Understanding Economic Growth in Indian States

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By

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Abstract

The present study tries to understand the trends and determinants of economic growth in Indian states. For this, it considers two important determinants such as infrastructure and financial development. With the help of panel time series models, the study concludes that although both the variables are highly correlated with economic growth, it is the social sector development that is having higher impact on the economic growth. In terms of the role of financial sector, the results show that although it is necessary to have development in terms of increase in number of bank branches, it is the extent of bank business that is more important in the growth process.

Key Words: Economic Growth, Infrastructure, Financial Development, Panel Time Series, India.

JEL Classification: H54, N20, F43 and O16

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Introduction

India's recent success in growth and its sources have been widely discussed and debated both in academic and policy circles extensively. But the conclusions regarding the timing, pace and the determinants of the structural shift in overall economic growth is rather inconclusive (see Balakrishnan & Parameswaran (2007a, b), Rodrik & Subramanian(2005), Bosworth et al. (2007) and these are only a selected studies). Most of these studies have attempted to explain this growth story with the help of standard growth theories and its variants such as endogenous growth schools. There are other set of studies that have shown that indeed these high growth phase has also resulted in widening regional disparities at the state level (Ahluwalia (2000), Rao, et al. (1999)). To some extent this conclusion has been widely accepted and has been discussed at the policy level to reduce the spatial disparities emanating in the growth process. The Eleventh Five Year Plan's focus of achieving 'inclusive growth' is in itself major evidence that the regional divergences are quite severe and are in need of immediate policy responses. Towards this direction, the Indian Planning Commission, in the current Five year plan, is re-emphasizing micro approach by focusing more on the District level planning process through establishing District Planning Committees. But, unlike at the all India level, there are not many rigorous studies at the state level that examines the underlying determinants of economic growth in the recent period. At the District level, the unavailability of output data restricts any such studies.

Towards this direction, the present study makes an attempt to examine the timing, pace and determinants of economic growth at the state level. In particular, the study would examine the role of infrastructure faculties and financial sector development and its reach at the state level growth process. In the theoretical literature, these two factors have been identified as the major determinants for enhancing growth atleast in the developing countries. Even at the all India level, the Eleventh Plan does focus on these two factors to stimulate growth. At the empirical level, there are many cross-country studies that have shown significant role for infrastructure in the developing and LDCs of Asia and Africa.

Some studies have even showed that the growth achieved through improvement in these factors would have more potential to reduce poverty and inequality.

The rest of the paper is organized as follows. In the next section, the analytical framework that is adopted in the study would be discussed. In section-3, the details about the database, preliminary results about the trends and behavior of state GDP, infrastructure and financial indicators would be discussed. A brief description about the methodology adopted in the study would be presented in Section-4. Structural shifts in the state GDP would be discussed in section-5. In section-6, econometric results regarding the impact of infrastructure and finance at the state level would be dealt. The last section would draw conclusions.

Analytical Framework for the study

Taking from Barro (1990) and Hulten, et al. (2005), to examine the effect of social and physical infrastructure and financial development at state level in India, the analytical framework for this study uses a production function approach wherein both infrastructure and financial development variables enter the function as in the form of capital. For this purpose, the study adopts some variation of the Cobb-Douglas production function as under the neo-classical framework that this production function would indeed serve as a basic form (Jorgensen (1963)). This can be expanded by incorporating decisions regarding investments in fixed assets such as infrastructural facilities that are expected to improve efficiency of any production activity.

Standard production function with labour and capital as inputs are taken and extended the same by including infrastructure and financial sector development for determining production. Endogenous growth theory extends the definition of the word capital to include other forms of capital such as human capital, social capital, infrastructure, and financial capital in addition to the microeconomic definition of capital that includes machinery i.e. physical capital and capital in form of investments. To make things simpler, as per the requirement of the study we have not included all the measures of capital. Instead here the focus is on capital at macroeconomic level i.e. infrastructure and

financial capital. Broadly, infrastructure can be divided into physical and social infrastructure. Physical infrastructure includes transport facility (road, rail, sea and air), telecommunication etc, whereas education, health and sanitation etc are grouped in social infrastructure.

In this framework infrastructure affects output in two ways; one is the direct channel where infrastructure increases the output by reducing the cost of intermediate goods and helps in achieving higher investments (Bougheas, et al. (2000)). For example, a proposed business investment avenue at a proposed location will loose its viability because of the infrastructure unavailability (transport, telecommunication etc.) but availability of infrastructure will make the investment viable. Thus higher per capita availability of infrastructure capital reduces the fixed cost of production. The other channel is through externality effect. This channels works through higher human capital returns due to education, good quality health and higher efficiency of the human capital due to lower marginal depreciation of capital. Additionally, physical infrastructure affects the cost/output by its effect on social infrastructure. Better physical infrastructure helps in swelling the human capital through increasing its efficiency in turn affects output by increasing the R&D, innovation and lower fixed cost of production.

Similar to infrastructure, the role of finance is also very crucial in any production process. The literature on the relationship between finance and growth is vast. Although the impact of finance on growth is not clear, it is very well established that better financial institutions and instruments would reduce the transaction and information cost and makes the production activity competitive and viable in the long run. Financial institution provides incentive to restructure the market allocations in such a way that it would reduce the fixed cost of production. Gathering information and evaluation of the firm and its management before making any investment decision entails a huge transaction cost, thus makes availability of funds costlier for the firms. Financial intermediaries helps in reducing transaction cost in acquiring and processing the necessary information and helps the better allocation of scarce resources. Further, it also helps in mobilization of savings from different economic agents and channels them to profitable investments (Stiglitz &

Weiss (1983) and Diamond (1984)). Financial sector also plays a major role in the corporate governance. A developed financial market reduces the cost of corporate governance compared to less developed financial sector, (Bencivenga & Smith (1993)). This is very important from sustainability and viability point as the effectiveness of corporate governance mechanisms directly impacts firm performance with potentially large ramifications on national growth rates and this would largely depend on the extent of development of financial sector.

Greenwood & Jovanovic (1990) explains the role of financial intermediaries in accelerating growth by better allocation of resources through improved information on firms, managers, and economic conditions, though this information is not free but the cost is very much lower as compared to the cost incurred by individual for the same amount of information. Besides this access to lower cost information to the investors helps them in making better decision and thus helps the directors to oversee the managements effectively. King & Levine (1993b) introduce financial intermediaries in growth process, where financial intermediaries boost the rate of technological innovation through reward to the entrepreneurs.

Considering the arguments of infrastructure-growth and finance-growth literature the theoretical model that can be used for empirical verification of the role of infrastructure (both physical and social) and finance in growth dynamics at state level for India is specified below.

Y = F (IP, IS, F and L)

Y is output (State Domestic Product)

IP is expenditure on physical infrastructure

IS is expenditure on social infrastructure

F is variables reflecting financial sector development

L is labour

In general, physical infrastructure can include revenue and capital expenditure on transport, energy and irrigation and flood control whereas, social capital includes revenue and capital expenditure on education, health and family welfare and water supply and

sanitation. Increase in the social capital is supposed to have positive effect on output through its positive long run effect on development of human capital. Similarly, improvements in physical infrastructure capital will have positive effect on state level output by reducing the fixed cost as well as its effect on human capital. In order to study the effect of financial development at state level we have used number of bank branches and credit to deposit ratio as the indicator of financial development in the absence of typical variables of financial development at state level. Here, increases in the number of bank branches is supposed to have positive effect on state output as increase in the number of bank branches signifies financial inclusion and thus will have positive effect on savings mobilization and investment. Similarly credit to deposit ratio is supposed to have positive effect on output as increase in credit to deposit ratio indicates increase in profitable investments. Due to unavailability of the data at the state level, we excluded labour from the empirical model although it is integral part of growth model. All the variables are in real terms except number of bank branches and credit to deposit ratio.

Review of Literature

In this section, as this paper addresses the issue of economic growth in Indian states and its linkage to the development of financial sector and infrastructure, review of some of the existing studies on finance-growth and infrastructure-growth linkages would be undertaken.

On Finance and Growth:

It was Bagehot (1873) and Schumpeter (1912), who first explained the link between finance and growth. Latter, number of studies has been done in this area and the role of financial system in economic growth process has been extensively discussed. Some of them have even studied the role of banking system separately and some have discussed the importance of stock market in economic development. There is no dearth of studies on both at individual country level and at the cross-country level. Diamond (1984) highlights importance and positive role of bank based financial system in the capital allocation process and better corporate governance by acquiring information about firms and their management thus reducing the cost by providing incentives for delegated

monitoring by a financial intermediary. Rajan & Zingales (1998) modeled and explains the role of powerful banks in debt repayment enforcements especially when the country is having weak enforcement laws through its mutually beneficial effect on relationship between borrowers and arm's length but they find this is only valid till there is no shock like East-Asian financial crisis. Some studies explain the importance of banking system in improving the efficiency of investments by managing inter-temporal and liquidity risk involved. This increased efficiency significantly reduces the information cost and increases the spectrum of the information (Allen & Gale (1999); Bencivenga & Smith (1991)). Issue of economies of scale in mobilising the savings by banking sector has been dealt by Sirri & Tufano (1995) and shows that using economies of scale banks pool large surplus savings and help corporates in reaching optimum and efficient production point.

Market based financial system helps in improving the performance of managements as better performance gives reward to them in the form managerial compensations and it also exerts better governance (Jensen & Murphy (1990)). In this regard, Bhide (1993) argues other way round, and exhibits that greater market development may hinder corporate control and economic growth by increasing the number of times a particular share is being sold and thus reducing the incentives to exert rigorous corporate control. Further, Stiglitz (1985) argues that well-developed markets quickly and publicly reveal information, which reduces the incentives for individual investors to acquire information.

Most of the popular studies by using different estimation procedures and different variables for both bank and stock market show that development of financial sector are positively related to economic growth (King & Levine (1993a), Demirguc-Kunt & Levine (1996) Demetriades & Hussein (1996) Levine & Zervos (1998) Levine, Loayza & Beck (2000) and Beck, Levine & Loayza (2000)). There are some studies which show negative relationship between financial development and economic growth. One such study is by Liu & Hsu (2006) which shows that financial sector development is negatively related to growth in Japan and Korea by low efficiency of banking system/financial intermediaries in allocating investment to profitable projects. Again in a recent study by Sarkar (2009) cast serious doubt over the role of finance in economic

growth in developed countries and also in less developed countries. Even much earlier Lucas (1988) argued that there is a negative relationship between finance and growth and concludes that financial variable is an "over-stressed" determinant of economic growth. Study by Fitzgerald (2006) put forward that there is no simple relationship between financial development and economic growth. Further, there is no clear cut evidence that financial liberalisation raise overall savings or investment rates. He also argues that rapid pace of financial reform and opening to global capital markets can create considerable instability despite efficiency gains, leading to a net reduction of investment and growth.

But given the preponderance of evidence from empirical works and theoretical modeling, the role of financial system cannot be dismissed in economic growth process. Additionally, Alfaro et al. (2004; 2006); Durham (2004) provide evidence that only countries with well-developed financial markets gain significantly from FDI in terms of their growth rates.

On Infrastructure and Growth:

The studies on infrastructure and growth are largely concentrated on developing and less developed countries. And most of them are largely stresses the positive role of infrastructure development in the overall growth and development process. In particular the United Nations' Millennium Development Goals (MDGs), in which the infrastructure is the major goal, stresses the role that infrastructure plays in enhancing growth, and, hence, reducing poverty. Dutta et al. (2007) exhibits the importance of infrastructure for macro economic growth at the state level in a study of fourteen states in India, particularly the role of economic infrastructure in determining the productivity. Results of the study indicate that infrastructure plays an important role in determining the level of investment and productivity of the industrial activity. Binswanger et al. (1989) uses district level data for India and examine the impact of physical infrastructure on agricultural output, and illustrates that infrastructure helps in reducing the transaction cost, and thus promote agriculture output. Whereas, Elhance & Lakshmanan (1988) finds, investment in infrastructure; both physical and social, helps in reduction of production cost in the manufacturing industry in India. Studying the link between infrastructure and

development for West Bengal, Majumdar & Mukherjee (2005) confirm the existence of long run relationship between infrastructure and development with a strong causation from infrastructure availability on development levels. Additionally, effect of different facets of infrastructure seems to have different impacts on different dimensions of development.

Following, the methodology of pioneer work of Hulten & Schwab (1991), which allows accounting for externalities effect of infrastructure on growth exclusively, Hulten, et al, (2006) found significant spillover effect of infrastructure on total factor productivity (TFP) in the Indian manufacturing sector, contrary to that of the findings from Hulten & Schwab (1991) study on U.S manufacturing sector. Study by O'Fallon (2003) though failed to provide causal link between infrastructure investment and economic growth, instead, provides an interesting conclusion that the impact of infrastructure on growth depends on the initial conditions of the economy. Rodriguez (2007) clearly documents the role of difference in infrastructure investment in increasing or decreasing the growth rate of the economies. Empirical evidence of the Rodriguez (2007) study using a data set of country-level infrastructure stocks for 121 countries since 1960 clearly shows that cutbacks in infrastructure investment does have a significant effect on living standards and productivity and thus growth rate.

In a series of papers Aschauer (1989a, 1989b and 1989c) provides evidence on high economic return associated with investments in infrastructure. In fact, these studies correlate the slowdown in the productivity of U.S. economy to that of decline in the investment in the infrastructure sector. Results of these studies, where economic returns from infrastructure investments are as high as 60%, invited series of debate about use of production function and estimation methods in investigating the effect of infrastructure on economic growth. According to Hulten & Schwab (1991), Evans & Karras (1994) and also Holtz & Eakin (1994) a positive and statistically significant coefficient for a government input in an estimated "production function" may only indicate the degree to which increased income causes an increased level of government activities. Munnell (1990), Uchimura & Gao (1993), Canning & Fay (1993) and Easterley & Rabelo (1993)

provide almost similar evidence on high return of infrastructure investments to that of Aschauer (1989c). Taking infrastructure as technology, which reduces cost in the production of intermediate inputs, Bougheas, et al. (2000) highlights the importance of infrastructure in growth process. Ghosh & De (1998) using OLS and principal component analysis examined infrastructure and regional growth dynamics in India. The study shows that infrastructure do play an important role in explaining difference in growth at regional level. Ghosh & De (2000) again found in a different study for South Asian countries that endowment of physical capital is responsible for the difference in growth level attained. Argy, et al. (1999) see infrastructure as a catalyst, which not only enables opportunities for economic development but also creates future opportunities provided government makes sound and active policy for investment in infrastructure. Though result of Canning & Pedroni (2004) demonstrate strong and positive inducing effect from infrastructure to economic growth but there exits vast variation in this inducing effect. They attribute this variation to the existence of infrastructure beyond growth maximizing level. In other words, the study is raising an issue of threshold level of infrastructure facilities. But these findings may not be applicable to most of the developing countries as infrastructure constraints are quite obvious.

Though most of the studies on infrastructure - growth relationship have showed positive effect of infrastructure on economic development either directly through productivity or through its effect on output, there are some studies which have reported negative results of infrastructure on growth (Devarajan et al. (1996), Sanchez-Robles (1998) and Pritchett (1996)). These studies argue that excessive amounts of transportation and communication expenditures makes capital expenditures unproductive, which imply that developing-country governments have been misallocating public expenditures in favor of capital expenditures at the expense of current expenditures and Pritchett (1996) brought the issue of public investment in unproductive projects making marginal productivity of the output capital lower than the investment.

To sum up, the review shows that there are some mixed results regarding the impact of financial sector development and infrastructure on growth. The studies show that in the

case of infrastructure, although most show positive impact, there are non-linearities as excessive investments might have negative impact. But this situation may not be same in developing countries like India where the infrastructure deficit has been clearly identified as one of the major factor that could hamper in sustaining high growth. Further, in the case of financial sector also, the sector has not covered even of half of the population in most of the developing countries. Hence, in this study, we try to examine the impact of financial sector development and infrastructure on growth in Indian states.

Data Description:

Study uses annual data for the period 1985-86 to 2005-06. For state domestic product the data is taken from RBI sources (Handbook of statistics on Indian economy). Trend and Progress of Banking in India published by RBI is used for financial sector development indicators such as number of bank branches and credit to deposit ratio at the state level by scheduled commercial banks. For the data on infrastructure (both physical and social), we have largely relied on the RBI report on おState Finances: A Study of Budgetsめ

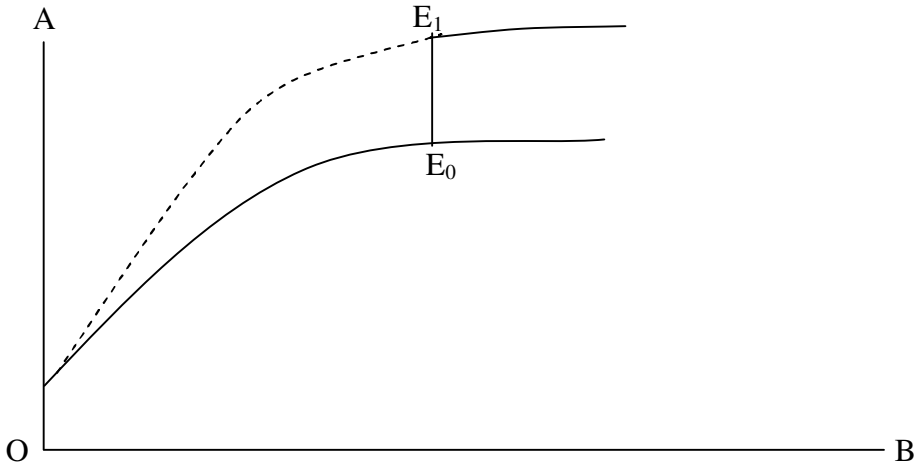
Following are the variables we have used in the study: SDP (real state domestic product at 1993-94 prices in rupee crore), for economic infrastructure variable we have used expenditure on economic infrastructure ま(irrigation, energy and transport) in real terms/deflated by WPI in rupee crore (RSOC) where as for social infrastructure we have taken expenditure on social infrastructure ま(health, education and water and sanitation) in real terms/deflated by WPI with 1993-94 base in rupee crore) (RECO). In addition to these variables, credit-deposit ratio of scheduled commercial banks according to point of utilization wise (CDRUW) and number of scheduled commercial bank branches (BB) has been used in the study to represent development in the financial sector.

Conversion of SDP series to new Base year

Use of long time series data of StatesやGDP in India is an issue. The change in the base period from 1980-81 to 1993-94 at the all India level has led to this problem. Although at the all India level, the data on real economic activity with base 1993-94 is available even for backwards years, but at the State level these data are not available. As the change in the base period is done based on shift in both consumption (for estimation for price

index) and the production basket, simply price splicing is not sufficient. Hence, it is necessary to shift upwards the production curve as well. As the study covers the data from 1980-81 to 2005-06 for the estimation, we need to convert the SDP series to the 1993-94 base year from the 1980-81 base. There are two steps: first, compute the difference in SDP for period 1993-94 between both the series with base years 1980-81 and 1993-94 for which data are available. This difference in the SDP at 1993-94 between two series has occurred due to upward shift in the production function that includes new economic activities and exclusion of few older activities that are extinct. Now to get the new series on the base year 1993-94, we first assume that this shift in production has not occurred in a single year and it is also assumed that production changes has also happened in the year 1980-81. This difference in output, which has been accounted in the year 1993-94, needs to be redistributed asymptotically backwards with an annual declining rate up to year 1980-81. This can be better understood from figure-1, where E_0 is the common year (here it is 1993-94) and the difference of output due to change in production is represented by the gap E_1-E_0. In this case, to get the new series from 1980-81 to 1992-93, i.e., for thirteen years, we use the formula $Y^*_{1992\text{-}93}=Y_{1992\text{-}93}+(E_1-E_0)*(12/13)$ for 1992-93, $Y^*_{1991\text{-}92}=Y_{1991\text{-}92}+(E_1-E_0)*(11/13)$ for 1991-92 and finally $Y^*_{1980\text{-}81}=Y_{1980\text{-}81}+(E_1-E_0)*(1/13)$, where superscript ‘*’ indicates new series. It may be noted from the graph that the difference has been redistributed by sliding backward up to year 1980-81 shown as dashed line, indicating a declining weight backwards for the new economic activities in the production basket. In the next step, we compute the price deflator with 1993-94 by simple splicing and then divide the nominal series by this deflator to get real SDP at 1993-94 prices.

Figure-1: Shift in Production Function with change in Base year



Before we get into empirical estimations, some discussion on the trends and structural behaviour of infrastructure, finance and growth variables is pertinent.

Trends in State indicators

Recent research on Indian states has largely focused on the issue of growth divergence/convergence in the post-reform period. While it is largely accepted that economic reforms in India has led to growth divergences and the public policy has started addressing this issue, here we concentrate on the factors that determine growth at the regional level in the endogenous growth framework. A study by Sachs et al. (2001) shows that urbanization as the major factor in shaping the output growth at state level in India for 15 major states. Social and demographic factors (like infant mortality rate and adult literacy rate) were found to be explaining the standard of well-being, but found to be weak determinant of economic growth at the state level. Rao, Shand, & Kalirajan (1999) bring out the importance of infrastructure and human resource in determining the level of investment at the state level and thus output growth. Nagaraj et al. (2000) highlights the growth impact of specific types of infrastructure (like: primary education, health conditions, irrigation, roads and rail network, power capacities, and financial development) on the growth performance of Indian States during 1970-94. Besley & Burgess (2000) provide evidence on the importance of land reforms as an instrument of increasing the output growth at state level in India.

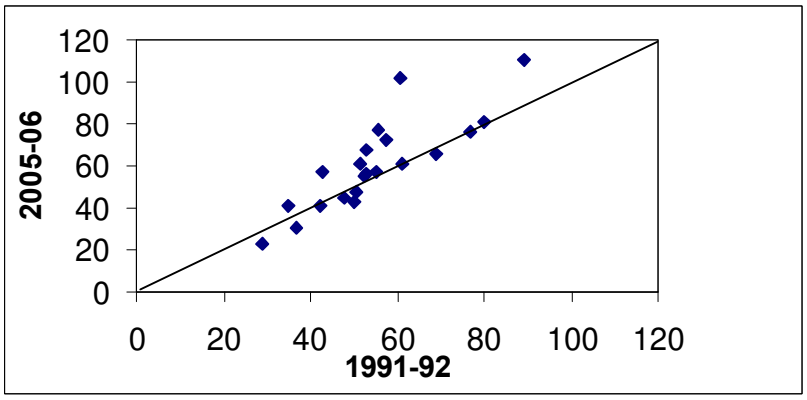
Based on the literature we find that studies on the factors that affect economic growth is limited in the post-reform period. Although some have done in the 1990s, as the reforms in most of states were implemented in the later half of 1990s and further there is large heterogeneity across states, it is necessary to address this issue now with the availability of sufficient data for empirical examination in the post-reform period. Investment on infrastructure (both physical and social) has been focused more from the 10th Plan onwards and in the 11th Plan the targets for infrastructure investment has been set at more than US$500 billions under public-private partnership. Hence, it is necessary to understand the impact of infrastructure on the economic growth, particularly at the state

level in the recent period. Before getting into econometric exercise, discussion on some trends might be useful.

Trends in financial indicators

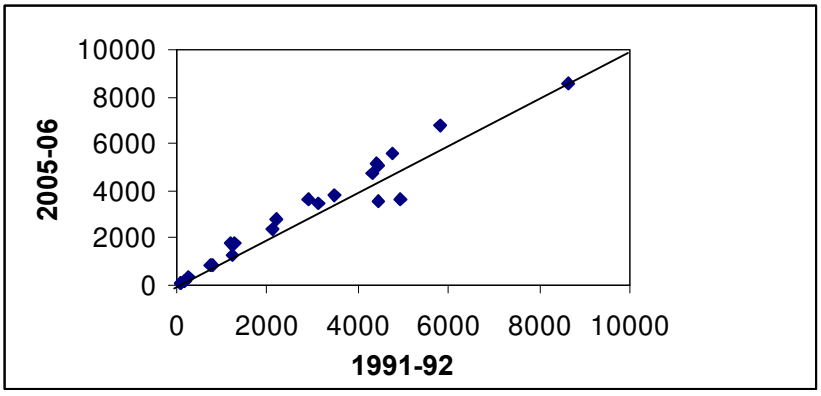
Financial sector development in terms of credit-deposit ratio, which is likely to increase in the post-reform period as reforms were expected to increase competition in the banking sector and help stimulate the credit disbursement for productive investments, shows that the process of financial reforms has not brought substantial improvement in the credit deposit ratio in most of the states (see figure-2). Instead the ratio has either remained same or even deteriorated in more than half of the states that are covered in this study. It seems that there is mixed effect of financial sector reforms and has increased inequality among the states, which could one of the reasons for widening inequality of growth among the states in the post-reform period.

Figure-2: Comparison of Credit-Deposit Ratio



Source: Trends and Progress of Banking in India, RBI

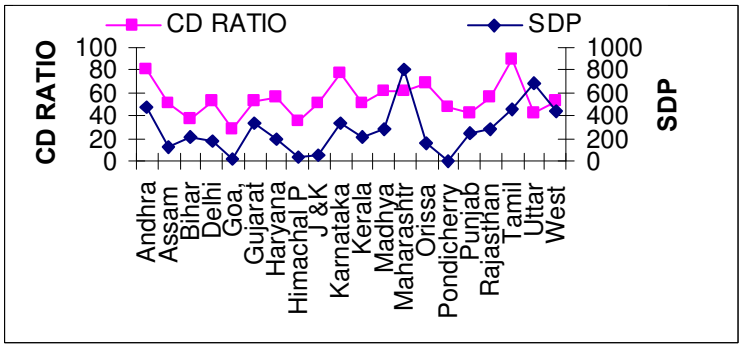
Figure-3: Comparison of Number of Bank Branches



Source: Trends and Progress of Banking in India, RBI, various issues

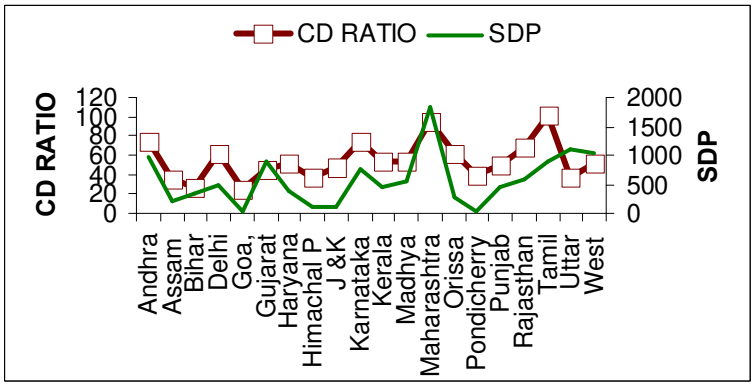
Similarly, with the introduction of new private and foreign banks, it was expected that number of bank branches (which is used as proxy for reach/accessibility) would alsoincrease. But there was no major increase in this variable as well during 1991-92 and 2005-06 (see figure-3). Thus, it is quite clear that banking sector in particular and financial sector as a whole, although developed at the all India level, shows some mixed results at the state level. This vindicates our view that the reforms at the state level are highly heterogeneous and is expected to have differential impact on the growth at the state level. These results are similar when the normalized variables such as credit-GDP ratio and banks per 1000 population are used.

Figure-4: Plot of Credit to Deposit Ratio and SDP in1991-92



Source: Trends and Progress of Banking in India, RBI and National Income Accounts and Statistics, CSO

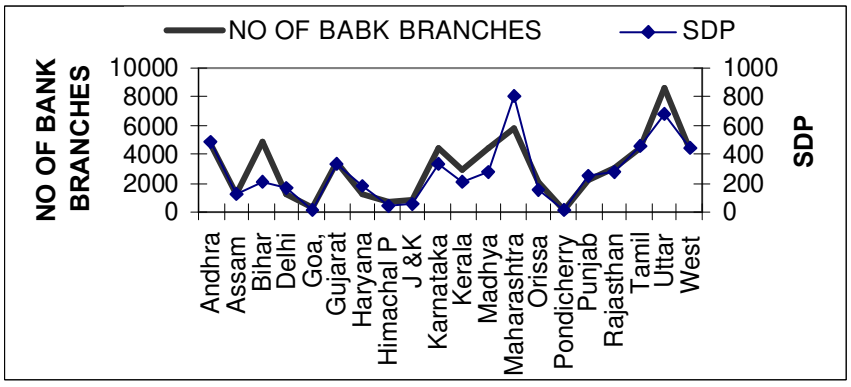
Figure-5: Plot of Credit to Deposit Ratio and SDP in 2005-06



Source: Trends and Progress of Banking in India, RBI and National Income Accounts and Statistics, CSO

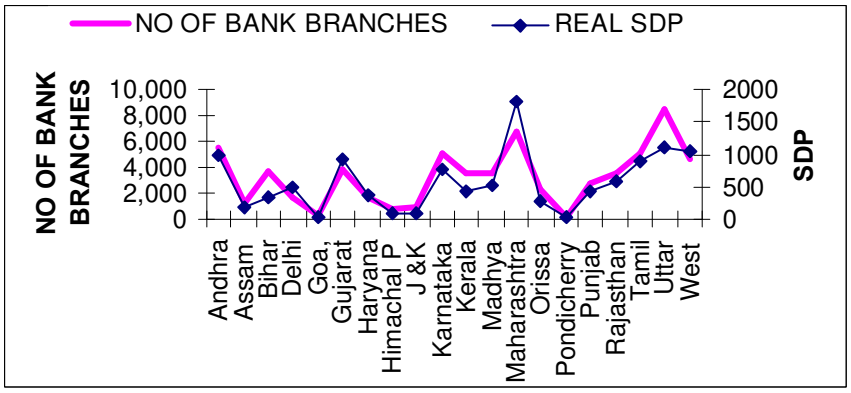
This trend in credit deposit ratio is found to be similar to that of the real SDP for both the time points 1991-92 and 2005-06 (see figure- 4 and 5). A simple correlation estimates show that the relation between credit-deposit ratio and SDP shows an increased positive correlation from 0.41 to 0.65 between two time points (1991-92 and 2005-06). This indicates that in states where the credit-deposit ratio is high the output in the corresponding state is also high and vice-versa (see figure-4 and 5). Similarly the plot of the number of bank branches and SDP shows that development of financial sector is important for output growth (see figure 6 and 7). To understand the cause and effect relationship, we estimate the cross-sectional regression to see the impact of credit deposit ratio and number of bank branches on real SDP at both the points (1991-92 and 2005-06). Regression result shows that credit deposit ratio has a positive and significant effect on the SDP and also a substantial improvement in the effect of the credit deposit ratio on SDP (the coefficient changed from in 1991-92 5.87 to 14.56 in 2005-06). Although the effect of number of bank branches is positive but its coefficient is very small as compared to that of credit deposit ratio. Increase in the value of coefficient of number of bank branches from 0.017 in 1991-92 to 0.8 in 2005-06 shows that increased reach of banks are important for the economic growth. Thus, cross-sectional estimation also testifies the well established and argued effect of development in the financial sector on output.

Figure-6: Plot of Number of Bank Branches and SDP in 1991-92



Source: Trends and Progress of Banking in India, RBI and National Income Accounts and Statistics, CSO

Figure-7: Plot of Number of Bank Branches and SDP in 2004-05



Source: Trends and Progress of Banking in India, RBI and National Income Accounts and Statistics, CSO

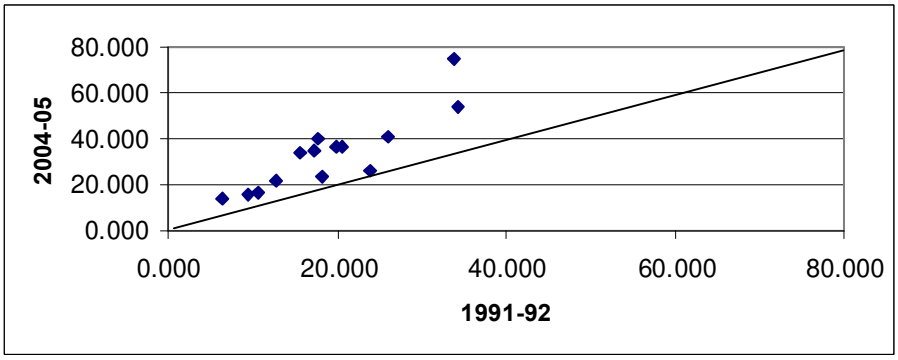
Based on these figures and simple empirical estimations, one can conclude that financial sector development is indeed highly correlated with the overall economic growth performance of the states as it helps in providing timely and cheaper credit to the production activities. It would also helps in channeling the scarce capital resources. It is important to point out here that India is one of the highest saving countries in the world and is continuously increasing over a period of time. In the following section a similar analysis regarding the infrastructure development.

Trends in Infrastructure indicators

As in the case of financial development, similar plots have been used to understand and investigate at primary level the changes in infrastructure (both economic and social) at the time of reforms and now and its effect on the state output level. Figure-8 examines changes in social infrastructure in 2004-05 compared to situation in 1991-92, the point when reforms took place. The plot of expenditure on social infrastructure depicts improvement in the situation of the social infrastructure in almost all the states, though the improvement in the condition is not very huge in some states. This only indicates that the expenditure on social sector development has increased over a period of time, which is in line with the government's approach in achieving the MDG goals by 2015. But one needs to be cautious that initial conditions in India were quite low and, hence, there is a need for further increase in social sector expenditure.

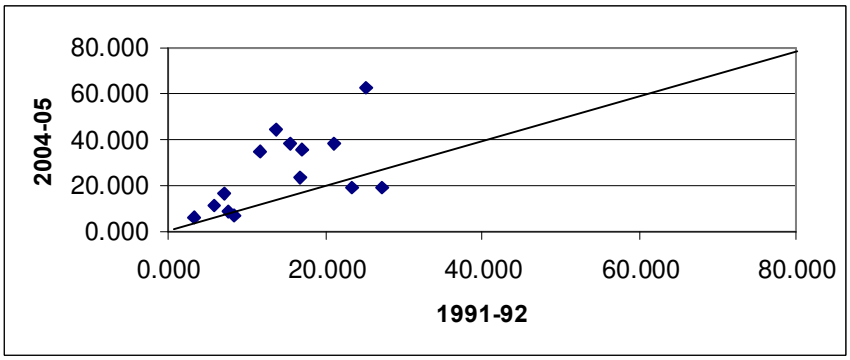
In the case of economic infrastructure, we find mixed results where the situation has improved for some of the states but for some it has deteriorated (see figure-9). Even in the case where the states have shown improvement they are not very substantial.

Figure-8: Comparison of expenditure on social infrastructure



Source: State Finances: A Study of Budgets and National Income Accounts and Statistics, CSO

Figure-9: Comparison of expenditure on economic infrastructure



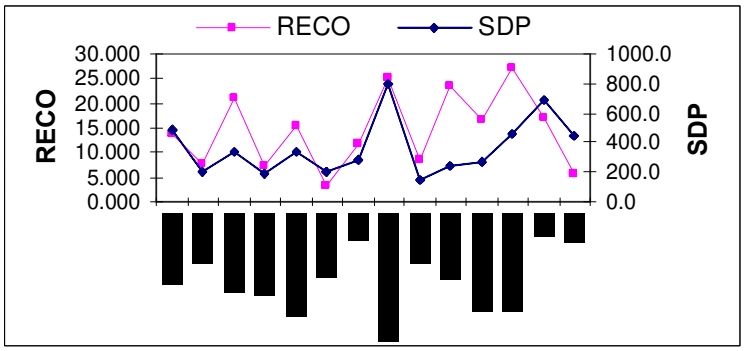
Source: State Finances: A Study of Budgets and National Income Accounts and Statistics, CSO

It has been perceived by many that ‘infrastructure deficit’ would be a major deterrent sustenance of current high economic growth in India. But, in our view, more important is the ‘infrastructure inequality’ would be a bottleneck for balanced regional development.

Figure 10 and 11 draw upon the co-movements of economic infrastructure (RECO) and real SDP in 1991-92 and 2004-05 respectively. These plots can be used to understand correlation between economic infrastructure and state output. Unlike in the case of financial development, the linkage between economic infrastructure and state performance on output appears to be not so robust. But one thing that is clearly coming

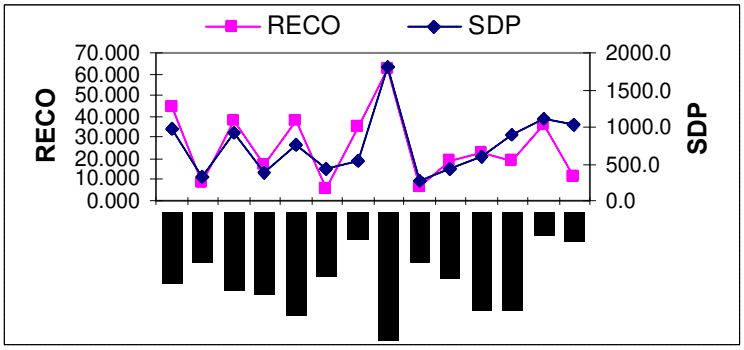
out of these plots is that over the period the linkages seem to be improving. The cross-correlation coefficient and regression results also testify increasing positive linkage between economic infrastructure and state domestic product (correlation coefficient in 1991-92 is 0.537 and it is 0.779 in 2004-05 and the coefficient of cross section regression is 13.42 and 19.49 respectively).

Figure-10: Plot of economic infrastructure and SDP in 1991-92



Source: State Finances: A Study of Budgets and National Income Accounts and Statistics, CSO

Figure-11: Plot of economic infrastructure and SDP in 2004-05

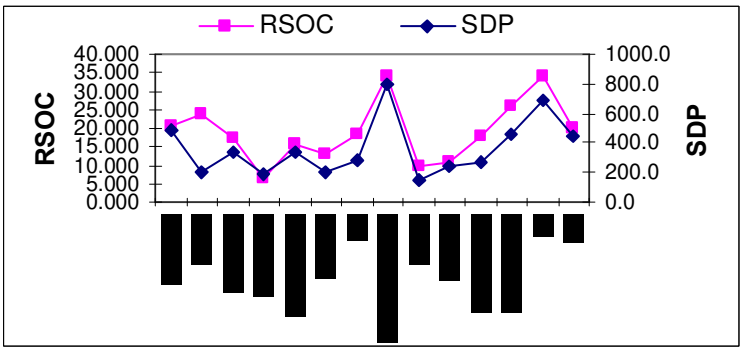


Source: State Finances: A Study of Budgets and National Income Accounts and Statistics, CSO

It is clearly visible from the plot of social infrastructure (RSOC) and real SDP that, except for Bihar, there is strong and positive link in 1991-92 (see figure-12). This linkage has even improved in the following years as evident from the plot for year 2004-05 (see figure-13). The effect of social infrastructure on real SDP is even higher in comparison to that of economic infrastructure. Results of correlation coefficient and cross section estimation also reveal the increased role of RSOC both over the time period and in comparison to that of economic infrastructure (correlation coefficient has gone up from

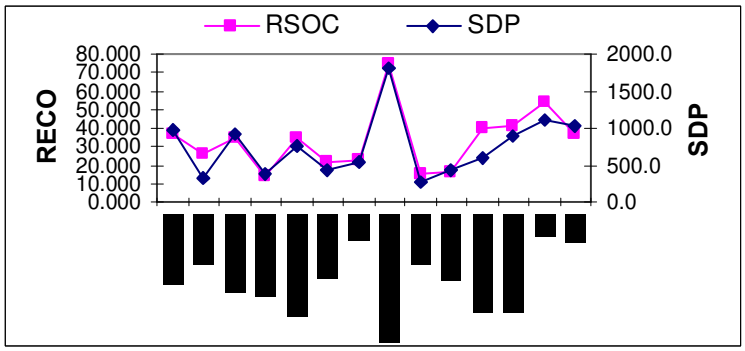
0.86 in 1991-92 to 0.93 in 2004-05 and coefficient of cross section estimation is 19.98 in 1991-92 and 23.65 in 2004-05). However, it is important to note here that cross correlations gives only the contemporaneous relationships. But as it is well established that the improvement in social sector would have impact on economic growth with a significant lag and would have returns in the very long term, we have also analysed this cross sectional relationships with five year averages in social sector development prior to 2005-06 and 1991-92. The conclusions based on these are similar to that of the contemporaneous relations.

Figure-12: Plot of social infrastructure and SDP in 1991-92



Source: State Finances: A Study of Budgets and National Income Accounts and Statistics, CSO

Figure-13: Plot of social infrastructure and SDP in 2004-05



Source: State Finances: A Study of Budgets and National Income Accounts and Statistics, CSO

This preliminary analysis shows that both financial sector development and infrastructure are essential for the growth in the regions. In the post-reform period, there is improvement in all the indicators, but banking performance (credit deposit ratio) and

improvement in economic infrastructure is slightly showing some mixed results and creating conditions for growth divergences. But for these conclusions to be robust we undertake panel estimation procedures such as cointegration and causality exercises and they are discussed in the methodology section. In the literature, it is found that the impact of infrastructure on growth is generally examined through estimating the direction of total factor productivity. But here, as we are focusing specifically on two inputs, we undertake impact analysis through panel econometrics.

Behaviour of State Domestic Product

Before undertaking panel exercise, we try to understand the growth behaviour in the India states in pre and post-reform period. For this, we have undertaken structural break analysis using Lee and Strazicich (2003) test to examine if there are significant structural breaks in the time series. We have taken this as this issue has been widely debated in the all India context to draw conclusions regarding efficacy of economic reforms in pushing the overall economic growth in India (see Balakrishnan & Parameswaran (2007a, b); Dholakia (2007) for the debate). Here we have also undertaken this exercise for all India GDP and its sectoral growth and the results are presented in table-2. It may be noted that for GDP growth we have found two structural breaks in 1981-81 and 1999-2000. Further, as it is also necessary to understand whether the break has shifted the growth curve upward or downwards, we have used the average annual growth rates. For example, as we found that there is second break in 1999-2000, we have estimated average annual growth rate from 1960-61 to 1998-99 and between 2000-01 to 2007-08 (it may be noted that as consistent series is available for all India we have used the data from 1960-61 to 2007-08). As we have found that the average annual growth in the second period is higher than in the first period, we conclude that there is a positive structural break in 1999-2000. The method also helps us in getting partial structural breaks in the series. Based on this we have found there is one partial break as well in GDP growth series in 2002-03 and it is positive. This could be largely due to sharp rise in the investment rates (particularly the foreign investments) that might have shifted the growth path upwards. In the case of sectoral GDP growth, the results are mixed. In the case of industrial growth (GDPI) the complete breaks show negative shift in 1962-63 and positive shit in 1995-96.

Service sector also shows a positive shift in 1995-96, indicating that economic policy reforms have indeed helped immensely both industrial and service sector growth in India. But agriculture sector (GDPA) seems to be left out of the reform process and has not seen strong break in the post-reform period. It only shows in 1972-73, which can be attributed to the Green Revolution process that was initiated in 1966, although with lot of opposition that is common to the economic reforms in early 1990s.

Table – 1: Structural Break in State Domestic Product

STATE	Complete break		Partial breaks	
	I	II	I	II
Andhra Pradesh	1989-90 (-)	1996-97(-)	2000-01(+)	2002-03 (+)
Assam	1990-91(-)	1996-97(-)	2001-02(+)	
Bihar	1990-91 (+)	1999-00(-)	1993-94 (+)	2002-03 (+)
Delhi	1995-96 (+)	2001-02 (+)		
Goa	1986-87 (+)	1995-96 (+)	1998-99 (-)	
Gujarat	1987-88 (+)	1989-90 (+)	1993-94 (+)	
Haryana	1989-90 (-)	1996-97 (-)	2001-02 (+)	
Himachal Pradesh	1987-88 (+)	1991-92 (+)	1996-97 (+)	2002-03(+)
J and K	1991-92(+)	1994-95 (+)	2000-01 (+)	
Karnataka	1989-90 (+)	1996-97 (+)	1994-95 (+)	1999-00 (+)
Kerala	1994-95 (+)	1999-00 (+)	2000-01 (+)	
Madhya Pradesh	1991-92 (+)	1998-99 (-)	2002-03 (+)	
Maharastra	1993-94 (-)	1998-99 (+)		
Manipur	1992-93 (-)	1999-00 (+)	1996-97 (+)	
Meghalaya	1989-90 (+)	1996-97 (+)	2000-01 (+)	
Orissa	1986-87 (-)	1990-91 (-)	1999-00 (+)	
Pondicherry	1990-91 (+)	1995-96 (+)	1993-94 (+)	1998-99 (+)
Punjab	1993-94 (-)	2002-03 (-)	1998-99 (-)	
Rajasthan	1993-94 (-)	2000-01 (-)		
Tamilnadu	1992-93 (-)	1999-00 (+)	1997-98 (-)	
Uttar Pradesh	1989-90 (-)	1997-98 (-)	2000-01 (-)	
West Bengal	1990-91 (+)	1995-96 (+)	1998-99 (+)	2000-01 (+)

Note: This is based on Lee and Strazicich (2003) Break test (for methodology see Appendix).
Sign in the parenthesis indicates the direction of the shift. ‡ indicates positive shift and ‡ indicates negative shift.

At the state level, as expected, the structural breaks in real SDP growth are mixed. But one important reading of table-1 is that fast growing economies, with the exception of Andhra Pradesh, such as Gujarat, Karnataka, Maharastra, Tamil Nadu, have experienced positive structural break between 1995-96 and 2000-01. This is also coinciding with the all India results, where GDP growth has seen positive break in 1999-2000. The case of

Andhra Pradesh, which was ahead of other states in the case of initiation of reforms, is surprising. It has seen negative structural shift in 1997-98. But partial break result show that it has seen positive break in 2001-02. This could be explained by the fact that the IT boom in the state. Unlike in Karnataka, in Andhra Pradesh the IT sector expanded in a big way in the later half of 1990s resulting in sharp rise in service sector output.

Table- 2: Structural break in all India and Sectoral GDP

VARIABLES	COMPLETE BREAK POINTS		PARTIAL BREAK POINTS	
	I BREAK	II BREAK	I BREAK	II BREAK
GDP	1980-81(+)	1998-99 (+)	2001-02(+)	
GDPA	1965-66(-)	1971-72 (+)	1994-95(+)	2000-01 (+)
GDPI	1961-62(-)	1994-95 (+)	1997-98(+)	2000-01 (+)
GDPS	1977-78 (+)	1994-95 (+)	1999-00(+)	2003-04 (+)

Note: Same as table-1

The rest of the states such as Bihar, Assam, Himachal Pradesh, Madhya Pradesh, Orissa Punjab, Rajasthan, and Uttar Pradesh have indeed experienced a negative structural break in the post-reform period. This indicates that these states have either not undertaken reform measures or, if reforms initiated it has not brought in intended results as it has shown in fast growing states. But there are some positive structural breaks, indicating that these states are trying to catch-up with the trends in rest of the country. Nevertheless, these results clearly indicate that reforms have shown mixed results at the state level. It is also showing that in the long run all the states are expected to see positive shift in their production function. With this understanding, in the next section, we discuss the results derived from the panel estimations.

Methodology

In this section, the methodology that is used in the study are discusses. As the study is trying to examine its objectives across the states, normally panel data models are used. But the time series property of the data restricts the use of standard panel data models. Hence, before deciding the type of models to be used, the study examines the time series properties of all the series at a panel level. As it turned out that some of the variables are non-stationary (the results would be discussed in next section) the study undertakes the panel cointegration approach, which is discussed below.

In the empirical literature, use of co-integration technique to test for the presence of long run equilibrium relationship among the non-stationary (integrated at same level) variables have gained much popularity over time. Use of panel data has helped in sorting out the problems associated with power of the test by increasing number of observations and allowing inter-cross section variations. To examine the presence of long run equilibrating relation among the variables of interest in the panel data series, first step is to find out the level of integration of the series using different unit root test/ stationarity test. Once the order of integration is decided and all the variables are integrated at same level then only test of co-integration is applied.

To avoid any spurious regression, econometric theory suggest for test of presence of unit root. In studies related to panel data test of unit root commonly uses test proposed by Levine, Lin and Chu (2002) (LLC hence forth) and other by Im, Pesaran and Shin (1997) (IPS hence forth) among the others in the literature. Both the tests (LLC and IPS) use the principle of Augmented Dickey-Fuller (ADF) unit root test. LLC differs from IPS on the ground of homogeneity constrain put in the LLC test on coefficient of autoregressive variables whereas IPS allows for heterogeneous coefficient. In order to understand IPS unit root test consider an autoregressive panel data series:

$$\Delta Y_{it} = \rho_i Y_{it-1} + \sum_{L=1}^{p_i} \alpha_{iL} X_{i,t-L} + z_{it}'\gamma + \varepsilon_{it} \qquad (1)$$

Where, i (i = 1, 2, 3 ...n) represent cross section units like country, state or firm etc and t (t= 1, 2, 3…T) represents time period of the observation. Error term ε_{it} follows normal distribution. Y_{it} is said to have unit root or non stationary if $|\rho_i| = 0$ and stationary if $|\rho_i| <$ 0. IPS test averages the ADF individual unit root test statistics that are obtained from estimating the equation (1) for each i (allowing each series to have different lag length if necessary); that is

$$\bar{t} = \frac{1}{N}\sum_{i}^{N} t_{\rho} \qquad (2)$$

as T → ∞ (for a fixed value of N) followed by N → ∞ sequentially, IPS test statistics is standard normal distribution.

Panel Cointegration Tests

Pedroni (1999, 2004) extends the Engle-Granger (1987) construction to tests the existence of cointegrating relationship in the panel data. Where Engle-Granger (1987) uses the unit root test on the residual of the spurious regression on I(0) variables. If the unit root test of the residual is stationary then the considered variables are said to be cointegrated. Pedroni (1999, 2004), proposes several tests for cointegration that allow for heterogeneous intercepts and trend coefficients across cross-sections. Pedroni considers the following panel regression

$$Y_{it} = \alpha_{it} + \delta_{it} t + X_i + \varepsilon_{it} \tag{3}$$

Where Y_{it} and X_{it} are the observable variables with dimension of $(N*T)X_1$ and $(N*T)X_m$, respectively. He develops asymptotic and finite-sample properties of testing statistics to examine the null hypothesis of no-cointegration in the panel. The tests allow for heterogeneity among individual members of the panel, including heterogeneity in both the long-run cointegrating vectors and in the dynamics, since there is no reason to believe that all parameters are the same across countries.

Two types of tests are suggested by Pedroni. The first type is based on the within dimension approach, which includes four statistics. They are panel ν -statistic, panel ρ statistic, panel PP-statistic[1], and panel ADF-statistic. These statistics pool the autoregressive coefficients across different members for the unit root tests on the estimated residuals. The second test by Pedroni is based on the between-dimension approach, which includes three statistics. They are group ρ -statistic, group PP-statistic, and group ADF-statistic. These statistics are based on estimators that simply average the individually estimated coefficients for each member. Following Pedroni (1999), the heterogeneous panel and heterogeneous group mean panel cointegration statistics are calculated as follows.

Panel -ν statistic:

$$Z_{\nu} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} L_{11i}^{-2} \hat{\varepsilon}_{it-1}^{2} \right)^{-1}$$

[1] PP tests are likely to be more robust to be fat tails in data.

Panel - ρ statistic:

$$Z_{\rho} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{2} \varepsilon_{it-1}^{2} \right)^{-1} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{2} \left(\varepsilon_{it-1} \Delta \varepsilon_{it} - \hat{\lambda}_{i} \right) \right)$$

Panel - *PP* statistic:

$$Z_{t} = \hat{\sigma}^{2} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{2} \varepsilon_{it-1}^{2} \right)^{-1/2} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{2} \left(\varepsilon_{it-1} \Delta \varepsilon_{it} - \hat{\lambda}_{i} \right) \right)$$

Panel - *ADF* statistic:

$$Z^{*}{}_{t} = \hat{\sigma}^{2} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{2} \varepsilon_{it-1}^{*2} \right)^{-1/2} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{2} \left(\varepsilon_{it-1}^{*} \Delta \varepsilon_{it}^{*} \right) \right)$$

Group ν statistic:

$$\tilde{Z}_{\rho} = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \varepsilon_{it-1}^{2} \right)^{-1} \left(\sum_{t=1}^{T} \left(\varepsilon_{it-1} \Delta \varepsilon_{it} - \hat{\lambda}_{i} \right) \right)$$

Group *PP* statistic:

$$\tilde{Z}_{t} = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \varepsilon_{it-1}^{2} \right)^{-1/2} \left(\sum_{t=1}^{T} \left(\varepsilon_{it-1} \Delta \varepsilon_{it} - \hat{\lambda}_{i} \right) \right)$$

Group *ADF* statistic:

$$\tilde{Z}^{*}{}_{t} = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} s_{i}^{2} \varepsilon_{it-1}^{*2} \right)^{-1/2} \left(\sum_{t=1}^{T} \left(\varepsilon_{it-1}^{*} \Delta \varepsilon_{it}^{*} \right) \right)$$

Here, $\hat{\varepsilon}_{it}$ is the estimated residual and $\hat{L}_{11i}$ is the estimated long-run covariance matrix for $\Delta \varepsilon_{it}$. Similarly, $\hat{\sigma}_{i}$ and $s_{i}\left(s_{i}^{*2}\right)$ are, respectively, the long-run and contemporaneous variances for individual I (cross section). Pedroni (1999) discuss these issues in details with the appropriate lag length determined by the Newey-West method. Pedroni (1997, 1999) shown that all seven tests distribution follow standard normal asymptotically as:

$$\frac{\chi_{N,T} - \mu \sqrt{N}}{\sqrt{\nu}} \rightarrow N(0,1)$$

Where $\chi_{N,T}$ is standardized form of for each seven statistics. While μ and ν are the mean and variance of the underling series.

The panel ν -statistic is a one-sided test where large positive values reject the null of no cointegration. The remaining statistics diverge to negative infinitely, which means that large negative values reject the null. The critical values are also tabulated by Pedroni (1999).

FMOLS Methodology:

Once results of panel cointegration rejects the null of no cointegration, we can apply panel fully modified OLS (FMOLS) to find the long run coefficient of the variables. FMOLS is preferred over OLS with differenced series in case of cointegration because of FMOLS ability to produce consistent result with endogeneity effect. Pedroni (2001) FMOLS is non parametric estimation technique which transforms the residuals from the cointegration regression and thus get rid of serial correlation. Therefore, the problem of endogeneity of the regressors and serial correlation in the error term are avoided by using FMOLS. Group-mean FMOLS estimators have relatively minor size dissertation in small sample. Additionally it allows for heterogeneity across the cross section. To understand the correction of endogeneity and serial correction in FMOLS let us consider a panel model of two variables:

$$Y_{it} = \alpha_i + \beta_i X_{it} + u_{it}$$

OLS estimate of the coefficient β_i in panel regression is given by:

$$\hat{\beta}_{i,OLS} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \left(X_{it} - \bar{X}_i \right)^2 \right)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \left(X_{it} - \bar{X}_i \right)\left(Y_{it} - \bar{Y}_i \right)$$

Where, $\bar{X}_i$ and $\bar{Y}$ refers to the individual means of each *i* cross section. This estimator is asymptotically biased and its distribution is dependent on nuisance parameter Pedroni (2000). To correct for endogeneity and serial collation, Pedroni (2000) has suggested for group mean FMOLS estimator that incorporates the Phillips & Hansen (1990) semi parametric correction to the OLS estimator to eliminate the bias due to the endogeneity of

the regressors. He also adjusts for the heterogeneity that is present in the dynamics underlying X and Y. The FMOLS statistic is:

$$\hat{\beta}_{i,FOLS} = N^{-1}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\left(X_{it}-\bar{X}_i\right)^2\right)^{-1}\left(\sum_{t=1}^{T}\left(X_{it}-\bar{X}_i\right)Y^*_{it}-T\hat{\gamma}_i\right)$$

where

$$Y^*_{it} = \left(X_{it}-\bar{X}_i\right)-\frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}}\Delta X_{it}$$

$$\hat{\gamma} = \hat{\Gamma}_{21i}+\hat{\Omega}^0_{21i}-\frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}}\left(\hat{\Gamma}_{22i}+\hat{\Omega}^0_{22i}\right)$$

where $\hat{\Omega}$ and $\hat{\Gamma}$ are covariance and sum of autocovariances obtained from the long run covariance matrix fro the model.

Panel Causality

To test for panel causality, the most widely used method in the literature is that proposed by Holtz-Eakin et al. (1988 and 1989). Their time-stationary VAR model is of the form:

$$Y_{it} = \alpha_0 + \sum_{j=1}^{m}\alpha_j Y_{it-j} + \sum_{j=1}^{m}\delta_j X_{it-j} + f_{yi} + u_{it}$$

$$X_{it} = \beta_0 + \sum_{j=1}^{m}\beta_j Y_{it-j} + \sum_{j=1}^{m}\gamma_j X_{it-j} + f_{xi} + \nu_{it}$$

where Y_{it} and X_{it} are the two co-integrated variables, i=1,...,N represents cross-sectional panel members, u_{it} and v_{it} are error terms. This model differs from the standard causality model in that it adds two terms, f_{xi} and f_{yi} which are individual fixed effects for the panel member i.

In the equations above, the lagged dependent variables are correlated with the error terms, including the fixed effects. Hence, OLS estimates of the above model will be biased. The remedy is to remove the fixed effects by differencing. The resulting model is:

$$\Delta Y_{it} = \sum_{j=1}^{m}\alpha_j \Delta Y_{it-j} + \sum_{j=1}^{m}\delta_j \Delta X_{it-j} + \Delta u_{it}$$

$$\Delta X_{it} = \sum_{j=1}^{m} \beta_j \Delta Y_{it-j} + \sum_{j=1}^{m} \gamma_j \Delta X_{it-j} + \Delta v_{it}$$

However, differencing introduces a simultaneity problem as lagged endogenous variables in the right hand side are correlated with the new differenced error term. In addition, heteroscedasticity is expected to be present because, in the panel data, heterogeneous errors might exist with different panel members. To deal with these problems, instrumental variable procedure is traditionally used in estimating the model, which produces consistent estimates of the parameters (Arellano & Bond (1991)**)**.

Assuming that the u_{it} and ν_{it} are serially uncorrelated, the second or more lagged values of Y_{it} and X_{it} may be used as instruments in the instrumental variable estimation (Easterly *et. al.*, 1997). Then, to test for the causality, the joint hypotheses $\delta_j = 0 \quad for\ j = 1,.....,m$ and $\beta_j = 0 \quad for\ j = 1,.....,m$ is simply tested.

The test statistics follow a Chi-squared distribution with (*k-m*) degrees of freedom. The variable *X* is said not to Granger-cause the variable *Y* if all the coefficients of lagged X in equations are not significantly different from zero, because it implies that the history of *X* does not improve the prediction of *Y*.

Results and Discussion:

It is well-known that to arrive at robust results, any analysis requires a stationary variable. Hence, there is a need to test the stationarity properties of the variables under consideration. Although there are many procedures that exist for testing the time series data, there are very few for testing the same in panel data. Here, we have used the panel unit root test proposed by Im, Pesaran and Shin (2003), which allows each panel member to have a different autoregressive parameter and short run dynamics under the alternative hypothesis of trend stationarity. Result of the individual series unit root test is reported in the table-3. Result of the panel unit root suggests that at level null of unit root is not rejected for all the series and, hence, all the series are non-stationary at their level with constant and trend term included in regression. We then test for a unit root in first differences. Here the alternative hypothesis is stationarity without a trend contrary to constant and trend in level series null, since any time trend in levels is removed by

differencing. When we use first differences, the test statistic is negative and significant for all the variables. This indicates that all the variables are difference stationary.

Table-3: Panel Unit Root Test Result

Variables	Period	Number of states	t- statistic(level)	t- statistic(difference)
SDP	1986- 2005	14	-1.7691	-4.8790*
BB	1986- 2005	14	-1.7134	-2.6605*
CDRUW	1986- 2005	14	-1.3595	-3.4899*
RSOC	1986- 2005	14	-2.2624	-4.2792*
RECO	1986- 2005	14	-3.2230	-5.6110*

NOTE: Based on Im-Pesaran-Shin (2003) Method. At level trend and constant both are included but for difference series only constant while testing the unit null in the series.
* indicates significant at 1% level of significance.

Now once the order of integration of the variables is determined and all the series are I(1) we have tested the presence of cointegration among the variables. Here we have used the panel cointegration developed by Pedroni (1999 and 2004), which gives a robust cointegration statistic even in the presence of bi-directional causality and heterogeneous cointegrating vectors that is supposed to be present in the infrastructure, finance and SDP variables. We have also tested cointegration with inclusion of trend and time dummy to capture any possible effect of common time specific effect on the relationship. This effect could be presence of business cycle, reforms or technological shocks. We have also tested the cointegration using different combination of infrastructure and financial development variables. Panel cointegration results are presented in tables 4, 4a and 4b. The results indicate presence of cointegration among the variables at 5 % level of significance as all the three combinations show at least provides four significant statistics. Results are significant for all the combination used to test the null of no cointegration.

Table – 4: Pedroni Panel Cointegration Test Result (SDP-Finance-Infrastructure)

TEST	TREND	TIME DUMMY	TREND AND TIME DUMMY
Panelν -stat	5.4468*	-0.3286	3.6476*
Panel ρ -stat	-0.2842	-0.0563	0.8179
Panel PP-stat	-11.3126*	-3.1068*	-4.8793*
Panel ADF-stat	-9.2979*	-2.0373*	-3.8012*
Group ρ -stat	1.5587	1.2775	2.3066
Group PP-stat	-12.1298*	-3.6725*	-5.6957*
Group ADF-stat	-8.5388*	-2.4245*	-4.6133*

Note: For V-Stat 5% Critical Value Is 1.645 and for rest of the statistics it is -1.645
* indicates significant at 5% level of significance

TABLE - 4a: Pedroni Panel Cointegration Test Result (SDP-Finance-Infrastructure without cdruw)

TEST	TREND	TIME DUMMY	TREND AND TIME DUMMY
Panelν -stat	4.1841*	0.2128	4.0110*
Panel ρ -stat	0.2084	-0.9501	-0.2183
Panel PP-stat	-4.1362*	-3.3706*	-4.9340*
Panel ADF-stat	-4.0222*	-2.7111*	-4.1480*
Group ρ -stat	1.8183	0.2329	1.2516
Group PP-stat	-5.3003*	-3.9140*	-5.5828*
Group ADF-stat	-4.4064*	-2.5684*	-4.8816*

Note: For V-Stat 5% Critical Value Is 1.645 and for rest of the statistics it is -1.645
* indicates significant at 5% level of significance

Table-4b: Pedroni Panel Cointegration Test Result (SDP-Finance-Infrastructure without BB)

TEST	TREND	TIME DUMMY	TREND AND TIME DUMMY
Panelν -stat	10.9354*	-0.1134	4.6893*
Panel ρ -stat	-1.8586*	-1.1008	-0.0703
Panel PP-stat	-8.4051*	-3.6368*	-4.7848*
Panel ADF-stat	-1.6737*	-2.3755*	-2.4302*
Group ρ -stat	1.1310	0.0101	1.3208
Group PP-stat	-6.8908*	-4.4634*	-5.5256*
Group ADF-stat	-2.7720*	-2.2406*	-3.5775*

Note: For V-Stat 5% Critical Value Is 1.645 and for rest of the statistics it is -1.645
* indicates significant at 5% level of significance

Once we have been able to establish long run relationship among SDP infrastructure and financial development variables, we now turn to quantify this relationship through estimating long run parameters using FMOLS technique for panel data again developed by Pedroni (2001). We have estimated long run coefficients for all the combination for which we have tested for cointegration. Additionally, we have also estimated the long run coefficient including time dummy in the regression to factor out effect of common time events on the estimated coefficients. Table ま5 reports the result of the FMOLS estimation. When we have estimated models without time dummy, model which includes all the variable shows that economic infrastructure is negatively affecting the SDP rest all other variables have positive effect and significant on the state output. But once we have introduced time dummy in the model effect of economic infrastructure also becomes positive and significant. Whereas in all other models inclusion of time dummy does not have any effect in sense that there is no sign change for any of the variables coefficient. It

is clearly evident that sizes of the coefficient have reduced once we have introduced the time dummy in the model. The effect social infrastructure is highest in the models i.e. return from expenditure on social infrastructure is highest in terms of output gain in the state income. Return from economic infrastructure and financial development shows a mix trend. Return from financial development is higher when we have used all the variables in the estimation but it is lower than that of economic infrastructure when we have used interchangeably bank branches and credit deposit ratio alone.

Table- 5: FMOLS Result Table (With Time Dummy)

VARIABLES	MODEL-1		MODEL-2		MODEL-3	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
RSOC	6.43	8.62*	10.7	13.36*	6.3	9.39*
RECO	1.03	2.17*	2.8	6.75*	1.61	3.42*
BB	0.12	6.27*			0.13	5.87*
CDRUW	1.82	4.61*	2.07	4.64*		
Without Time Dummy						
VARIABLES	MODEL-1		MODEL-2		MODEL-3	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
RSOC	10.07	18.08*	18.48	30.06*	10.73	17.46*
RECO	-0.11	4.91*	3.26	8.14*	0.89	5.61*
BB	0.23	16.18*			0.20	10.7*
CDRUW	1.21	6.45*	0.27	0.53		

Note: * indicates significant at 1% level of significance

Table- 6: Panel Causality Test Result

DIRECTION OF CASULITY	NO OF LAGS	t - STAT	F-STAT
RSOC → SDP	2	5.270*	6.987*
SDP → RSOC	2	3.947*	2.438**
RECO → SDP	1	5.770*	14.672*
SDP → RECO	1	3.167*	2.128**
BB → SDP	2	-0.740	1.076
SDP → BB	1	0.885	0.783
DCDR → SDP	2	5.934*	16.835*
SDP → CDR	2	-1.888**	4.787*

Note: ⇆ shows direction of causality
* and ** indicates significant at 1% and 5% level of significance respectively

Finally we have employed panel causality to see is any feedback relationship is present on not among the variable in the study. Result of the panel causality show there is bidirectional causality between social infrastructure and economic growth of the state.

Bidirectional causality also exists for physical infrastructure and economic growth at state level. Where as, there is some divergence in the causality test for financial development variable and SDP causality result. Here, causality happens to bidirectional only credit-deposit ratio but we failed to establish causal relation between number of bank branches and SDP in any direction.

Conclusions

In this paper, an attempt has been made to understand the trends in economic growth in the Indian states. Similar to many existing studies, this study also finds that in the post-reform process, while some of the states have benefited in terms of growth and seen a positive structural shift while many of the states have experienced negative shifts in their growth path. Further, the study tries to understand the determinants of this divergent growth in the states. In doing so, it tries to examine specifically whether divergences in the performance of two important factors in the production process, namely infrastructure and financial development, is contributing to this growth divergence.

Based on some simple cross-sectional regressions and with the help of panel estimates, the study finds that there is a high correlation of the extent of infrastructure and financial sector development with economic growth. Between the two, infrastructure (particularly the social infrastructure) appears to be highly correlated with growth compared to financial variables over a period of time. The cross sectional regressions also show a similar picture indicating that both the variables are important in the production process. But it is well known that the relationship between inputs and output is not contemporaneous, rather dynamic with lead-lag relation, and the cross sectional analysis does not take care of this aspect, panel analysis has been used.

The panel analysis suggests that there exist long run cointegration relationship, with various combinations, between infrastructure, financial development and economic growth. The long run coefficients, after adjusting for time, suggests that return to expenditure on health and education is higher compared to other variables. The results also suggest that although financial development in terms of number of bank branches is

necessary, it is the credit-deposit ratio (in other words the extent of business) that is important for the growth. This result raises doubts about the conclusion of some studies that use only number of bank branches as an indicator of financial development. But the causality results show that there exist bi-directional causality between infrastructure and economic growth while there is a unidirectional causality running from financial development to growth. This indicates that for social sector development rise in economic growth is also necessary, while in the case of financial sector development it is not. One policy conclusion that arises here is that financial development is necessary pre-condition for expansion in economic activity in the states. Hence, expansion in financial inclusion program should be taken in a priority basis to address the growth and divergence issues at the regional level in India. Here it is also necessary to be noted that just increase in bank branches or increase in bank accounts is not sufficient for enhancing financial inclusion. Recently some of the Districts in India have been declared to achieve full financial inclusion as all the households have atleast one bank account. But our results suggest that this may not be sufficient, although necessary. Instead, it is the extent of business and transactions that decide the extent of financial inclusion.

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Appendix: LS test methodology

Study uses the minimum LM based unit root tests of Lee and Strazicich (2003) hereafter LSみto identify the possible structural breaks in the time series of state domestic product at unidentified time. The LS test not only allows for endogenously multiple breaks in the series but it also gives information that whether these breaks are significant or not.
The LS test allows two break of three different kinds endogenously in the series these are as follows: The むrashめModel A allows for a one-time change in level; the むhanging growthめModel B allows for a change in trend slope; and Model C, which allows for a change in both the level and trend. Consider the data generating process (DGP) as follows to understand LS test for simplicity we will take single break model:

$$Y_t = dZ_t + e_t, \qquad e_t = be_{t-1} + \varepsilon_t \tag{A}$$

where Z_t is a vector of exogenous variables and ε_t ~ iid $N(0,\sigma^2)$. Now two structural breaks can be considered on the line of one structural break model as follows. Model A allows for two shifts in level compared to only one in the one break model and is described by $Z_t = [1, t, D_{1t}, D_{2t}]'$, where $D_{jt} = 1$ for $t \geq T_{Bj} + 1$, $j=1,2$, and zero otherwise. T_{Bj} denotes the time period when a break occurs. Model C includes two changes in level and trend and is described by $Z_t = [1, t, D_{1t}, D_{2t}, DT_{1t}, DT_{2t}]'$, where $DT_{jt} = t$ for $t \geq T_{Bj} + 1$, $j=1,$ 2, and zero otherwise. Note that the DGP includes breaks under the null (b = 1) and alternative (b < 1) hypothesis in a consistent manner. For instance, in Model A (a similar argument can be applied to Model C), depending on the value of b, we have:

$$H_o: \; y_t = \mu_o + d_1 B_{1t} + d_2 B_{2t} + y_{t-1} + v_{1t} \tag{B}$$

$$H_1: \; y_t = \mu_1 + \gamma\, t + d_1 D_{1t} + d_2 D_{2t} + y_{t-1} + v_{2t} \tag{C}$$

where v_{1t} and v_{2t} are stationary error terms, $B_{jt} = 1$ for $t = T_{Bj} + 1$, $j=1,2$, and zero otherwise, and $d = (d_1, d_2)'$. In Model C, D_{jt} terms are added to equation B, and DT_{jt} terms to equation C, respectively. Note that the null model in the equation B includes dummy variables B_{jt}.