, States and Districts but not below the level of districts.

The 73rd and 74th Constitutional Amendments in 1993 created the structure for local government in rural and urban areas respectively. Panchayats in rural areas and Municipalities in urban areas are the institutions of self-government at the local level. States are mandated to devolve functions associated with 29 subjects to the Panchayats. Both the central and state governments obtain funds through tax and non-tax revenues. In addition, the Constitution provides for setting up a Central Finance Commission to suggest devolution of funds from the Centre to States. Giving due consideration to the federal structure of India's polity, most of the financial powers and authorities to be endowed to the local government have been left at the discretion of concerned state legislatures. Consequently, the powers and functions vested in local governments vary from state to state. Nonetheless, States are mandated to constitute a State Finance Commission every five years to determine the share of Panchayats in the financial resources of the State.

Understanding of the infrastructure-inequality relationship assumes significance for India because balanced regional development has been one of the key objectives of economic policy (Misra, 2007). Post-Independence, India articulated its development ambitions through the five-year plans beginning with 1951. The second five-year plan (1956-61) was a watershed as it enunciated the state led heavy industrialisation strategy. The decision to allocate mega infrastructure projects in the different states as a part of this strategy was guided by concerns of balanced regional development (Misra, 2007). The third five-year plan explicitly mentioned that “balanced development of different parts of the country, extension of the benefits of economic progress to the less developed regions and widespread diffusion of industry are among the major aims of planned development” (GoI, 1961). The focus on the development of lagging states has continued, notwithstanding India embracing economic reforms in 1991 when market forces were accorded a greater role in resource allocation. While redressing interstate disparity was a concern all through the planning period, it gained added importance beginning with the 10th five-year plan (2002-07) when the central government introduced a new initiative 'Rashtriya Sam Vikas Yojana' (RSVY) to address the problem of regional disparity (Misra, 2013). The RSVY as a specific programme was launched in 2003-04 which was subsumed into the Backward Regions Grant Fund (BRGF) programme in 2006-07. BRGF covers 250 districts as against 147 districts in 27 States covered by the RSVY. The panchayats were involved in choosing the schemes, their implementation and preparation of district plans for utilizing the BRGF. The fund provided under BRGF can be used for different purposes including education, health, drinking water and electrification. In view of the continued policy focus to promote balanced regional development and infrastructure as a key area of intervention, it would be useful from a policy perspective to assess how infrastructure impacts output and inequality in the states.

Bajar and Rajeev (2015) and Majumder (2012) are the only two India based studies on the relationship between infrastructure and regional inequality. Both studies focus on the impact of infrastructure on consumption inequality computed from state wide quinquennial consumer expenditure surveys undertaken by the National Sample Survey Organisation (NSSO). Bajar and Rajeev (2015) study inequality in consumption expenditure for 1983, 1987-88, 1993-94, 2004-05 and 2009-10 in 17 major states categorised as high and low income. This study which used only components of physical infrastructure found that road and power increase inter personal consumption inequality for the low-income states. Bajar and Rajeev (2015) have attributed this seemingly paradoxical result to better accessibility of the rich to luxurious goods made possible because of improvement in the road and power network. The Majumder (2012) study developed a composite index by combining physical, financial and social infrastructure. Majumdar (2012) studied how the different infrastructure categories impact consumption-based inequality for 1993-94 and 2004-05. This study found that, economic infrastructure accentuates, and social infrastructure helps to reduce, inequality in consumption. Both these studies are silent on the methodological nuances associated with the estimation of infrastructure and inequality relationships. The Bajar and Rajeev (2015) study suffers from the additional limitation that it has excluded social infrastructure.

Given the limitations of the existing studies, this paper contributes to the literature in three distinct ways. First, panel data analysis of infrastructure and inequality relationships is preferred as it uses a richer information set. However, panel data studies have only been developed for sets of developing, developed or a mix of both developing and developed countries limiting their utility from a country specific policy perspective (Calderon et al., 2011). One way to draw robust country specific inferences about the infrastructure, output and inequality relationship is to employ panel methods for a single country by using sub-nation level data. Since there are no such studies for India, we fill this gap in the literature by studying the infrastructure, output and inequality relationship for twelve states of India in the post 2000 period. Second, India based studies have used consumption rather than income inequality at the state level. This is the first study to track income inequality at the state level using sub state or district level income. We study how infrastructure impacts inter-district income inequality. Third, unlike the extant literature which considers either the quantity or quality dimension, we use an alternate perspective that considers both availability and usage of infrastructure. To the best of our knowledge, this is the first study which tries to analyse the relative importance of economic and social infrastructure in impacting inter-district inequality in the Indian states using panel data.

The rest of the paper is structured as follows. The next section describes the data and methodology used in the study. Specifically, we discuss the motivation behind our choice of indicators and the method of constructing the infrastructure index. The stylized facts related to evolution of output, inequality and infrastructure during the study period is discussed in the third section. The fourth section discusses the empirical results. The conclusions are discussed in the sixth section.

2. METHODOLOGY FOR COMPUTING THE COMPOSITE INFRASTRUCTURE INDEX

A standard approach in many studies on infrastructure and inequality relationships is to employ a monetary measure of public investment to denote infrastructure (Straub, 2008). Using public investment to denote infrastructure can lead to systematic measurement error if the private sector plays a significant role in provision of infrastructure. This is especially true in the post 1990 period of India when the private sector was assigned a significant part of total infrastructure investment (Misra, 2013). Another limitation of public capital stock as a proxy for infrastructure is that they may not truly reflect the effective capital stock. This is because the costs incurred over the years may exaggerate the values associated with public stock of infrastructure on account of inefficiency, corruption and faulty accounting practices. The weakness of using public capital can be appreciated as around 48 per cent of the studies that use aggregate public capital to denote infrastructure do not find its beneficial effect on output (Straub, 2008). Given these limitations, physical indicators of infrastructure are often preferred for empirical studies. As such, we have used tangible indicators of economic infrastructure in this study.

Literature tends to suggest that infrastructure is often proxied through a single indicator. Omitting relevant indicators can lead to invalid inferences and including too many indicators may lead to imprecise estimates (Calderon and Servén, 2014). Use of infrastructure indices can overcome these problems. In this study we have used a composite index to get more precise estimates of the impact of infrastructure on output and inequality. We have constructed the composite index encompassing both the social and economic dimensions of infrastructure. We consider basic infrastructure facilities like water, electricity and road to denote economic infrastructure. Health and education facilities represent social infrastructure.

One approach in the literature is to combine the indicators of infrastructure quantity to construct a composite index of physical infrastructure. Aggregate indices of infrastructure quality are also constructed by considering indicators that represent quality of physical infrastructure services (Calderon and Servén, 2004). Instead of approaching infrastructure from a 'quantity' and 'quality' perspective we consider the 'availability' and 'usage' of infrastructure. This is particularly relevant for India, a lower middle-income country, where availability and usage of infrastructure can differ because of demand as well as supply side forces.

Availability need not translate to usage if there are supply side constraints. For instance, despite high installed capacity, electricity available for consumption may be low on account of poor maintenance or higher transmission and distribution losses. Usage of the available capacity can also be relatively low from the demand side if people cannot afford to purchase power. When we consider social infrastructure, establishment of schools and hospitals is necessary but not sufficient to ensure better education and health outcomes. This is because schools or hospitals without the necessary men and material support, may not matter much to influence human capital formation. In addition, people may not be able to make use of available social infrastructure if they find the opportunity cost of sending children to school or availing medical facilities to be quite high.

In the economic dimension, the specific indicators that we have used to represent capacity and usage for water are 'gross irrigated area as a per cent of gross cropped area' and 'fertiliser consumption per hectare' respectively. For electricity, 'installed capacity' and 'per capita electricity consumption' is used to reflect capacity and usage. We consider 'road density' to reflect availability and 'surfaced road as proportion of total road' to connote its effective usage in facilitating trade and commerce. In the social dimension we have taken 'number of teachers per school in a state' and the 'literacy rate' to denote availability of education infrastructure and its usage, respectively. For measuring health infrastructure, we consider the 'availability of health centres in a state' and their effective usage represented through the 'infant survival rate' (Appendix 1).

For each infrastructure indicator in the economic and social dimension, the index for a particular state in a given year is computed using the following formula: Component Index = (actual−minimum)/(maximum−minimum).

Apart from choosing the indicators, one needs to assign them weights to create the composite index. The standard approach in the literature is to use principle component analysis (PCA) to determine weights (Calderon and Servén, 2004; Calderon *et al.,* 2011). We use PCA to obtain weights for the different components of economic and social infrastructure index. Once the economic and infrastructure indices have been computed, we again assign weights to them using PCA to obtain the composite infrastructure index. The economic, social and composite infrastructure index obtained using the PCA to assign weights is labelled as ECOINFPCA, SOCINFPCA and INFPCA.

In order to assess the robustness of our findings, we have used one more methods to assign weights. In the alternate method, the three indicators of economic infrastructure are assigned weights based on the relative importance of the sector they represent in state output proxied through state domestic product (SDP). As water is vital for agriculture, electricity for industry, and road network for the service sector; we assign the share of agriculture, industry and services in SDP as weights respectively for water, electricity and road. The weights for the different components of the economic infrastructure index as per this alternate method is dynamic because the share of each sector in SDP can differ both across states for a year and for a particular state across the years.

Since there is no concrete production or output in the social infrastructure, the health and education sub-indices were assigned weights using PCA. The economic and social infrastructure indices were also assigned weights based on PCA to construct the composite infrastructure index for each year for the period 2000-01 to 2010-11. The economic, social and composite infrastructure index obtained using the alternate method is labelled as ECOINSS, SOCINFSS and INFSS.

State level inequality is represented through the Gini index computed from the income of sub state units i.e. districts within a state. We have considered district domestic product at 2004-05 as the base to denote income at the district level. Guided by availability of consistent data at the district level, we have considered 12 states for the study. As a percentage of combined SDP of all States, these twelve states accounted for 76.4 per cent in 2001 and 74.5 per cent in 2011. These 12 states also accounted for 80.3 per cent of India's population in 2001 and 77.2 per cent in 2011.

We conceptualise states in India to fall in two broad categories viz, leading and lagging. We consider per capita income at the state level and pervasiveness of backwardness at the district level within states to classify states as leading or lagging. The Niti Aayog in Sep 2017 has identified the 115 most backward districts of India. We have imposed the condition that a state will be categorised as lagging if at least five districts of that state feature in this list of 115 backward districts. By this criterion, we found six states viz, Bihar, Madhya Pradesh, Odisha Rajasthan, Uttar Pradesh and West Bengal as lagging. When we used income classification at the state level, we found that the six lagging states had a real per capita SDP less than the average for all the 12 states both in 2001 and 2011. We have classified the other six states Andhra Pradesh, Karnataka, Kerala, Maharashtra, Punjab and Tamil Nadu as leading as the number of backward districts in these states were relatively less and they had a real per capita SDP greater than the average for the 12 states both in 2001 and 2011.

There is a broad convergence of our categorisation of states in the study with that of the Raghuram Rajan Committee (GoI, 2013). The Raghuram Rajan Committee (2013) had categorised states as relatively developed, less developed and least developed based on composite index scores of less than 0.4. 0.4-0.6 and above 0.6, respectively. Except West Bengal which scores 0.55, all the other states that we have considered as lagging states are also categorised as the least developed by this Committee.

We have analysed the impact of infrastructure on output and inequality by using panel data econometric methods. We describe the general specifications to study the infrastructure-growth relationship through Eqs. 1-2 and the relationship between infrastructure-inequality through Eqs. 3-4. Eqs. 1-2 estimate the impact of infrastructure on output with inequality, financial depth and inflation as conditioning variables. While Eq. 1 estimates the impact of composite infrastructure, Eq. 2 estimates the impact of economic and social infrastructure separately. Eqs. 3-4 estimate the impact of infrastructure on income inequality with SDP, squared SDP, financial depth and inflation as conditioning variables. We have chosen conditioning variables based on those existing in the literature and the context of our analysis. For instance, a conditioning variable such as external orientation has been excluded as they are mostly applicable at a country level.

$$SDP_{i,t} = \eta_1 + \eta_2 INFR_{i,t} + \eta_3 GINI_{i,t} + \eta_4 INFL_{i,t} + \eta_5 DPTH_{i,t} + \varepsilon_{I,t} \quad \textbf{(1)}$$

$$SDP_{i,t} = \eta_6 + \eta_7 ECOINFR_{i,t} + \eta_8 SOCINFR_{i,t} + \eta_9 GINI_{i,t} + \eta_{10} INFL_{i,t} + \eta_{11} DPTH_{i,t} + \varepsilon_{i,t} \quad \textbf{(2)}$$

$$GINI_{i,t} = \eta_{12} + \eta_{13} INFR_{i,t} + \eta_{14} SDP_{i,t} + \eta_{15} SDPSQ_{i,t} + \eta_{16} INFL_{i,t} + \eta_{17} DPTH_{i,t} + \varepsilon_{i,t} \quad \textbf{(3)}$$

$$GINI_{i,t} = \eta_{18} + \eta_{19} ECOINFR_{i,t} + \eta_{20} SOCINFR_{i,t} + \eta_{21} SDP_{i,t} + \eta_{22} SDPSQ_{i,t} + \eta_{23} INFL_{i,t} + \eta_{24} DPTH_{i,t} + \varepsilon_{i,t} \quad \textbf{(4)}$$

where,

INFR=Composite infrastructure index. This variable can be either INFPCA or INFSS

ECOINFR = Economic infrastructure index. This variable can be either ECOINFPCA or ECOINFSS

SOCINFR=Social infrastructure index. This variable can be either SOCINFPCA or SOCINFPCA

SDP= Per capita real state domestic product at 2011-12 base

SDPSQ= Square of real per capita SDP

INFL= Inflation

DPTH = Financial depth measured as credit outstanding as a per cent of SDP

GINI= Income inequality in a state measured through Gini Coefficient computed from district domestic product at 2004-05 base

$\varepsilon_{i,t}$= Error term

η= the parameter to be estimated.

We use the log of each variable in the estimation. We have used econometric methods taking into account the small size of the dataset which has a total of 132 observations. Categorised as leading and lagging states, the data points further reduce to 66 for each state category. There is a good deal of debate whether panel data models should be estimated using fixed-effects or random effects models. Field (2001) also observes that although fixed-effects models have attracted considerable attention they are appropriate only for drawing conditional inferences. Random effects models are more appropriate when one is interested in unconditional inferences. Typically, a Hausmen test is used to ascertain the appropriateness of a random effects model. Monte Carlo simulations by Clark and Linzer (2015) suggests random effects estimation is preferred in very small datasets even when there are extreme violations of the assumption of zero correlation between the fixed effects and the independent variables. This implies that the random effect estimation is more appropriate for the dataset available for this study.

The use of a random effects model requires specifying the variance component method to be used in the estimation. A number of Generalised Least Square (GLS) estimators have been developed for this purpose such as those by Wansbeek and Kapteyn (WK), Wallace and Hussain (WH) and Swamy and Arroa (SA). Monte-Carlo simulation of a random effect model by Mohammadi (2012) suggests that SA is inappropriate for small samples. Mohammadi (2012) points out that if the number of cross sections is equal to the number of parameters, the SA model wrongly favours the fixed effects model. If the number of cross sections is smaller than the number of parameters, mathematically SA becomes infeasible but WH and WK are feasible. As such, we have not used the SA estimator in this study. Baltagi (2011) recommends that more than one of the GLS estimators should be used in estimating the random effects model to draw robust inferences. We have used WK and WH estimators. In addition to the GLS estimators, we have used the Maximum Likelihood (ML) method of estimating the random effect model as it is more efficient. The three methods of estimation were applied separately to infrastructure indices computed using PCA and SS based weights to ascertain their impact on output and inequality. To overcome problems of endogeniety in estimation, we used the first lag of infrastructure variables in the estimation following Seneviratne and Sun (2013). Thus, we ran six sets of regressions to draw inferences. Given the alternate methods of estimation, we adopted a majority criterion decision rule to infer the impact of infrastructure on output and intrastate inequality. The majority criterion is based on congruence of results from at least four or more estimation methods. Congruence of results from at least three methods of estimation was used to reflect the weak impact of the regressors. We undertook empirical estimation for three groups of states viz, 12 states as one group (Group A) and separate groups of leading (Group B) and lagging (Group C) states. In the rest of the paper, 'infrastructure' has been used to indicate composite infrastructure. Before deliberating upon the results from the empirical estimations, we discuss some of the stylized facts regarding the evolution of inequality and infrastructure status in the 12 states for the beginning and terminal year of our study.

3. STYLISED FACTS

We found that both interstate and intrastate income inequality has increased in 2011 compared to 2001 (Table 1). Odisha and Punjab respectively had the highest and lowest inter-district income inequality both in the beginning and last year of the study period. Inequality in each of the 12 states under study had increased by 2011 compared to 2001.Though inequality has increased both for the group of leading and lagging states in 2011 compared to 2001, the former had a consistently lower Gini coefficient than the latter.

Table 1. Evolution Inequality in the States.

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Lagging States												
Bihar	0.16	0.17	0.17	0.18	0.19	0.18	0.18	0.19	0.20	0.22	0.22	0.19
Madhya Pradesh	0.21	0.20	0.21	0.20	0.21	0.21	0.22	0.22	0.22	0.22	0.23	0.21
Odisha	0.21	0.20	0.23	0.23	0.24	0.24	0.25	0.26	0.27	0.26	0.26	0.24
Rajasthan	0.20	0.19	0.21	0.20	0.22	0.21	0.23	0.24	0.23	0.23	0.22	0.22
Uttar Pradesh	0.21	0.21	0.22	0.22	0.24	0.24	0.25	0.25	0.25	0.26	0.26	0.24
West Bengal	0.13	0.13	0.13	0.12	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.14
Average for Lagging States	0.19	0.18	0.20	0.19	0.20	0.20	0.21	0.22	0.22	0.22	0.22	
Leading States												
Andhra Pradesh	0.12	0.13	0.14	0.15	0.14	0.13	0.15	0.14	0.14	0.15	0.16	0.14
Karnataka	0.16	0.18	0.19	0.19	0.20	0.20	0.20	0.20	0.21	0.23	0.22	0.20
Kerala	0.09	0.09	0.09	0.08	0.08	0.09	0.09	0.10	0.11	0.11	0.10	0.09
Maharashtra	0.20	0.20	0.20	0.21	0.22	0.23	0.22	0.22	0.24	0.25	0.24	0.22
Punjab	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.10	0.09	0.08
Tamil Nadu	0.14	0.14	0.15	0.15	0.16	0.16	0.16	0.17	0.17	0.18	0.19	0.16
Average for Leading States	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.17	0.17	
India	**0.20**	**0.20**	**0.21**	**0.20**	**0.21**	**0.22**	**0.22**	**0.23**	**0.22**	**0.22**	**0.23**	**0.21**

Note: The state level inequality is computed from district level income for each state and inequality for India is computed from the state level income inequality. Source: the Author.

Bihar had the lowest composite infrastructure index both in the beginning and last year of the study period irrespective of the method used to assign weights (Table 2). However, when seen in terms of its variants, the lowest economic infrastructure index value under both methods of weighing was observed for Odisha in 2001 and for Bihar in 2011. Punjab had the highest economic infrastructure index value in 2001 as well as 2011 as per both methods of weighting the indicators. As far as social infrastructure is considered, the lowest index value in 2001 was observed for Bihar in 2001 and for Madhya Pradesh in 2011. The highest index value in social infrastructure was observed for Kerala both in 2001 and 2011. The economic infrastructure status in 2011 compared to 2001 improved for all states except for Bihar and Punjab. The social infrastructure position reflected through the index value deteriorated for Madhya Pradesh, Rajasthan and Uttar Pradesh in the group of lagging states and for Punjab and Kerala in the group of leading states. The composite index value declined for Bihar and Madhya Pradesh among the lagging states and for Punjab in the leading states in 2011 compared to 2001.

In general, the economic infrastructure improved mildly for the group of lagging states and significantly for the group of leading states over the period 2001 to 2011. However, social infrastructure position deteriorated mildly in the group of lagging states but increased marginally in the group of leading states. As a result, we found very little progress made in composite infrastructure for the lagging states but significant improvement for the leading states. We also found that the gulf between the leading and the lagging states has widened both in respect of economic and social infrastructure over the period 2001-2011. Thus, the groups of leading states have exhibited higher growth, lower inequality and better infrastructure status compared to the group of lagging states during the study period.

Credit outstanding as a per cent of SDP increased from 23.4 in 2001 to close to 50 in 2011 for these twelve states (Appendix 2). However, when seen in terms of the lagging and the leading regions, there is a huge difference. The leading states had credit penetration twice that of the lagging states both in 2001 and 2011. Credit as a per cent of SDP increased for both categories of states but the increase was relatively fast paced for the leading states.

Table 2. Changing Infrastructure Position in States Between 2001 and 2011.

	Principal Component Based Weights			SS based weights			Principal Component Based Weights			SS based weights		
State	Economic	Social	Composite	Economic	Social	Composite	Economic	Social	Composite	Economic	Social	Composite
	2001						2011					
Lagging States												
Bihar	0.37	0.16	0.27	0.26	0.16	0.21	0.36	0.17	0.27	0.22	0.17	0.20
Madhya Pradesh	0.48	0.36	0.42	0.34	0.36	0.35	0.50	0.16	0.33	0.36	0.16	0.26
Odisha	0.29	0.34	0.32	0.31	0.34	0.32	0.35	0.35	0.35	0.35	0.35	0.35
Rajasthan	0.46	0.39	0.43	0.29	0.39	0.34	0.66	0.32	0.49	0.44	0.32	0.38
Uttar Pradesh	0.39	0.18	0.29	0.30	0.18	0.24	0.59	0.18	0.39	0.44	0.18	0.31
West Bengal	0.48	0.35	0.42	0.37	0.35	0.36	0.48	0.40	0.44	0.36	0.40	0.38
Average of Lagging States	0.41	0.30	0.36	0.31	0.30	0.30	0.49	0.26	0.38	0.36	0.26	0.31
Leading States												
Andhra Pradesh	0.54	0.34	0.44	0.61	0.34	0.48	0.71	0.35	0.53	0.65	0.35	0.50
Karnataka	0.52	0.41	0.47	0.53	0.41	0.47	0.72	0.48	0.60	0.60	0.48	0.54
Kerala	0.30	0.95	0.63	0.37	0.95	0.66	0.44	0.89	0.66	0.57	0.89	0.73
Maharashtra	0.38	0.37	0.38	0.36	0.37	0.36	0.75	0.39	0.57	0.68	0.39	0.53
Punjab	1.00	0.36	0.68	0.85	0.36	0.61	0.98	0.34	0.66	0.71	0.34	0.52
Tamil Nadu	0.64	0.49	0.56	0.62	0.49	0.55	0.90	0.55	0.73	0.65	0.55	0.60
Average of Leading States	0.56	0.49	0.53	0.56	0.49	0.52	0.75	0.50	0.63	0.64	0.50	0.57
Average for 12 States	**0.49**	**0.39**	**0.44**	**0.43**	**0.39**	**0.41**	**0.62**	**0.38**	**0.50**	**0.50**	**0.38**	**0.44**

Source: the Author.

4. ESTIMATION RESULTS

Impact of Infrastructure on Output

When we consider all 12 states as one group (Group A), estimates of Eq. 1 unequivocally bring out the positive impact of infrastructure in influencing state income (Col. 1 of Appendices 3-8). Not only the aggregate infrastructure but both its variants positively impact output. This result is invariant under all the three methods of estimation using SS and PCA based weights and thus attests to the robustness of the result (Col. 2 of Appendices 3-8).

Estimates of Eq. 2 suggest that the infrastructure positively impacts output for both the leading (Col. 5 of Appendices 3-8) and lagging (Col. 9 of Appendices 3-8) states. Estimates of Eq. 2 suggest that economic infrastructure impacts output positively as per all the six estimates for the leading states. However, economic infrastructure weakly impacts state output for the lagging states. As far as social infrastructure is concerned, impacts on output are positive but this pattern is not statistically significant.

Conditioning Variables in Infrastructure and Output Relationships

Inflation does not appear to have a statistically significant impact on state income in any of the three state groupings as per all the six estimates of Eqs. 1-2. As far as financial depth is concerned, it has a statistically significant positive impact on state output in all six of the estimates from Eqs. 1-2 for all three groups of states. Inequality turns out to have a statistically significant positive impact on state output for all the three groups of states for Eqs. 1-2 as per all the six estimates. As inert district income inequality has increased during the study period in all the 12 states, the empirical results suggest that growth in the states is driven by the better performing sub state units or districts.

5. IMPACT OF INFRASTRUCTURE ON INEQUALITY

We first consider Group A states to ascertain the impact of infrastructure on inequality. Applying a majority criterion to the empirical estimates of Eq. 3 (Col. 3 of Appendices 3-8) we can infer that the composite infrastructure does not lower inequality in a statistically significant manner. However, when seen separately (Eq. 4), only the economic infrastructure is found to have a statistically significant ameliorating impact on inequality as per all the six estimates. In contrast, social infrastructure was not found to reduce inequality in a statistically significant manner.

Composite infrastructure was found to lower income inequality in the leading states. The ameliorating impact of infrastructure on inequality was primarily accounted for by economic infrastructure. This is because five out of six estimates had a statistically negative coefficient when economic infrastructure was used as the regressor. As far as impact of social infrastructure on inequality is concerned, we found that it tends to accentuate inequality but there is not adequate statistical evidence to this effect. The WK-PCA and ML-PCA estimates suggest that social infrastructure accentuates inequality. The rest of the four estimates are not statistically significant.

In the lagging states, composite infrastructure does not seem to have a statistically significant impact on inequality. However, when seen separately, we found as per the majority criterion, economic infrastructure lowers and social infrastructure accentuates intrastate income inequality. It appears that the adverse impact of social infrastructure in the lagging states is so strong that it is neutralising the sobering impact of economic infrastructure on income inequality in both the leading and lagging states. This explains why the composite infrastructure does not impact inequality when we consider all the 12 states as a group.

The empirical results which suggest that social infrastructure accentuates inequality in the lagging states could be because, despite policy intent, the relatively backward districts within the states do not get a preferential treatment in the provision of health and education facilities from the respective state governments. To evaluate such a possibility, we perform exploratory analysis of the evolution of education and health infrastructure in the backward districts in different states. We make use of the list of backward districts identified by the NITI Aayog (GoI, 2017) for this purpose.

To assess whether the backward districts in the states have received preferential treatment in the creation of health infrastructure, we study how the share of health centres in backward districts compared to the total health centres in a state has changed during our study period. For this purpose, we consider different kinds of health care centres viz, Primary Health Centres, Community Health Care Centres and Sub Centres in a state in 2004 and 2011.

For education, we consider two indicators viz, percentage of 'primary schools with a single teacher' and percentage of 'primary schools with a single classroom' out of total such schools in a state. We analyse how the percentage of such schools, which is an indicator of poor education infrastructure, in the backward districts have changed in 2011 compared to 2003. We would expect the education and health infrastructure to have improved in the backward districts if there is synchronisation between policy intent and implementation.

A total of 61 districts in the 12 states under study have been classified as backward by the NITI Aayog. We found that 47 out of these 61 belong to the lagging and the rest to the leading states (Table 3). We found that the backward districts have not received any preferential treatment in education and health facilities. In fact, health infrastructure deteriorated in more than half of the backward districts in the lagging states under study. In the leading states, health infrastructure deteriorated in around two fifths of the backward districts. As far as education is concerned, the percentage of schools with a single classroom and a single teacher increased in one fourth of the total and more than one third of the backwards districts in the lagging states. Such proportions for the leading states were one fifth and one third respectively.

Table 3. Changing Share of Education and Health Infrastructure in the Backward District.

State	District Name	Percentage of Schools with Single Classroom at Primary level		Percentage of Schools with Single Teacher at Primary level		Share in total number of PHCs, CHCs and Sub Centres	
		2002-03	2010-11	2002-03	2010-11	2004	2011
Lagging States							
BIHAR	ARARIA	9.10	3.56	14.00	4.97	2.42	2.03
BIHAR	AURANGABAD (BIHAR)	27.50	9.31	26.60	11.49	2.78	2.50
BIHAR	BANKA	16.90	9.46	35.40	14.01	1.96	2.70
BIHAR	BEGUSARAI	5.40	1.54	7.40	3.75	2.89	2.86
BIHAR	GAYA	6.30	3.57	42.90	7.65	5.40	4.45
BIHAR	JAMUI	16.30	3.50	55.50	14.81	1.11	2.94
BIHAR	KATIHAR	30.20	9.86	17.20	1.24	2.76	3.41
BIHAR	KHAGARIA	9.30	3.40	5.20	3.77	0.48	1.72
BIHAR	MUZAFFARPUR	8.70	3.70	34.10	6.66	4.66	4.98
BIHAR	NAWADA	31.40	4.37	23.10	7.36	2.28	3.42
BIHAR	PURNIA	11.20	0.23	21.80	16.18	2.29	3.29
BIHAR	SHEIKHPURA	25.70	18.58	36.20	10.62	4.25	3.71
BIHAR	SITAMARHI	6.10	3.15	9.30	12.77	1.12	0.94
MADHYA PRADESH	BARWANI	11.40	11.17	31.10	23.00	3.18	3.22
MADHYA PRADESH	CHHATARPUR	17.40	10.92	3.70	16.21	2.27	2.36
MADHYA PRADESH	DAMOH	8.70	3.07	7.70	18.40	1.73	1.81
MADHYA PRADESH	GUNA	5.10	0.00	10.60	11.92	3.15	2.07
MADHYA PRADESH	KHANDWA	10.20	5.89	12.70	17.94	2.39	1.37
MADHYA PRADESH	RAJGARH	4.90	5.34	7.20	16.96	1.95	1.97
MADHYA PRADESH	SIDHI	2.50	4.11	22.80	18.31	**3.42**	**3.33**
MADHYA PRADESH	VIDISHA	4.30	4.80	17.20	24.39	1.63	1.72

Table 3. (Continued) Changing Share of Education and Health Infrastructure in the Backward District.

State	**District Name**	**Percentage of Schools with Single Classroom at Primary level**		**Percentage of Schools with Single Teacher at Primary level**		**Share in total number of PHCs, CHCs and Sub Centres**	
		2002-03	2010-11	2002-03	2010-11	2004	2011
Lagging States							
ORISSA	BALANGIR	15.70	19.44	19.30	29.34	3.96	3.98
ORISSA	DHENKANAL	8.50	8.13	26.10	15.60	2.96	2.94
ORISSA	GAJAPATI	34.90	20.38	59.30	32.18	2.20	2.31
ORISSA	KALAHANDI	4.70	3.90	7.40	31.97	4.13	4.23
ORISSA	KANDHAMAL	10.70	21.21	39.90	39.59	4.13	3.12
ORISSA	KORAPUT	13.90	15.59	16.20	32.78	6.39	5.22
ORISSA	MALKANGIRI	9.10	14.33	31.40	25.36	2.59	2.68
ORISSA	RAYAGADA	19.50	17.83	29.10	27.64	3.82	3.96
RAJASTHAN	BARMER	5.20	3.32	64.00	66.36	4.17	4.64
RAJASTHAN	DHAULPUR	6.70	5.82	35.60	36.58	1.57	1.66
RAJASTHAN	JAISALMER	5.00	7.21	75.90	76.50	1.21	1.18
RAJASTHAN	KARAULI	3.30	5.43	31.20	31.19	2.16	2.15
RAJASTHAN	SIROHI	2.20	3.45	46.50	28.50	1.84	1.64
UTTAR PRADESH	BAHRAICH	3.00	0.67	55.00	35.69	1.35	1.34
UTTAR PRADESH	BALRAMPUR	0.50	0.47	48.50	44.84	1.04	1.03
UTTAR PRADESH	CHANDAULI	4.60	0.00	16.30	10.92	1.17	1.16
UTTAR PRADESH	CHITRAKOOT	1.10	0.11	33.40	17.00	0.70	0.70
UTTAR PRADESH	FATEHPUR	0.20	0.74	10.10	7.84	1.51	1.50
UTTAR PRADESH	SHRAWASTI	3.30	0.36	23.90	38.52	0.79	0.79
UTTAR PRADESH	SIDDHARTHNAGAR	0.10	0.00	21.60	21.60	1.48	1.46
UTTAR PRADESH	SONBHADRA	0.30	0.30	37.50	31.18	0.82	0.82
WEST BENGAL	BIRBHUM	19.10	13.20	3.80	5.11	4.83	4.83
WEST BENGAL	DAKSHIN DINAJPUR	47.90	30.72	2.00	10.06	2.35	2.35
WEST BENGAL	MALDAH	30.40	16.85	2.00	1.48	4.83	4.83
WEST BENGAL	MURSHIDABAD	11.80	15.18	2.90	0.76	7.99	7.99
WEST BENGAL	NADIA	18.10	12.72	1.30	2.21	4.60	4.59

Table 3. (Continued) Changing Share of Education and Health Infrastructure in the Backward District.

State	District Name	Percentage of Schools with Single Classroom at Primary level		Percentage of Schools with Single Teacher at Primary level		Share in total number of PHCs, CHCs and Sub Centres	
		2002-03	2010-11	2002-03	2010-11	2004	2011
Leading States							
ANDHRA PRADESH	CUDDAPAH	45.50	43.53	10.40	20.18	3.78	3.78
ANDHRA PRADESH	VISAKHAPATNAM	24.50	43.16	40.00	36.46	4.59	4.59
ANDHRA PRADESH	VIZIANAGARAM	39.80	42.99	19.70	27.12	3.75	3.73
KARNATAKA	GADAG	7.50	0.52	5.30	6.22	1.33	1.55
KARNATAKA	GULBARGA	20.10	6.46	8.90	12.92	5.27	5.08
KERALA	WAYANAD	2.10	2.08	0.00	0.00	3.83	2.97
MAHARASHTRA	GADCHIROLI	41.30	20.00	43.60	22.96	4.24	3.92
MAHARASHTRA	JALGAON	6.90	3.84	6.80	2.30	4.87	4.88
MAHARASHTRA	NANDED	17.70	8.69	13.80	5.87	4.46	4.13
MAHARASHTRA	NANDURBAR	23.90	13.73	0.00	0.00	3.12	3.28
PUNJAB	FIROZPUR	6.40	3.11	2.90	17.24	8.34	8.64
PUNJAB	MOGA	7.00	4.31	7.80	6.20	3.88	4.69
TAMIL NADU	RAMANATHAPURAM	52.20	5.91	6.10	4.83	2.92	3.04
TAMIL NADU	VIRUDHUNAGAR	0.10	12.25	0.00	4.53	2.94	2.94

Source: the Author.

Thus, notwithstanding the policy intent and specific programmes launched to uplift the backward districts across the country, the facts on the ground indicate no perceptible improvement in the social infrastructure of the backward districts in both leading and lagging states during the study period. The divergence between intent and actual provision of social infrastructure in the backward districts is more prominent in the lagging states. This possibly explains why the adverse impact of social infrastructure on inequality is statistically significant for the lagging states. Thus, the empirical result which indicates that social infrastructure has adverse consequences for inequality because of misplaced priorities in creation of social infrastructure should not lead to wrong conclusions about the importance of social infrastructure in the Indian states in general and lagging states in particular. The empirical results reflect the inability of the state governments to implement a policy of balanced development of the districts rather than the ineffectiveness of social infrastructure in creating more equitable outcomes in the states. We considered the quantitative aspect of social infrastructure. However, study of the quality aspect of social infrastructure can bring out the difference in the delivery of education and health infrastructure in the lagging states more glaringly.

6. CONDITIONING VARIABLES IN INFRASTRUCTURE AND INEQUALITY RELATIONSHIPS

Financial depth does not appear to have a statistically significant effect on inter-district income inequality when we consider the estimates of Eq. 3 for Group-A states. Estimates of Eq. 3 for Group-B and Group-C state groups suggest that financial depth accentuates inequality as per the majority criterion only for the leading states. Estimates of Eq. 4 where economic and social infrastructures enter the estimation separately as regressors suggest that financial depth appears to be accentuating inequality for both the leading and lagging states. The results tend to suggest that financial institutions also seem to be accentuating inter-district inequality in the states through their credit allocation process. The validity of Kuznets Hypothesis for the Group-B states suggested by Eq. 3 is not borne out when we use Eq. 4. We do not get a clear picture on how income impacts inequality for the Group-A and Group-C states from the estimates of Eqs. 3-4. When we consider the impact of inflation on inequality, estimates of Eqs. 3-4 suggest that inflation is statistically insignificant in impacting inequality for the Group-A and Group-B states. However, for the Group-C states, inflation accentuates inequality in the states as per the estimates of Eq. 3 and Eq. 4.

7. CONCLUSION

The present study had three objectives. First, to assess the achievement of the states in the provision of infrastructure in India through the construction of a composite infrastructure index which combines the economic and social infrastructure indices that were constructed separately. The second objective was to ascertain the impact of infrastructure on output in the spatial context. The third and central objective was to explore how infrastructure impacts inequality in the spatial dimension. The analysis was undertaken for groups of leading and lagging states for the 2001-2011 period.

A time series of infrastructure index over eleven years for 12 large states taking both the economic and social dimensions was constructed using two different methods of assigning weights to assess the evolution of infrastructure. We found that while some progress is marked in the provision of economic infrastructure, not much progress has been made in terms of social infrastructure between 2001 and 2011 for all the 12 states taken together. The leading states have made significant strides in providing economic infrastructure compared to lagging states. While marginal improvement in the provision of social infrastructure was observed for the leading states, lagging states experienced a slight decline. We found that the lagging states are characterised by higher inequality and relatively low growth compared to the leading states. The empirical estimates in this study suggests that composite infrastructure impacts output for all the 12 states and also for the groups of leading and lagging states. When seen in terms of its variants, economic infrastructure impacts output for all three groups of states. Social infrastructure also impacts output when we consider all the states as a group. However, when seen for the leading and lagging group of state separately, social infrastructure does not seem to have a statistically significant impact.

We found that composite infrastructure helps to reduce inequality only in the leading states. However, when considered separately, we found that economic infrastructure reduces inter-district income inequality both in the leading and lagging states. Thus, low income districts tend to benefit more from the opportunities created through the provision of economic infrastructure in all the states. Social infrastructure was found to accentuate inequality in the lagging states and had no statistically significant impact on inequality in the leading states. An exploratory analysis regarding the causes of the positive relationship between social infrastructure and inter-district inequality indicated that social infrastructure availability has worsened in many backward districts of both leading and lagging states and the deterioration has been more pervasive in the lagging states. Thus, it is the lackluster progress in creating social infrastructure coupled with the bias against the poorer districts in the creating of social infrastructure that is driving the empirical results.

The results of this study are at odds with the findings of existing studies. This is possibly explained by the tendency of previous studies to consider the impact of infrastructure on inequality in personal consumption rather than on inter-district income inequality. Greater endowment of social infrastructure improves productivity and expands earning opportunities for the poor either in their own locality or through migration and hence, has the potential to reduce consumption inequality. Infrastructure serves as an input as well as an indicator of development. The lower endowment of social infrastructure in the backward districts of a state may be prompting channelisation of human and material resources away from it and accentuating inter-district income inequality.

Hence, greater emphasis on the provision of social infrastructure in general and priority to the backward districts in the creation of such infrastructure should get due attention from policy makers to promote balanced regional development.

Note: The original version of this published article contained some errors in Table 1. These have been corrected by the author in this revised version, which was published on the AJRS website in September 2019.

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Appendix 1. Data Source of Various Indicators.

Indicator	Source
a) Per capita Installed Capacity of Electricity b) Per capita Electricity consumption	1. Annual Report of Central Electricity Authority, Ministry of Power, Government of India (Various Issues) 2. Energy Statistics, Central Statistical Office, Ministry of Planning and Programme Implementation, Government of India (Various Issues)
c) Gross Irrigated Area as Percentage of Gross Cropped Area d) Fertiliser consumption in a State	1. Pocket Book on Agricultural Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India (Various Issues) 2. State of Indian Agriculture, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India (Various Issues)
e) Road Density f) Surfaced Road as Percentage of Total Road	1. Infrastructure Statistics, Central Statistical Office, Ministry of Planning and Programme Implementation, Government of India (Various Issues)
g) Number of PHCs, CHCs and Sub centres per lakh population h) Infant Mortality Rate	1. National Health Profile (Various Issues) 2. The survival index is a residual index derived from the IMR. Literacy rate in the states is available only on a decadal basis from census conducted in 2001 and 2011. As such, the annual literacy rate in the states is derived by using exponential growth between 2001 and 2011 for which actual data is available.
i) Average number of teachers per school at the primary level j) Literacy Rate	1. Selected Educational Statistics, Ministry of HRD, Government of India (Various Issues)
k) State Domestic Product	1. Statistical Handbook, Directorate of Economics and Statistics of Different State Governments (Various Issues)
l) District Income	1. District Statistical Handbook from Each State (Various Issues)

Source: the Author.

Appendix 2. Growth, Sectoral Shares and Financial Depth in States During 2001-2011.

	Growth				Share			Share			Financial Depth	
State	PRIMARY	SECONDARY	TERTIARY	SDP	PRIMARY	SECONDARY	TERTIARY	PRIMARY	SECONDARY	TERTIARY		
	2001-2011	2001-2011	2001-2011	2001-2011	2001			2011			2001	2011
Lagging States												
Bihar	0.73	10.66	6.18	5.16	32.08	12.44	55.48	22.67	19.28	58.04	9.2	18.7
Madhya Pradesh	3.35	6.49	4.79	4.74	33.08	22.27	44.65	26.57	26.17	47.26	18.2	31.9
Odisha	4.42	10.65	8.77	7.83	34.94	22.06	43.00	24.41	28.30	47.29	13.3	29.3
Rajasthan	3.53	5.85	6.03	5.30	29.92	25.83	44.25	25.15	27.50	47.34	15.2	37.9
Uttar Pradesh	0.19	6.63	5.59	4.23	34.15	19.55	46.29	23.77	23.44	52.79	14.3	29.6
West Bengal	1.29	5.84	7.18	5.44	28.61	18.09	53.30	19.13	19.15	61.72	20.6	43.8
Average for Lagging States	2.25	7.69	6.42	5.45	32.13	20.04	47.83	23.62	23.98	52.41	15.14	31.86
Leading States												
Andhra Pradesh	4.52	8.80	8.28	7.33	30.21	20.11	49.68	23.67	22.70	53.63	23.0	57.1
Karnataka	2.61	6.88	8.02	6.52	23.18	28.28	48.53	17.37	28.58	54.05	29.3	66.4
Kerala	-0.20	7.29	9.02	7.12	21.11	20.25	58.65	11.06	20.13	68.80	23.8	45.6
Maharashtra	2.69	8.51	8.28	7.66	13.66	28.08	58.26	8.98	30.26	60.77	53.1	102.0
Punjab	0.34	8.09	5.24	4.49	35.02	23.37	41.61	24.14	30.88	44.98	25.0	63.1
Tamil Nadu	2.33	7.70	9.09	7.81	15.37	28.31	56.32	8.81	30.58	60.61	35.9	72.1
Average for Leading States	2.05	7.88	7.99	6.82	23.09	24.73	52.17	15.67	27.19	57.14	31.69	67.72
Average for 12 States	**2.15**	**7.78**	**7.21**	**6.14**	**27.61**	**22.39**	**51.10**	**19.64**	**25.58**	**54.77**	**23.4**	**49.8**

Source: the Author.

Appendix 3. Two Way Random Effect Estimation ML Estimation-PCA Based Weights.

	All States				Leading States				Lagging States			
	Col.1	Col.2	Col.3	Col.4	Col.5	Col.6	Col.7	Col.8	Col.9	Col.10	Col.11	Col.12
	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI
Constant	10.673* (25.556	10.585* (25.661)	-8.264* (-3.288)	-6.095** (-2.398)	9.642* (17.811)	10.173* (19.791)	8.379 (0.666)	8.483 (0.723)	12.118* (21.535)	11.876* (19.905)	-11.207* (-3.145)	-8.280** (-2.331)
LPGINI	0.895* (6.047)	0.834* (5.826)			0.551* (3.519)	0.726* (4.921)			1.613* (7.041)	1.510* (5.908)		
LINFPCA(-1)	0.628* (4.704)		-0.077 (-1.085)		0.497* (2.826)		-0.040 (-0.302)		0.369** (2.035)		-0.063 (-0.863)	
LECOINFPCA(-1)		0.327* (3.728)		-0.121* (-2.718)		0.479* (4.222)		-0.217** (-2.440)		0.204*** (1.753)		-0.073*** (-1.718)
LSOCINFPCA(-1)		0.294* (3.298)		0.075 (1.577)		-0.171 (-1.238)		0.181*** (1.777)		0.187 (1.577)		0.084*** (1.817)
LINFLATION	0.009 (0.561)	0.009 (0.561)	0.011 (1.438)	0.012 (1.642)	0.026 (1.114)	0.010 (0.506)	-0.003 (-0.241)	0.002 (0.135)	-0.012 (-0.590)	-0.011 (-0.551)	0.018* (2.372)	0.017** (2.452)
LFINLDPTH	0.432* (8.573)	0.449* (8.418)	0.010 (0.337)	0.039 (1.215)	0.576* (8.145)	0.486* (7.178)	-0.001 (-0.023)	-0.0008 (-0.012)	0.212* (3.201)	0.248* (3.176)	0.029 (1.073)	0.066** (2.222)
LRPSDP			0.959** (1.968)	0.535 (1.087)			-2.258 (-0.957)	-2.336 (-1.061)			1.627** (2.259)	1.064 (1.490)
SDPSQ			-0.032 (-1.387)	-0.012 (-0.526)			0.120 (1.101)	0.127 (1.246)			-0.067*** (-1.863)	-0.041 (-1.142)
Hausman Statistics	15.162 (0.004)	16.380 (0.005)	11.156 (0.048)	11.515 (0.073)	7.566 (0.108)	6.658 (0.247)	6.185 (0.288)	6.174 (0.289)	6.346 (0.174)	7.541 (0.183)	6.074 (0.299)	6.085 (0.413)

Notes: LPGINI = Log of Gini Index; LINFPCA = Aggregate Infrastructure Index computed using PCA based weights; LECOINFPCA = Economic Infrastructure Index computed using PCA based weights; LSOCINFPCA = Social Infrastructure Index computed using PCA based weights; LINFSS = Aggregate Infrastructure Index computed using SS based weights; LECOINFSS = Economic Infrastructure Index computed using SS based weights; LSOCINFSS = Social Infrastructure Index computed using SS based weights; LRPSDP = log of real per capita SDP; SDPSQ = Square of real per capita SDP; LFINLDPTH = log of Financial Depth; LINFLATION = Log of Inflation; Parenthesis to coefficient estimates indicate t-statistics; Parenthesis to Hausman Statistics refers to the significance level; *, ** and *** refer to 1%, 5% and 10% level of significance respectively. Source: the Author.

Appendix 4. Two Way Random Effect Estimation ML Estimation-SS Based Weights.

	All States				Leading States				Lagging States			
	Col.1	Col.2	Col.3	Col.4	Col.5	Col.6	Col.7	Col.8	Col.9	Col.10	Col.11	Col.12
	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI
Constant	10.402* (25.633)	10.270* (25.807)	-8.772* (-3.426)	-7.535* (-2.969)	9.613* (18.234)	9.768* (19.435)	8.588 (0.670)	9.337 (0.760)	12.153* (21.874)	12.042* (20.149)	-11.669* (-3.211)	-8.731** (-2.472)
LPGINI	0.681* (5.184)	0.664* (4.993)			0.524* (3.413)	0.616* (4.095)			1.572* (6.881)	1.534* (6.066)		
LINFSS(-1)	0.767* (5.954)		-0.083 (-1.095)		0.642* (3.245)		-0.031 (-0.198)		0.404** (2.334)		-0.070 (-0.963)	
LECOINFSS(-1)		0.330* (3.969)		-0.088** (-2.127)		0.393* (3.788)		-0.112 (-1.382)		0.216** (2.093)		-0.073*** (-1.916)
LSOCINFSS(-1)		0.382* (4.518)		0.053 (1.089)		0.042 (0.316)		0.092 (0.926)		0.180 (1.526)		0.079*** (1.709)
LINFLATION	0.009 (0.572)	0.010 (0.619)	0.012 (1.465)	0.013 (1.636)	0.025 (1.097)	0.015 (0.703)	-0.003 (-0.226)	0.0004 (0.028)	-0.012 (-0.632)	-0.013 (-0.642)	0.018** (2.403)	0.018 (2.512)
LFINLDPTH	0.470* (9.434)	0.492* (9.507)	0.008 (0.273)	0.031 (0.972)	0.597* (8.885)	0.568* (8.888)	-0.003 (-0.043)	-0.013 (-0.174)	0.213* (3.243)	0.226* (2.895)	0.028 (1.045)	0.068** (2.300)
LRPSDP			1.055** (2.145)	0.820*** (1.682)			-2.293 (-0.955)	-2.457 (-1.066)			1.714** (2.345)	1.143 (1.613)
SDPSQ			-0.037 (-1.576)	-0.026 (-1.130)			0.122 (1.098)	0.131 (1.229)			-1.072*** (-1.954)	-0.044 (-1.257)
Hausman Statistics	19.880 (0.0005)	19.226 (0.001)	10.099 (0.072)	10.720 (0.097)	7.693 (0.103)	7.034 (0.218)	6.198 (0.287)	6.146 (0.407)	6.692 (0.153)	7.295 (0.199)	6.028 (0.303)	6.055 (0.417)

Notes: LPGINI = Log of Gini Index; LINFSS = Aggregate Infrastructure Index computed using SS based weights; LECOINFSS = Economic Infrastructure Index computed using SS based weights; LSOCINFSS = Social Infrastructure Index computed using SS based weights; LRPSDP = log of real per capita SDP; SDPSQ = Square of real per capita SDP; LFINLDPTH = log of Financial Depth; LINFLATION = Log of Inflation; Parenthesis to coefficient estimates indicate t-statistics; Parenthesis to Hausman Statistics refers to the significance level; *, ** and *** refer to 1%, 5% and 10% level of significance respectively. Source: the Author.

Appendix 5. Two Way Random Effect Estimation WK Estimation-PCA Based Weights.

	All States				Leading States				Lagging States			
	Col.1	Col.2	Col.3	Col.4	Col.5	Col.6	Col.7	Col.8	Col.9	Col.10	Col.11	Col.12
	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI
Constant	10.936* (24.696)	10.940* (24.420)	-8.150* (-3.174)	-6.051** (-2.317)	9.775* (17.172)	10.220* (18.698)	94.747* (8.063)	107.497* (9.942)	12.187* (20.577)	12.080* (18.807)	-11.210* (-2.993)	-8.278** (-2.194)
LPGINI	0.992* (6.578)	0.993* (6.422)			0.624* (3.748)	0.746* (4.808)			1.652* (6.889)	1.619* (5.900)		
LINFPCA(-1)	0.551* (4.008)		-0.090 (-1.240)		0.451** (2.447)		-0.360* (-7.309)		0.347 (1.836)***		-0.062 (-0.809)	
LECOINFPCA(-1)		0.324* (3.648)		-0.123* (-2.701)		0.485* (4.060)		-0.194* (-7.426)		0.198 (1.630)		-0.073 (-1.613)
LSOCINFPCA(-1)		0.228* (2.406)		0.069 (1.410)		-0.188 (-1.288)		-0.022 (-0.904)		0.143 (1.125)		0.084*** (1.716)
LINFLATION	0.008 (0.499)	0.007 (0.436)	0.012 (1.450)	0.013 (1.634)	0.024 (0.991)	0.009 (0.436)	-0.012 (-0.851)	-0.008 (-0.628)	-0.012 (-0.593)	-0.012 (-0.599)	0.018** (2.253)	0.017** (2.306)
LFINLDPTH	0.408* (7.970)	0.410* (7.375)	0.011 (0.353)	0.038 (1.168)	0.572* (7.899)	0.481* (6.803)	1.056* (32.265)	1.191* (43.756)	0.204*** (2.959)	0.220* (2.647)	0.029 (1.021)	0.067** (2.094)
LRPSDP			0.935*** (1.878)	0.526 (1.040)			-18.323* (-8.265)	-20.659* (-10.118)			1.627** (2.150)	1.063 (1.402)
SDPSQ			-0.031 (-1.311)	-0.012 (-0.496)			0.828* (7.938)	0.931* (9.669)			-0.067*** (-1.773)	-0.041 (-1.075)
Hausman Statistics	8.678 (0.069)	8.966 (0.110)	14.800 (0.011)	15.118 (0.019)	4.526 (0.339)	4.855 (0.433)	345.388 (0.000)	370.016 (0.000)	4.591 (0.331)	4.590 (0.467)	5.238 (0.387)	5.232 (0.514)

Notes: LPGINI = Log of Gini Index; LINFPCA = Aggregate Infrastructure Index computed using PCA based weights; LECOINFPCA = Economic Infrastructure Index computed using PCA based weights; LSOCINFPCA = Social Infrastructure Index computed using PCA based weights; LRPSDP = log of real per capita SDP; SDPSQ = Square of real per capita SDP; LFINLDPTH = log of Financial Depth; LINFLATION = Log of Inflation; Parenthesis to coefficient estimates indicate t-statistics; Parenthesis to Hausman Statistics refers to the significance level; *, ** and *** refer to 1%, 5% and 10% level of significance respectively. Source: the Author.

Appendix 6. Two Way Random Effect Estimation WK Estimation-SS Based Weights.

	All States				Leading States				Lagging States			
	Col.1	Col.2	Col.3	Col.4	Col.5	Col.6	Col.7	Col.8	Col.9	Col.10	Col.11	Col.12
	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI
Constant	10.932* (24.803)	10.831* (24.505)	-8.760* (-3.348)	-7.522* (-2.885)	9.765* (17.585)	9.845* (18.433	121.091* (10.571)	116.232* (10.416)	12.224* (20.893)	12.220* (19.022)	-11.671* (-3.054)	-8.729** (-2.326)
LPGINI	0.963* (6.415)	0.932* (6.082)			0.603* (3.672)	0.654* (4.106)			1.613* (6.744)	1.624* (6.012)		
LINFSS(-1)	0.599* (4.192)		-0.099 (-1.288)		0.587* (2.795)		-0.089** (-1.847)		0.387** (2.144)		-0.069 (-0.911)	
LECOINFSS(-1)		0.297* (3.545)		-0.092** (-2.183)		0.387* (3.567)		-0.168* (-5.122)		0.215** (2.004)		-0.073*** (-1.802)
LSOCINFSS(-1)		0.289* (3.070)		0.046 (0.922)		0.023 (0.167)		0.042*** (1.864)		0.145 (1.156)		0.079 (1.612)
LINFLATION	0.007 (0.418)	0.007 (0.414)	0.012 (1.483)	0.013 (1.635)	0.023 (0.983)	0.014 (0.614)	-0.009 (-0.640)	0.005 (0.406)	-0.013 (-0.637)	-0.014 (-0.683)	0.018** (2.283)	0.018 (2.362)
LFINLDPTH	0.421* (8.295)	0.435* (7.982)	0.008 (0.275)	0.031 (0.930)	0.590* (8.560)	0.563* (8.465)	1.169* (32.878)	1.179* (37.350)	0.205* (3.003)	0.202** (2.448)	0.028 (0.994)	0.068** (2.165)
LRPSDP			1.050** (2.089)	0.816 (1.628)			-23.192* (-10.715)	-22.249* (-10.547)			1.714** (2.230)	1.143 (1.518)
SDPSQ			-0.037 (-1.533)	-0.026 (-1.092)			1.051* (10.295)	1.004* (10.086)			-0.072*** (-1.858)	-0.044 (-1.182)
Hausman Statistics	8.443*** (0.076)	8.540 (0.128)	13.310 (0.020)	14.005 (0.029)	4.509 (0.341)	4.773 (0.444)	395.507 (0.000)	362.344 (0.000)	4.880 (0.299)	4.653 (0.459)	5.272 (0.383)	5.256 (0.385)

Notes: LPGINI = Log of Gini Index; LINFSS = Aggregate Infrastructure Index computed using SS based weights; LECOINFSS = Economic Infrastructure Index computed using SS based weights; LSOCINFSS = Social Infrastructure Index computed using SS based weights; LRPSDP = log of real per capita SDP; SDPSQ = Square of real per capita SDP; LFINLDPTH = log of Financial Depth; LINFLATION = Log of Inflation; Parenthesis to coefficient estimates indicate t-statistics; Parenthesis to Hausman Statistics refers to the significance level; *, ** and *** refer to 1%, 5% and 10% level of significance respectively. Source: the Author.

Appendix 7. Two Way Random Effect Estimation WH Estimation-PCA Based Weights.

	All States				Leading States				Lagging States			
	Col.1	Col.2	Col.3	Col.4	Col.5	Col.6	Col.7	Col.8	Col.9	Col.10	Col.11	Col.12
	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI
Constant	9.683* (23.477)	9.168* (24.319)	-5.345 (-0.848)	-4.471 (-0.551)	8.152* (13.229)	7.311* (12.789)	33.270 (1.207)	54.876*** (1.854)	11.816* (15.551)	8.692* (25.057)	-23.148* (-4.956)	-21.199* (-4.401)
LPGINI	0.380* (3.171)	0.219** (2.038)			-0.065 (-0.478)	-0.289** (-2.541)			1.439* (4.678)	0.103 (1.193)		
LINFPCA(-1)	0.845* (6.342)		-0.544* (-3.570)		0.590* (3.257)		-0.553** (-2.498)		0.464*** (1.867)		-0.751* (-14.101)	
LECOINFPCA(-1)		0.304* (3.325)		-0.283** (-2.269)		0.174*** (1.727)		-0.237*** (-1.761)		-0.019 (-0.275)		-0.445* (-13.524)
LSOCINFPCA(-1)		0.462* (6.316)		-0.198*** (-1.650)		0.217** (2.386)		-0.124 (-0.942)		0.558* (11.966)		-0.176* (-3.937)
LINFLATION	0.014 (0.758)	0.023 (1.161)	0.022 (1.083)	0.025 (0.998)	0.041 (1.320)	0.045 (1.391)	-0.029 (-0.843)	-0.033 (-0.870)	-0.010 (-0.345)	0.023 (0.938)	-0.004 (-0.356)	0.003 (0.297)
LFINLDPTH	0.517* (9.508)	0.578* (10.801)	0.052 (0.657)	0.058 (0.569)	0.656* (7.240)	0.735* (8.004)	0.468* (3.390)	0.675* (4.905)	0.249* (2.695)	0.610* (9.257)	0.091** (2.002)	0.142* (2.689)
LRPSDP			0.032 (0.272)	0.193 (0.122)			-7.001 (-1.352)	-10.994*** (-1.975)			3.859* (4.051)	3.588 (3.674)
SDPSQ			-0.004 (-0.078)	0.000 (0.010)			0.328 (1.357)	0.506 (1.942)			-0.180 (-3.689)	-0.173 (-3.475)
Hausman Statistics	27.379 (0.000)	31.216 (0.000)	28.172 (0.000)	27.113 (0.001)	19.350 (0.0006)	30.130 (0.000)	26.246 (0.000)	30.584*** (0.000)	6.255 (0.180)	38.220 (0.000)	442.622* (0.000)	426.324* (0.000)

Notes: LPGINI = Log of Gini Index; LINFPCA = Aggregate Infrastructure Index computed using PCA based weights; LECOINFPCA = Economic Infrastructure Index computed using PCA based weights; LSOCINFPCA = Social Infrastructure Index computed using PCA based weights; LECOINFSS = Economic Infrastructure Index computed using SS based weights; LRPSDP = log of real per capita SDP; SDPSQ = Square of real per capita SDP; LFINLDPTH = log of Financial Depth; LINFLATION = Log of Inflation; Parenthesis to coefficient estimates indicate t-statistics; Parenthesis to Hausman Statistics refers to the significance level; *, ** and *** refer to 1%, 5% and 10% level of significance respectively. Source: the Author.

Appendix 8. Two Way Random Effect Estimation WH Estimation-SS Based Weights.

	All States				Leading States				Lagging States			
	Col.1	Col.2	Col.3	Col.4	Col.5	Col.6	Col.7	Col.8	Col.9	Col.10	Col.11	Col.12
	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI	LRPSDP	LRPSDP	LPGINI	LPGINI
Constant	9.630* (24.571)	9.350* (24.531)	-8.950 (-1.592)	-7.488 (-1.074)	7.851* (14.115)	7.382* (13.796)	37.110 (1.238)	54.469*** (1.800)	11.067* (17.063)	8.885* (28.057)	-13.683* (-4.124)	-12.640* (-3.625)
LPGINI	0.329* (3.009)	0.258** (2.411)			-0.109 (-0.856)	-0.250** (-2.181)			0.956* (3.728)	0.117 (1.634)		
LINFSS(-1)	0.834* (7.270)		-0.406* (-2.853)		0.592* (3.345)		-0.517** (-2.051)		0.663* (3.175)		-0.339* (-6.616)	
LECOINFSS(-1)		0.342* (3.865)		-0.255** (-2.415)		0.261** (2.290)		-0.242 (-1.547)		0.076 (0.718)		-0.090** (-2.108)
LSOCINFSS(-1)		0.427* (5.945)		-0.150 (-1.350)		0.201** (2.341)		-0.093 (-0.705)		0.552* (11.809)		-0.188* (-6.128)
LINFLATION	0.018 (0.939)	0.021 (1.085)	0.019 (1.074)	0.023 (1.059)	0.033 (1.052)	0.034 (1.038)	-0.025 (-0.661)	-0.026 (-0.666)	-0.004 (-0.151)	0.023 (0.981)	0.020** (2.355)	0.017*** (1.943)
LFINLDPTH	0.525* (10.011)	0.559* (10.477)	0.019 (0.281)	0.035 (0.399)	0.720* (8.617)	0.751* (8.735)	0.463* (2.940)	0.614* (4.063)	0.334* (3.892)	0.585* (9.239)	-0.0003 (-0.011)	-0.042 (-1.193)
LRPSDP			1.037 (0.958)	0.762 (0.568)			-7.683 (-1.364)	-10.903*** (-1.915)			2.101* (3.151)	1.886* (2.687)
SDPSQ			-0.037 (-0.711)	-0.024 (-0.385)			0.358 (1.362)	0.503*** (1.890)			-0.093* (-2.752)	-0.079** (-2.239)
Hausman Statistics	26.502 (0.000)	27.677 (0.000)	19.063 (0.001)	21.614 (0.001)	20.067 (0.0004)	26.036 (0.0000878)	24.725 (0.000)	28.232 (0.000)	14.592 (0.005)	40.165 (0.000)	1396.948 (0.000)	1281.373 (0.000)

Notes: LPGINI = Log of Gini Index; LECOINFSS = Economic Infrastructure Index computed using SS based weights; LRPSDP = log of real per capita SDP; SDPSQ = Square of real per capita SDP; LFINLDPTH = log of Financial Depth; LINFLATION = Log of Inflation; Parenthesis to coefficient estimates indicate t-statistics; Parenthesis to Hausman Statistics refers to the significance level; *, ** and *** refer to 1%, 5% and 10% level of significance respectively. Source: the Author.