REGIONAL INEQUALITIES IN INDUSTRIAL DEVELOPMENT IN INDIA

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MASTER OF PHILOSOPHY

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DECLARATION

I, **Kanika Bhatnagar**, declare that the dissertation entitled "Regional Inequalities in Industrial Development in India" submitted by me for the award of the degree of Master of Philosophy of Jawaharlal Nehru University is my bonafide work. The dissertation has not been submitted for any other degree of this university or any other university.

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Above all, I convey my prayer to the Almighty for all His blessings.

KANIKA BHATNAGAR

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Abbreviations

ASI	Annual Survey of Industry
CSO	Central Statistical Organization
CV	Coefficient of Variation
GSDP	Gross State Domestic Product
OLS	Ordinary Least Squares
SEB	State Electricity Board
TFP	Total Factor Productivity
TI	Theil's Index

Chapter-1: Introduction and Review of Literature

1.1 Introduction:

Since the early 1950s up until the early 1980s the evolution of India's manufacturing sector was guided by industrial and trade policies that protected domestic industry and gave the union government the ultimate say in investment decisions. In 1948, government introduced the Industrial Policy Resolution which outlined the approach to industrial growth and development. It emphasized the importance to the economy of securing a continuous increase in production and ensuring its equitable distribution. The industrial policy was then revised again in 1956 and was redesigned to focus on accelerating industrial growth as a means of achieving socialist pattern of society (Bhargava, 1995 and Ahluwalia, 2002). The policy was changed yet again in 1973, 1977 and 1980 suiting to changing industrial scenes in the country but stopping short of recognizing the elephant in the room- restrictive regulations and excessive centralization of industrial policy were tightening the noose around the manufacturing sector.

The government, building on the concept of controlling rather than regulating the economy, introduced such policies that resulted in Indian economy being weighed down by a strict regime of import-export controls and industrial licensing. For instance as per the Industries Development and Regulatory Act of 1951, every investor over a very small size needed to obtain a license before establishing an industrial plant, adding a new product line to an existing plant, substantially expanding output, or changing a plant's location. However all this changed once the 1991 reforms were implemented aiming to liberalize the Indian economy. Specifically, the industrial policy was restructured and most of the central government industrial controls were dismantled. Massive deregulation of the industrial sector was done in order to bring in the element of competition and increase efficiency. Industrial licensing by the central government was abolished barring a few hazardous and environmentally sensitive industries. The list of industries reserved solely for the public sector -- which used to cover 18 industries, including iron and steel, heavy plant and machinery, telecommunications and telecom equipment, mining, air transport services and electricity generation and distribution was drastically reduced to three:

defense aircrafts and warships, atomic energy generation, and railway transport. Further, restrictions that existed on the import of foreign technology were withdrawn (Panagariya, 2006).

Since then, the markets have exponentially expanded, entrepreneurial activity has kick-off, per capita incomes have risen and the economic opportunities in general have multiplied. However, the picture is not as rosy as one might conceive it to be. Widespread inequalities in incomes between Indian states have generally been a point of major concern. Reduction of regional inequalities have had always been a policy imperative featuring in spirit in all five year plans of India. However, India could never really bridge the gap between the states in either economic or social indicators of growth. In this regard Williamson (1965), noted that the regions within nations do not typically possess equal capacity for growth, and when development begins in few regions, regional barriers may be too great to effectively the growth stimulus to other less fortunate regions. As long as the barriers to trade and factor flows (as well as communication of technological change) persist, regional inequality will clearly increase.

Myrdal (1957) and Kaldor (1970) believed that the basic forces at work in early stages of economic development are dis-equilibrating in nature. Although Myrdal (1957) recognized that the spread effects usually become stronger as a nation develops he also opined that the backwash effects are stronger than the spread effects. Even Hirschman (1959) believed that the polarization effects are stronger than the trickling-down effects in the earlier stages of development of a nation. However following in the footsteps of Solow's growth model, the neo-classical school of thought made the observation that given two countries, the country with lower per capita capital stock, hence lower per capita income, will grow at a faster rate. However, over a period of time the two countries would converge in terms of their per capita income levels as well as the growth rates which are assumed to be the same in the long run. Therefore after controlling for parameters such as saving rates and population growth rates, poorer countries will tend to grow faster and hence will catch up, converge to the levels of well-being enjoyed by their richer counterparts.

Indian states are heterogeneous and have a unique character of their own. The policy dialogue has undergone a shift from being centrally dictated to being largely state-led. Policy change and policy hindrance in regard to industrial development therefore needs to be analyzed at state-level.Therefore it needs to be analyzed whether in the post-reform period the industrial per capita state domestic product has converged or diverged across the Indian states. In this regard, many studies (some of which have been covered in the literature review) have time and again opined that Indian states have been suffering from wide inequalities in economic activity even after the 1991 reforms.

Studies in India have focused on the presence of convergence or divergence of per capita state domestic product across Indian states covering few years of the post-reform period and have piled on an overwhelming evidence of diverging incomes across Indian states over different time periods (Dhar and Sastry, 1969; Awasthi, 1991; Mitra and Marjit, 1996; Bajpai and Sachs, 1996; Kaliranjan et al., 1999; Bhattacharya and Sakhtivel, 2004; and Nair, 2004). Only one study however, by Jena et al. (2011) analyzed the convergence hypothesis for the industrial incomes across Indian states. However this study covered the period 1980-81 to 2008-09 and tested the static measures of convergence. Also, studies that have tested the convergence hypothesis for incomes across Indian states have either just focused on sigma convergence, have used cross sectional data to test the beta convergence or simply employed the fixed effects model to test for beta convergence for panel data. The aforementioned empirical methodology has been widely deemed to be insufficient, giving in inaccurate results.

It has been well accepted that for economic growth it is required that the factors of production such as capital and labour be used efficiently which is often referred to as productivity. Numerous studies have highlighted the importance of Total Factor Productivity (TFP) in context of economic growth (Virmani, 2004; Baier et al., 2005; Reddy, 2006 etc). The analysis of TFP is essential to study the extent and speed of industrial progress, since the TFP patterns reflect the micro-capabilities of the industrial units. To shed some light on the extent of inequalities in industrial growth across Indian states convergence hypothesis for total factor productivity levels will have to be tested. There is extensive literature present on TFP growth trends in India's registered manufacturing sector. However, there have been fewer studies estimating aggregate

TFP and almost negligible research in determination of whether TFP in registered manufacturing across major states has been converging or diverging. Mitra et al. (1998), Coondoo and Neogi (1998), Ray (2002) and Kumar (2006) are the few studies which have investigated the convergence hypothesis for TFP at mostly disaggregated levels. The latest time period extends till 2000 in one of the studies thus leaving a lot of time period to be covered. Also, the analysis at an aggregate industry level needs to be conducted to obtain a holistic picture of the sector across India.

Other very important question that comes up is that what exactly determines industrial development in Indian states. The 1991 reforms and the subsequent decentralization of policy making power to the Indian states haven't been able to pump up industrial growth in many of the Indian states. Also, central grants and industry specific programs haven't been able to generate growth in the sector in many Indian states. What can be the explanation?

The neoclassical growth models, as constructed by Solow (1956), Cass (1965) and Koopmans (1965), explain the differences in income per capita in terms of different paths of factor accumulation. The cross-country differences in factor accumulation according to the neo-classical school of thought are due to either differences in saving rates, preferences, or other exogenous parameters, such as total factor productivity growth (Acemoglu et al., 2004). Unfortunately for these theories, empirical evidence hasn't been able to support the predictions. According to Knack (2006), poor countries have grown slower than the richer nations since 1960. The endogenous growth theories on the other hand, following Romer (1986) and Lucas (1988) came up to fill in the gaps left by the neo classical theories. According to endogenous growth theory, externalities associated with investments in tangible or human capital allow for non-decreasing returns, explaining why rich countries can grow as fast or faster than poor countries. Therefore, this theory endogenizes steady-state growth and technical progress but their explanation for income differences is similar to that of the neo-classical models. Also Olson and Kähkönen (2000) points out that fastest growing countries at any point in time are never those with the highest per capita incomes, but are always a subset of the lower-income countries.

However as North (1990) rightly proclaimed that factor accumulation, innovation and TFP growth are not causes of growth; they are growth. The deep or fundamental determinant of economic growth has been identified to be quality of institutions. Institutions can be defined as the "rules of the game in a society or, more formally the humanly devised constraints that shape human interaction. In consequence they structure incentives in human exchange, whether political, social, or economic". Institutions matter for economic growth as they shape the incentive structure and wealth maximizing opportunities of economic agents (individuals and organizations) in the society thus influencing the investments in physical and human capital, technology and organization of production. Ahluwalia (2002) noted that the overall policy environment and quality of governance are important factors determining the growth potential of a state. General Law and Order conditions in a nation or a state are also reflection of the quality of governance. Quality of institutions has a significant impact on the level of private investment and entrepreneurial activity in the economy.

From this discussion it follows that there is a need to test the convergence hypothesis of per capita industry gross state domestic product and total factor productivity levels across major Indian states in the post-reform period (after 1991). This will aid in understanding whether the inequalities have reduced or risen across India in industrial sector. It also follows that neo classical and endogenous growth theories have failed dismally to explain the factors affecting growth in general and growth in industry. These cannot be applied to India's case to obtain accurate results. Hence, it is essential from the policy maker's point of view to understand the various factors that affect the industrial development in an Indian state.

1.2 Literature Review:

This section will give a detailed review of studies undertaken to test the convergence hypothesis for per capita incomes and total factor productivity as well determinants of industrial growth. An understanding of previous studies and their methodologies is necessary to gain a perspective on the topic and to realize that a fresh approach is required to study the regional disparities in industrialization in Indian states.

1.2.1 **Convergence of Per Capita Income:**

Inter-regional disparities have always been a major policy concern for the government. This led the government to establish central public sector undertakings in less industrially developed states, use of "backwardness" of regions as a criterion in industrial licensing, special packages for development of industrial infrastructure in poorer states, and special fiscal and financial incentives for industrial development in backward regions (Papola et al. 2011). However, in the post-reform period (after 1991-92) majority of such policies were discarded to provide a level playing field to all states. It was left to states to compete for investment and to facilitate industrial growth and employment, on their own. Therefore an important question that arises here is that whether the inter-regional disparities in industrial growth have subsided in the post-reform period or not.

Innumerable studies have been undertaken to inquire whether regional incomes have converged or diverged over a period of time. These studies are based on different databases, have used a variety of indicators and methodologies and have covered different time periods. Some of these studies are pertinent to the research objective of this thesis, which is to test the convergence hypothesis for the Industry State Domestic Product across 14 major states.

The first such important study was by Dhar and Sastry (1969), in which they studied inter-state variations in industry and reached the conclusion that regional disparities were reducing. The period covered by them was 1951 to 1961 and the indicator used to measure the industrial growth was Power Consumption. According to the study, power consumption is an indicator of capital intensity and degree of mechanization in the industry in a particular state. Two statistical techniques were employed to determine the presence of convergence or divergence of regional industrial inequalities. Firstly, Coefficient of Variation, a measure of relative dispersion was employed and secondly, shift analysis was conducted.[1]Both measures found that the industrial inequalities in both total and industrial power consumption on an absolute and per capita basis had gone down over the period 1951 to 1966 implying converging regional industrial inequalities. The study also noted that states of Maharashtra and West Bengal were

[1]According to Dhar and Sastry (1969), Shift Analysis isorganising data in order to measure regional growth or decline in terms of relative gains and losses among the States with regard to a given variable in comparison to national figure.

losing ground in the manufacturing sector while states of Punjab, Orissa, Madhya Pradesh and Andhra Pradesh, traditionally backward in this sector, were growing and narrowing the regional inequalities.

However, Mathur (1983) in his research on spatial economic inequalities in India during 1950-51 to 1975-76 reached a different conclusion. The indicators chosen for investigation of regional economic disparities were terms of per capita state domestic product (SDP) and Index of economic diversification. The study then analyzed the trends by estimating the weighted coefficients of variation in regional per capita SDP and shift analysis. The conclusion was that initially there was a narrowing down of regional inequalities and then a reverse trend was observed. The study found a broadly U shaped aggregate behavior of regional inequalities.

Awasthi (1991) in his study covering almost the same period reached a similar conclusion that regional industrial inequalities had converged over the period 1961 to 1978. However the study employed the value added, employment and fixed capital variables in the manufacturing sector to inquire into the presence or absence of regional inequalities. The author employed Thiel's inequality index, Gini coefficient, coefficient of variation, (weighted and unweighted) variance and Hirschman-Herfindahl index to measure the regional industrial inequalities. Further, to determine the trend of regional industrial inequalities over a period of time, the regression equations with time variable ('t') and its square as the independent variables and various indices as dependent variables are determined. This empirical exercise yielded a significant negative relation between time variable ('t') and all inequality indices implying that the regional industrial inequalities had converged for the time period in question.

Similarly, Bajpai and Sachs (1996), in their study panning a longer timeline of 1961 to 1993 found no evidence of convergence in regional per capita income. The study divided the timeline into three separate periods; first period (1961 to 1971), second period (1972 to 1982) and third period (1983 to 1993). It focused on both sigma and Beta convergence. For testing the former, they plotted the standard deviation of log of real per capita SDP and for testing the latter, they regressed proportionate growth in per capita SDP on the initial level of per capita SDP. For both the tests of convergence, the first period was confirmed to have witnessed convergence in regional disparities, while the second period witnessed divergence of real per capita SDP, implying increasing regional inequalities in the period 1972 to 1982. However, the third period did not witness any significant change in regional inequalities. It was noted that in the period, 1983 to 1993, some of the lagging states like Madhya Pradesh, Tripura, Assam and Karnataka, growth picked up and in the states which had experienced growth in the previous periods didn't see long term growth rates picking up.

Study by Mitra and Marjit (1996) focused on the period 1961-62 to 1989-90 with the objective of determining whether there had been convergence between Indian states in terms of per capita SDP. The study plotted the deviation from average growth rate of per capita net SDP against the ratio of base period per capita net SDP for each state to the average of per capita net SDP. A clear negative relationship between the previously mentioned two variables was clearly observed and it was concluded that Indian states have been diverging and that the strong states were growing stronger.

A study by Kaliranjan et al. (1999) covering the period 1960-61 to 1994-95 concluded that divergence had occurred in per capita SDP across Indian states over the time period in question. This finding was based on results obtained from estimating the unconditional convergence equation. Similar results were obtained on estimating conditional convergence equations with separate control variables; share of primary sector's income in per capita SDP (to control for exogenous shocks caused by fluctuations in agricultural output) and standardized measure of sectoral composition (to minimize inter-state differences in steady states).[2] Measure of dispersion, standard deviation was also estimated for the per capita SDP for the period 1965-66 to 1994-95. It turned out to be consistently rising in the said time period, reiterating the same result that there has been overall divergence in per capita SDP across Indian states.

Further, Bhattacharya and Sakhtivel (2004) concluded for the period extending from 1990-91 to 1999-2000 that the regional disparities had widened in terms of SDP growth rate and per

[2] Standardized measure of sectoral composition has been described in the paper as;

$$S_{i,t} = \sum_{j=1}^{3} Wij,t-T \quad \log(y_{j,t}/y_{j,t-1})$$

Where, $W_{ij,t-1}$= Weight of sector j in SDP of state I at time t-T

y_{jt}= All-state average SDP in sector j in time t expressed as ratio of national population in time t capita SDP. The coefficient of variation for each year across Indian states was studied and it was noticed that the statistic rose consistently over time. However the study also noted that the rise in the coefficient of variation did not necessarily imply a lack of convergence. To test convergence, it is required to estimate the marginal impact of initial levels of income (negative value would imply convergence) on subsequent periods of growth after including control variables which take into account the impact of different factors of growth, such as capital, labour, technology, etc. Bhattacharya and Sakhtivel (2004) also concluded that the states which had experienced higher growth rates of SDP in 1980s continued experiencing higher growth rates, implying no convergence.

Nair (2004) covered the pre-reform period of 1980 to 1993 and the post-reform period of 1994 to 1999. The study concluded that even though there had been convergence in the per capita value added in registered manufacturing in pre-reform period, no significant change occurred in the post-reform period implying neither convergence or divergence occurred.

Lastly, Jena et al. (2011) in their study on Industrialization in India focused on analyzing the inter-state variations in industrialization. The indicators studied were share of manufacturing in gross SDP, standard deviation and coefficient of variation of growth rates of gross manufacturing SDP. It was found that the standard deviation had declined in the period 1980-81 to 2008-09. However the coefficient of variation rose from 33% during 1981-91 to 36% in the period from 2000-01 to 2008-09. It was concluded that in the post-reform period the tendency of divergence had risen in growth rates of gross manufacturing SDP.

Therefore, from the literature review so far it can be concluded that in the period extending from 1950-51 to 1970-71, convergence of regional inequalities might have occurred. However, in the period beyond 1970s, especially in the post reform period (after the 1990-91 economic and financial reforms), divergence in regional inequalities has been observed.

1.2.2 **Convergence of Total Factor Productivity:**

Numerous studies have highlighted the importance of Total Factor Productivity (TFP) in context of economic growth (Virmani, 2004; Baier et al., 2005; Reddy, 2006 etc). Further, there is extensive literature present on TFP growth trends in India's registered manufacturing sector. However, there have been fewer studies estimating aggregate TFP and almost negligible research in determination of whether TFP in registered manufacturing across major states has been converging or diverging.

To start with, Total Factor Productivitymeasures the increase inefficiency with which resources are being used throughinnovations and improved management techniques toincrease the output from a given combination of capitaland labour. It can also be defined as the ratio of output to a weighted combination of inputs or can also be defined as the rate of transformation of inputs into output. According to Ahluwalia (1991), growth in TFP would incorporate a shift towards usage of improved machines, improved training and experience (implying a change in the quality of labour), better organizational skills, better labour-management skills and might also reflect the better utilization of existing capacities (p. 34). The analysis of TFP throws light on the extent and speed of economic progress, since the TFP patterns reflect the micro-capabilities of the industrial units.

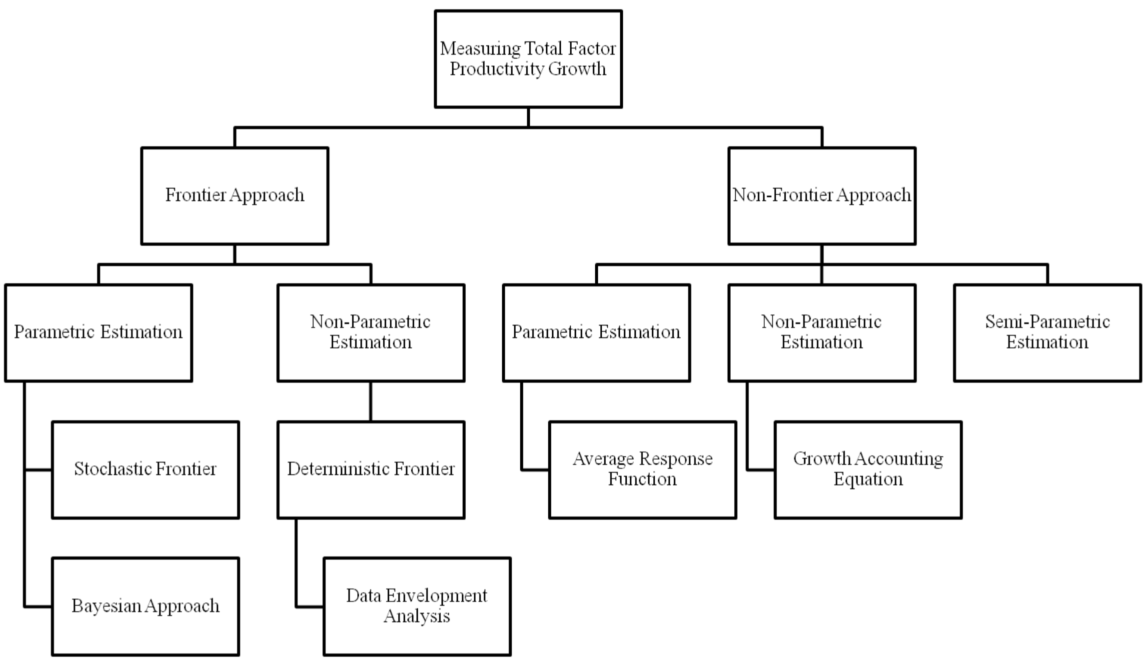
There are several studies on computation of TFP levels and growth rates using a plethora of methodologies. Figure 1.1 gives a clear picture of the methodologies at the disposal of a researcher to calculate TFP. There are two main categories; Frontier and Non-Frontier Approach. Most of the Indian studies have used Non-Frontier approach with the more recent ones emphasizing on parametric approach.[3] Non-Frontier approach is more suitable when considering unit level disaggregated data for the industry. Further, both the frontier and the non-frontier approaches are sub-divided further into parametric and non-parametric methods. The parametric method has to work with a specific production function and the TFP levels are estimated econometrically using the sample data on inputs and output implying that the accuracy of the TFP estimates depends on the functional form used. Therefore, it is relatively better to employ the non-parametric approach which doesn't assume any specific functional

[3]Kathuria et al.(2013) further explained the distinction between the two approaches. Frontier approach determines"the role of technical efficiency in overallfirm performance, whereas the non-frontier approach assumes that firms are technically efficient. This difference results in different interpretation for TFP growth for the two approaches. The TFP growth as obtained from frontier approach consist of two components - outward shifts of the production function resulting from technological progress, and technical efficiency related to the movements towards the production frontier. On the other hand the non-frontier approach considers technological progress as a measure of TFP growth" (p.152).

form. However, a negative point in using non-parametric approach is that the estimates can't be validated using standard statistical tests.

Further, there are three forms of production functions that are used; Cobb Douglas production function, constant elasticity substitution production function and transcendental logarithmic production function. Whereas the growth accounting approach involves the separation of change in production on account of change in the quantity of factors of production from residual influences, viz., technological progress, learning by doing, managerial efficiency, etc TFP growth proxies these residual influences Trivedi et al. (2000).

Figure 1.1: Methods of Calculating Total Factor Productivity



Source: Author's Illustration

The three main indices used under the growth accounting approach are; Kendrick Index, Solow Index and Translog Index. The Translog Index was explained by Ahluwalia (1991) in the following words: "The 'superlative' index of productivity change that is consistent with the 'flexible' production function can be applied to discrete data points. A 'flexible' functional form for which the Tornquist discrete approximation is exact, is the Translog (transcendental logarithmic) production function. It not only naturally accommodates the discrete time analysis, but also imposes fewer a priori restrictions on the underlying technology of production". The index doesn't make rigid assumptions about the elasticity of substitution between factors of production, doesn't require the assumption of Hick's neutrality but it is defined by the assumptions of competitive markets, factors of production get paid their marginal products and constant returns to scale.

Another issue that comes up while estimating TFP is whether to use gross output or value added as the measure of output. The proponents of gross output present the argument that the value added estimates of TFP present a distorted picture (as they don't include the prices of raw materials in cost of production and technology) and that they inflate the TFP levels. However, usually value added is preferable as the concept is useful to avoid double counting of intermediate inputs in national income, allows comparison of firms using heterogeneous raw materials and usage of gross output leads to an inclusion of raw materials which might diminish the role of capital and labour productivity growth. Most of the Indian studies have employed the Growth Accounting framework and the Cobb-Douglas production function to estimate TFP growth rates.

Balakrishnan and Pushpangadan (1994) used real value added as the measure of output from the Annual Survey Industries (ASI) database and employed both the single deflation and double deflation method to deflate the series of output and inputs. Single Deflation method involves deflating both the output and input series by the Wholesale Price Index for manufactured products. However, this study pioneered the usage of double deflation method which involves deflating the input series by a price index of raw materials. This input price index is constructed as the weighted average of the Wholesale Price Index of food products, non-food crops, minerals, and fuel and power. The weights are derived from the input-output table for a base year. Double Deflation method is critical if the input prices relative to output prices fluctuate then the TFP measure would (ceteris paribus) vary inversely. The authors employed the Divisia-Tornqvist approximation (Growth Accounting Framework) for the computation of TFP growth rates for India.

Similarly Trivedi (2004) focused on the analysis of inter-state differences in productivity levels and growth rates for specific industry groups during 1980-81 to 2000-01. The study employed both the Growth Accounting Framework and Production Function approach to compute TFP levels and growth rates. In case of Growth Accounting Framework the Divisia-Tornqvist approximation was used and instead of value added, gross output was used in the study. The study found evidence of a deceleration in TFP growth in most of the industries in the post-reform period. Also, it was concluded that inter-state differentials in TFP had widened for all the industries.

Goldar (1986) determined TFP growth rates for the aggregate Indian manufacturing sector using Cobb Douglas Production Function methodology and Divisia-Tornqvist approximation. He concluded that the computed TFP grew at an annual growth rate of 1.3% for the manufacturing sector in the period 1951-65. Measures of Partial or Single Productivity were also computed and it was found that while labour productivity and capital intensity showed a significant rising trend, capital productivity recorded a significant declining trend.[4] This result pointed towards a gradual process of capital deepening in the manufacturing sector in the period 1951-65. In his later work, Goldar (2004) again employed the Divisia-Tornqvist approximation to compute TFP growth rates for the period 1979-80 to 1990-91 and 1991-92 to 1997-98. It was concluded that the post-reform period (after 1990-91) experienced a decline in the TFP growth.

Besides these, Jayadevan (1996), Krishna and Mitra (1998), Pradhan and Barik (1998),Ray (2002), Aghion (2003), Veeramani and Goldar (2005),Goldar and Mitra (2008) etc., have estimated TFPG/TFP levels using aggregated/disaggregated data to investigate trends and determinants of TFP in Indian Industry.

However, very few studies have so far investigated into the presence or absence of phenomenon of convergence in industry across Indian states. However, Mitra et al. (1998) did venture into this unexplored territory in their study. The study firstly, estimated TFP levels for 15 Indian states using 2-digit NIC classification of Industrial units over the period 1976 to 1992. Secondly, conditional convergence equation was estimated in which the dependent variable was growth rate of TFP and the independent variables were lagged (by one year) TFP level as well as a composite Infrastructure Index. The study found evidence of conditional

[4] Partial or Single Productivity is defined as the ratio of volume of output to the quantity of the factor of production (labour, capital etc) for which the productivity measure has to be computed.

convergence of TFP across Indian states. It also concluded that Infrastructure development has had a positive impact on long-run TFP levels of Indian manufacturing industrial units.

However, Coondoo and Neogi (1998) did not find any presence of regional convergence or divergence in the period 1974-75 to 1988-89 in the Indian manufacturing sector. The study divided India into four regions- Northern region (Haryana, Himachal Pradesh, Punjab and Uttar Pradesh), Western Region (Gujarat, Madhya Pradesh, Maharashtra and Rajasthan), Eastern Region(Assam, Bihar, Orissa and West Bengal) and Southern Region (Andhra Pradesh, Karnataka, Kerala and Tamil Nadu). To detect the presence of a stochastic trend in the time series of indices the unit root testing procedure proposed by Levine and Lin (1992) was employed. The study concluded on the basis of this test that no significant stochastic trend was present and that inter-regional divergence in the aggregate TFP growth rates were transient in nature. Secondly, to test whether the TFP indices for the four regions showed any tendency to converge, the study constructed ratios of TFP indices of regions to TFP index for India over the said time period. The rationale was that if the region showed a tendency to diverge away from the all-India measure of aggregate TFP level then the ratio so constructed will have an increasing or decreasing time trend. These ratios were then plotted and it was observed that initially the time series for all four regions showed a mild declining trend but towards the end they all tapered to unity. Therefore, no clear picture of convergence or divergence of aggregate TFP growth could be drawn from the study.

Ray (2002) covered the time period 1986-87 to 1995-96 in his study comparing the trends of TFP and technical efficiency pre and post reform period (before and after the year 1990-91) in the Indian industry. The non parametric Malmquist and Tornqvist indices were used to compute TFP growth rates while Data Envelopment Analysis was used to compute technical efficiency for each of the states. On estimating a conditional convergence equation with independent variables as average capital-labour ratio, percentage of urban population, literacy rate and composite index of physical infrastructure development and pre-reform productivity growth rate and the dependent variable is the Malmquist growth rate for different states. It was found that the states with higher capital-labour ratio and higher percentage of urban population experienced a considerable rise in productivity growth rates after reforms. It was also concluded that there was a tendency of convergence of TFP growth rates across Indian states implying that states possessing higher TFP growth rate would experience lower rate of further improvement in TFP.

Kumar (2006) also found in his study that there was a tendency for the Indian states to converge in terms of TFP growth rates in the post-reform period for the aggregate Indian industry. The study covered the time period 1982-83 to 2000-01, focused on 15 Indian states and employed non-parametric Malmquist Index approach to compute TFP growth rates. The study found widespread regional variations in productivity changes in the specified period. Also, while only 9 out of 15 states had experienced productivity improvement in pre-reform period (before 1990-91) about 11 out of 15 states experienced improvement in the post-reform period. Therefore, the study concluded that the variations in TFP growth declined in the post-reform period and a tendency to converge in terms of TFP growth rates across Indian states was observed.

Besides the aforementioned studies focusing on the convergence or lack of convergence of TFP in the Indian Industry, there are several cross-national and cross-regional studies inquiring the same. Miller and Upadhyay (2002) in their study on presence or absence of convergence of aggregate TFP and Gross Domestic Product per worker in a pool of 83 developed and developing nations covered a time period of 1960 to 1989. The study employed the traditional Cobb Douglas production function approach to compute TFP levels. The study found strong evidence of absolute and conditional convergence of TFP across nations, especially among low and middle-income nations. This was taken to imply that technological convergence is an important phenomenon in the world.

Whereas, Leonida et al. (2004) in their study on testing the convergence hypothesis for aggregate TFP across Italian regions found evidence of divergence. The study computed the Malmquist productivity indices for a period of 1970 to 1995 for 20 Italian regions. Another study by Mukherjee and Kuroda (2003) launched an inquiry into the presence or absence of convergence in TFP in Indian agricultural sector (including output of thirty crops and three major livestock products). The Tornqvist-Theil Index for TFP growth was computed covering the time period from 1973 to 1993. The authors noted wide variation in the TFP growth rates across regions in India but still found evidence of long run convergence tendency.

Therefore, from the limited literature present on the testing of convergence hypothesis for TFP in industry across Indian states, it can be gleaned that the post-reform period (after 1990-91) there has been evidence of convergence in TFP. However, the aforementioned studies have taken a time period of at most 9 years in the post-reform period to test the hypothesis. Kumar (2006) had taken a period of 9 years and Ray (2002) took a time period of 5 years. Such a short time period might not present the true picture. This thesis will further build on this literature to test for the convergence hypothesis for TFP in industry across Indian states in the post-reform period.

1.2.3 **Quality of Institutions and Economic Growth**

Traditionally the neoclassical growth models, as constructed by Solow (1956), Cass (1965) and Koopmans (1965), explain the differences in income per capita in terms of different paths of factor accumulation. The cross-country differences in factor accumulation according to the neo-classical school of thought are due to either differences in saving rates, preferences, or other exogenous parameters, such as total factor productivity growth (Acemoglu et al., 2004). The endogenous growth theories on the other hand, following Romer (1986) and Lucas (1988), endogenize steady-state growth and technical progress but their explanation for income differences is similar to that of the neo-classical models.

These models have at best managed to enlighten the mechanics and patterns of economic growth but haven't been able to isolate the fundamental determinants of growth. They haven't been successful in explaining the development experience in developing and less developed nations and haven't been of much help in providing a practical guide for maintaining sustained economic growth. In this regard, North and Thomas (quoted by Acemoglu et al., 2004) noted that "the factors we have listed (innovation, economies of scale, education, capital accumulation etc.) are not causes of growth; they are growth". Thereafter, it has been accepted that factor accumulation and innovation are only proximate causes of growth. The fundamental or deep determinants of growth have been identified to be institutions, geography and openness to trade. However, most of the empirical studies like that of Acemoglu (2001, 2002 and 2003), Rodrik (1999), Hall and Jones (1999) and Mauro (1995) have reached a conclusion that only stronger institutional quality leads to a higher per capita income.

Health, population growth, food productivity and mobility of factors of production are factors influenced by differences in soil, climate and resource endowment, the simple characteristics of geography, thus affecting long term economic growth. One would expect resource-rich countries to perform relatively better and experience faster growth in comparison to those countries that are resource-poor. However, studies by Auty (1990), Gelb (1988), Sachs and Warner (1995, 1999, 2001), among others, concluded that resource-poor countries grew two to three times faster than resource-rich countries between 1960 and 1990, even after adjusting for differences in population, initial per capita income and other variables.

Openness to trade is argued to be another deep determinant of economic growth. Directly, openness to trade can increase the per capita income of an economy through comparative advantage in export of goods and services while indirectly, it can lead to technology transfer, increase in economies of scale and expansion of market, thus influencing economic growth. Barro and Sala-i-Martin (1995), Sachs and Warner (1995), Greenaway and Morgan (1998), and Vamvakidis (1998) are only some of the studies that using cross-country regressions found evidence that trade distortions caused by government intervention lead to slow growth rates. The success of the high-performing South Eastern Asian economies (Hong Kong, Korea, Singapore and Taiwan) and China provides a strong argument for export-led growth. However studies by Rodriguez and Rodrik (1999) and Levine and Renelt (1992) show that empirical evidence supporting openness to trade as a significant determinant of growth is at best circumstantial and the direct effect of openness to trade on growth is not robust. Openness, it is argued, only has an indirect effect on growth through higher investment. Therefore, geography and openness to trade might come out to be necessary but not sufficient factors to determine economic growth.

Institutions can be defined as the "rules of the game in a society or, more formally the humanly devised constraints that shape human interaction. In consequence they structure incentives in human exchange, whether political, social, or economic" (North, 1990). Institutions matter for economic growth as they shape the incentive structure and wealth maximizing opportunities of economic agents (individuals and organizations) in the society thus influencing the investments in physical and human capital, technology and organization of production. Structure of markets is endogenous, and partly determined by property rights. Once individuals have secure property rights and there is equality of opportunity, the incentives to create and improve markets gradually come up. Thus differences in markets are borne out of differing systems of property rights and political institutions.

Institutions are deemed weak when the rules are absent or poorly enforced or are sub-optimal. After all, resources are required not only to measure the attributes of a good or service involved in an economic exchange but also to define the rights that are transferred via the exchange and to protect these rights by policing and enforcing agreements. Aron (1998) notes in this regard that more complex is the exchange the more costly are the institutions. When the costs are prohibitive there is no motivation for defining the ownership rights or changing the rules. It can also be the case that even if rules do exist then they might turn out to be counterproductive (excessive import controls, for instance). Also it might be that even in the presence of useful rules appropriate enforcement might not take place if the costs of monitoring and enforcement are too high. Weak institutions, it is contended, reduce the efficiency of investment in the economy. Directly, these might reduce the efficiency of present stock of capital and indirectly, through increased transaction costs and bribery, they have an adverse effect on the investment function.

Market economy is therefore embedded in a set of non-market institutions. However, not all the non-market institutions serve the interests of markets as they can produce outcomes that are socially and economically undesirable and restrict the free play of market forces in pursuit of a larger goal, such as social stability and cohesiveness. Rodrik (1999) gave a brief description of five types of market-supporting institutions:

a. **Property Rights:**Secure and stable property rights are one of the major factors that have contributed to economic growth in Industrialized nations. An entrepreneur would not have the incentive to accumulate and innovate unless he has adequate control over the return to the assets that are thereby produced or improved. However, property right isn't just about a piece of legislation, but also involves provision of secure control rights which are upheld by customs, legislation and private enforcement.

b. **Regulatory Institutions:** Markets fail when participants engage in fraudulent activities, when prohibitive transaction costs don't let internalization of technological and other non-pecuniary externalities as well as when incomplete information results in moral hazard and adverse selection. Every successful market economy is overseen by a plethora of regulatory institutions, regulating conduct in goods, services, labor, asset, and financial markets.

c. **Institutions for Macroeconomic Stabilization:** Institutions like the central bank are concerned with whether the fiscal and monetary policies so adopted are able to smoothen the volatility in business cycle.

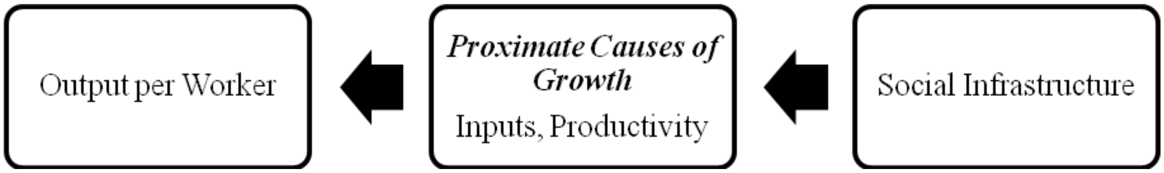
d. **Institutions for Social Insurance:** In the modern economy there is a lack of traditional risk-sharing institutions like the joint family, church or temple and village hierarchy. Besides taking the form of transfer programs that are paid out of fiscal resources, social insurance can be provided through a combination of enterprise practices (such as lifetime employment and enterprise-provided social benefits), sheltered and regulated sectors and an incremental approach to liberalization and external opening.

e. **Institutions for conflict management:** The rule of law, a high-quality judiciary, representative political institutions, free elections, independent trade unions, social partnerships, institutionalized representation of minority groups, and social insurance are examples of such institutions that attempt to prevent coordination failure among various social factions in order to arrive at mutually beneficial outcomes.

According to Rodrik (1999), these aforementioned institutions are required for an economy to grow and sustain high growth in the long-term.

However a study by Hall and Jones (1999) concluded that differences in capital accumulation, productivity and output per worker are fundamentally related to differences in Social Infrastructure, comprising of Institutions and Government Policies, across countries. The study summarized the research objective of analysis of determinants of economic growth as follows in Figure 1.2.

Figure 1.2: Process of Economic Growth



Source: Author's Illustration

They employed two indices to measure the government's anti-diversion policies and nation's openness to international trade while taking output per worker as the dependent variable.[5] While these indices were used in the structural equations, the Instrument variables – distance from the equator, trade share (predicted) and fraction of the population speaking a European language – were used in the reduced form equations to document the relation between social infrastructure and economic growth. It was noted that the characteristics of an economy like size of government, rate of inflation and share of high-tech goods in international trade are economic outcomes rather than determinants of growth. This is just the same as skills, capital stock and technologies are variables determined by social infrastructure and not the determinants of growth. The study found significant evidence of differences in social infrastructure across countries causing large variations in capital accumulation, education attainment, productivity and incomes across countries.

Knack and Keefer (1995) in their study employed two indices compiled by private international risk services; International Country Risk Guide (ICRG) and Business Environmental Risk Intelligence (BERI), to measure the impact of quality of institutional environment on economic growth. ICRG variables like Expropriation Risk (measures the risk of expropriation) and Rule of law (measures whether there are established peaceful mechanisms for adjudicating disputes) were taken to be proxies for the security of property and contract right. If countries score low on these dimensions then it can be interpreted that they are likely to suffer a reduction in the quantity and efficiency of physical and human capital investment. Other two very important

[5]Thievery, squatting, and Mafia protection are examples of diversion undertaken by private agents while expropriation, confiscatory taxation, and corruption are examples of public diversion. Even though the government is supposed to be the provider of social infrastructure that protects against diversion, it is also in majority of the scenarios a primary agent of diversion throughout the world. Regulations and laws protecting against diversion may be present but they all too often constitute the chief vehicle of diversion in an economy.

ICRG variables taken in this study were Corruption in Government and Quality of Bureaucracy. They were taken as proxies for the efficiency with which government services are provided, and for the extent and damage of rent-seeking behavior. Scoring low on the Quality of Bureaucracy dimension can be interpreted as being an indication that a bureaucracy lacks procedural clarity or technical competence and is likely to introduce criteria other than efficiency into the determination of government policies or the allocation of public goods. A high score in the Corruption in Government Index may lead to entrepreneurs facing greater uncertainty regarding the credibility of government commitments. The resulting distortions in investment and trade due to the weak institutions and weak enforcement may reduce the quantity and efficiency of capital investment and foreign technology introduced into the country. The measures from BERI used in the study were Contract Enforceability and Infrastructure Quality.

Knack and Keefer (1995) used Barro's Growth Equation to adjudge the speed of convergence between nations. If countries converge to their steady state incomes when institutional variables are incorporated as control variables (that is the variables are significant determinants of the steady state incomes to which countries converge) then the coefficient on initial income should be higher relative to when institutional variables aren't included. The crux is that if the convergence hypothesis is correct then the countries should grow faster, the lower their initial income, after controlling adequately for the quality of the institutions. The study estimated two different equations with the dependent variables as average annual per capita GDP growth rate and average ratio of real private investment to real GDP over the time period 1974 to 1989. The results indicated that the property rights are crucial to economic growth and investment, as all institutional variables came out to be significant in growth equations. Also, it was concluded that when quality of institutions are controlled for, stronger evidence emerges for conditional convergence.

In case of India, there have been only a handful of studies looking into the impact of quality of institutions on economic growth and development. One of such studies was published in the Asia-Pacific Development Journal carried out by Dash and Raja (2009). The study constructed institutional indices based on secondary data and employed statistical methods to test the hypothesis that institutions affect economic performance in case of seventeen Indian states. The dependent variables were taken to be per capita state domestic product and share of secondary sector in state gross domestic product. The institutional variables taken in the study were analyzed under following heads:

a. **Index of Creditors' Property Rights Protection:** Credit-Deposit Ratio of commercial banks across Indian states was taken to measure the risk banks' face in different states in lending operations. Higher the ratio, higher is the risk taken signaling poor protection of creditors' property rights.

b. **Legal Efficiency Index:** Average disposal of cases per court reflect presence or absence of delays in disposal of cases, the presence of which leads to high costs. An inefficient judiciary is not conducive to the smooth functioning of the market since it often creates an environment of high risk for business and makes the reliance of firms on the market less secure.

c. **Index of Rule of Law:** Transmission and Distribution losses as a percentage of total generation of electricity is taken to reflect the quality of enforcement mechanism in preventing illegal consumption of electricity.

d. **Extent and Quality of state intervention:** Index of Economic Freedom which is basically ratio of total expenditure to state domestic product. The Economic Freedom is deemed higher in cases where the aforementioned ratio is lower and there are lower possibilities of rent-seeking and corruption. Another Index computed is the Index of Fiscal Governance with the intention that an unhealthy fiscal environment, there are less incentives for private investment. Two indicators are taken in this regard, interest payments and revenue expenditure as a percentage of total expenditure. The third index is the Index of the state as a provider of necessary goods and services. Ratio of paved roads to total roads, percentage of population accessing telephone connections and per capita development expenditure are the indicators employed to determine the same. Finally, there is the Political Stability Index which incorporates number of times the President's rule is imposed and the number of times the Chief Ministers headed a coalition form of government.

The first three indices were clubbed to be the institutional variables. It was found in the study that the institutions play a significant role in explaining the variations in the extent of industrialization across Indian states but do not account for the variations in per capita GDP.

State as a provider of necessary goods and the fiscal governance came out to have a significant impact on economic performance in Indian states.

Another study by Debroy et al. (2011) reiterated that the occurrence of potentially advantageous exchanges are dependent on presence of sound money, rule of law and security of property rights. Loosely based on the Economic Freedom Index for the world published by the Fraser Institute, the study computed economic freedom indices for 20 major states of India. The three broad categories capturing the quality of institutions at two points in time, years 2005 and 2009, were size of the government (the premise being that greater the size of the government, lower is the economic freedom)[6], legal structure and security of property rights and regulation of business and labour. According to the final analysis of composite indices, Tamil Nadu, Gujarat and Andhra Pradesh were the top performing states on the economic freedom index. The worst performing states were Madhya Pradesh, Uttarakhand, Punjab, Orissa, Himachal Pradesh and Maharashtra. The study concluded that Indian states need to improve the economic freedom to encourage entrepreneurial activity and innovation.

World Bank in its report 'Building Institutions for Markets' asserted that the institutions affect distribution of wealth, assets and incomes as well as costs and incentives of market participants thus affecting the efficiency of transactions or exchanges. Therefore, quality of institutions is a vital factor in determining the direction and speed of economic growth and development.

1.2.4 **Determinants of Inter-regional disparities in Industrial Development:**

Several studies have attempted to explain Industrial deceleration and inter-regional disparities in income and industrial growth across Indian states. Industrial liberalization undertaken by the central government has to be supplemented by supporting action by state governments. Private investors require a variety of permissions from state governments to start operations, like connections to electricity and water supply and environmental clearances and they must interact with the state bureaucracy in the course of their operations because of laws governing pollution,

[6] This view of larger sized governments being detrimental to economic freedom can be strongly argued against. Countries like Singapore and Taiwan have large governments but the score highly on economic freedom. Also, nations like Germany and Japan employed state owned enterprises to develop the economy.

sanitation, workers' welfare and safety and such. In such a scenario complaints of delays, corruption and harassment arising from these interactions are common Ahluwalia, "Economic Reforms in India Since 1991: Has Gradualism Worked?". This section will review the existing literature on determinants of inter-regional disparities in income levels and industrial performance across states.

Goldar and Seth (1989) in their analysis of trends and determinants of inter-state disparities in growth of industrial output covered the period 1960-61 to 1985-86 and 12 major Indian states. The study noted that a sharp fall in the rate of industrial growth occurred in Orissa, West Bengal, Kerala, and Rajasthan, while Andhra Pradesh and Maharashtra experienced only a marginal diminution in the rate of industrial growth. However recovery in the rate of industrial growth after the mid-seventies was observed in the states of Orissa, Bihar, West Bengal and Uttar Pradesh. Three explanatory variables were considered in this study to explain the inter-state disparities in industrial growth; agricultural growth rate, growth rate in power supply and regional intensity of public sector investment. Then the rank correlation coefficients were computed between annual growth rate of real net value added in registered manufacturing in Indian states and the aforementioned explanatory variables. A positive rank correlation coefficient between agricultural growth and Industrial deceleration was obtained which implies that states facing poor agricultural growth did not experience as much industrial deceleration as the states experiencing better agricultural growth. In this case, the expectation of a negative correlation coefficient is not met. Also, a positive rank correlation coefficient between industrial deceleration and regional intensity of public sector investment was computed. According to the study, this implied that the states which gained relatively more from public sector investment in the late 1950s and 1960s experienced a more pronounced slow down in industrial growth after the mid-sixties, because there was a significant slowdown in public investment in this period (p.1239). Power Supply growth rate was taken as a proxy for Infrastructure availability but was found to be inadequate in explaining the Industrial deceleration and regional industrial patterns. The rank correlation coefficient between power supply growth and industrial deceleration was found to be negative but low in value. Therefore the results were inconclusive and contrary to expectations.

Ahluwalia (2000) conducted an analysis of economic growth in 14 major states over pre-reform (1980-81 to 1990-91) and post-reform (1991-92 to 1997-98) period. He noted that the increased variation in annual growth rate of per capita SDP brings up the presence of two conflicting trends; firstly acceleration of the Indian economy as a whole and secondly deceleration in Bihar, Uttar Pradesh and Orissa, which were already poor states to begin with. Deceleration in Haryana and Punjab was also observed but these states were at a higher level of income in the pre-reform period. The acceleration of growth was observed not only in the rich states of Maharashtra and Gujarat but also in West Bengal, Kerala, Tamil Nadu and Madhya Pradesh. It was noted that investment is an important driver of growth and that poor performing states suffer from severe handicaps in attracting private investment. Private investment usually flows to states which have a skilled labour force with a good business environment, good infrastructure especially power, transport and communications, and good governance. It is also argued that in the post-reform period, since the decontrol of central government's ability to direct investment to different regions in the country has diminished incentives for private investment to flow wherever there is a promise of higher returns and diminished costs have increased.

Ahluwalia (2000) also concedes that rapid industrial growth depends on quality of infrastructure. Availability of good infrastructure not only increases the productivity of the existing resources but also aids in attracting more investment which can drive growth. In this regard, he advised the states to privatize the state public sector units and use the proceeds to develop infrastructure. Indian states have to play a major in developing infrastructure as many of the critical areas of development and growth comes under the purview of state governments. Social infrastructure comprising of education and health facilities as well as economic infrastructure comprising rural electrification, state highways and development of irrigation and water management systems are important subjects in control of the states. The importance of overall governance and policy environment in driving growth was also acknowledged. An explanation of how good governance affects growth was explained as following:

- **a.** Direct impact of governance is gauged by the effectiveness with which developmental programs are implemented. Poor administration and corruption are two major factors responsible for reducing the effectiveness of the programs.

b. Indirect impact can be observed in the nature of overall policy environment for business. Industrial growth can be stimulated by deregulation, decontrol and procedural simplification undertaken by state governments. Poor states have usually lagged behind in this dimension.

c. General conditions of law and order are also a reflection of the quality of governance in the state.

d. The need to amend the central legislation to allow greater labour flexibility has been a point of heated discussion and therefore has been stuck in limbo. However, even without legislation state governments can formulate more flexible guidelines in order to increase employment and investment levels. States suffering from low growth and low investment can create a transparent system in which retrenchment and closure can be allowed.

Problem of state finances was also cited as one of the factors determining growth in Indian states. Sheer volume of direct and indirect subsidies, loss making state electricity boards and state public sector units as well as inefficient state tax administration and bureaucracy has been held responsible for the mess in state finances. The study concluded that there is a need to identify economic, institutional and socio-political factors explaining the inter-state disparities in economic growth.

Hasan et al. (2008) noted that to test whether industrial performance improves in presence of better policy and institutional framework the inter-state heterogeneity in the policy and institutional environment (including labour market regulations), financial sector development and infrastructure can be exploited. According to the study, rigidity in the Indian labour market is one of the important factors holding back the Industrial development. Indian labour regulations have been criticized time and again on account of complexity, scope and inconsistencies. Panagariya (2006) noted that historically, India always has had very high level of protection of labour rights. The labour legislation in India, a developing nation, has been at par with that in most of the developed nations. The study gives an instance of the rigidity by quoting Chapter VB of the Industrial Disputes Act, 1947 according to which a firm employing more than 100 workers practically loses rights to retrench, lay off or reassign workers. Slow progress on reforms in the financial sector is another important factor cited in the study determining the industrial growth in India. High share of public ownership in banks and regulations forcing banks to park a percent of their total advances in government securities and priority sector are only some of the instances of financial repression in India.

Therefore, Hasan et al. (2008) conducted an econometric exercise in which they firstly determined the impact of de-licensing on Indian manufacturing industries and secondly, tested for three industrial characteristics; labour intensity (ratio of total employment to capital stock), dependence of industries on external finance (ratio of outstanding loans to invested capital), and infrastructure dependence (ratio of expenses on distribution that is storage and transportation as well as power and fuel to gross value added). ASI unit level data for the period 1973 to 2003 was used. The study attempted to test whether industries that are more labour intensive or that are more dependent on infrastructure or financial sector grew less than the ones that are less dependent on these characteristics in the post de-licensing period. The study concluded that the industries with greater reliance on infrastructure, financial sector and labour intensity have performed relatively worse in the post de-licensing period (1991 to 2003). Thus, inadequate and poor quality infrastructure, failure of the financial sector in identifying and financing credit-worthy firms and investors and the rigid labour regulations were held responsible for slow growth in manufacturing sector.

Awasthi (1991) on the other hand in his work on explaining the inter-regional differences in industrial growth, classified the explanatory variables as demand side and supply side variables. Following are the demand side variables:

a. Population of the state: Taken as a measure of size of the market.

b. Per Capita Income: Taken as a measure of purchasing power of buyers

c. Proportion of the population residing in towns with 20,000 or more population: Reflects the urban demand for modern consumer goods.

d. Inter-Industry demand: Taken to be the inverse of the coefficient of specialization. It is based on the assumption that greater is diversification of the industrial structure, higher will be the inter-industry demand for capital and intermediate goods leading to industrial growth.

e. Level of Agricultural Mechanization: A composite index was created comprising of number of tractors per 1000 hectares, number of oil engines and pumping sets used for the purpose of irrigation per 1000 hectares and use of fertilizer. It is based on assumption that higher the level of agricultural mechanization, higher will be the demand for industrial goods leading to higher industrial growth.

The supply side variables employed in the study were:

a. Availability of raw material: Based on the assumption that spatial availability of raw materials determines inter-regional industrial variations.

b. Agglomeration Economies: It is presumed that higher the agglomeration index, higher is the industrial growth in the region. The index comprises of the number of urban centers per 1000 km square, relative size of urban settlements and the average inter-city distance between them.

c. Infrastructure Index: The index comprises of length of roads and railways per 1000 square Km of area and per lakh persons, power availability per capita and rates per kilo watt hour and number of bank offices per 1000 square Km and per lakh population across states.

d. Government Participation: Direct participation was measured in terms of per capita block investment in public sector undertaking and indirect participation was measured by a composite index.

e. Labour Indiscipline: A composite index of number of mandays lost per 1000 workers due to industrial disputes and number of trade unions per 1000 workers was computed to determine whether labour indiscipline affects industrial growth.

Besides the aforementioned variables, variables measuring the entrepreneurship initiative, availability of skilled labour and efficiency wage were also incorporated in the study. The dependent variables taken in the study were per capita net value added in registered manufacturing sector and proportion of net output generated in registered manufacturing sector to state domestic product of respective states. The empirical analysis was carried out for a cross-section of states in the years 1961, 1969 and 1978. Single equation linear models using OLS was estimated for the cross-section and pooled data. The study concluded that demand for industrial goods by the agricultural sector is an important factor in explaining the inter-regional disparities in industrial growth. Also, availability of infrastructure was an important variable at different points of time but agglomeration economies and government's participation though important till 1969 lost its significance by 1978. However, the results have to be considered carefully since the study didn't take into account the simultaneity issue of the explanatory variables.

Nagaraj et al. (1998) carried out an empirical study of the determinants of long-run growth rates of per capita SDP of 17 Indian states over the time period 1970 to 1994. Barro's growth equation using panel data with fixed effects method was employed to test for conditional convergence and test for the control variables that account for differences in steady state per capita SDP across states. The study analyses growth potential of each State borne out of the existing gap between its steady-state output and that of a benchmark State exhibiting strong growth, making it possible to explain the steady-state output gaps in terms of the differences in production structures and infrastructure endowments among States. The control variables used in the study can be classified primarily as physical, social and economic infrastructure variables like Per capita power consumption, net irrigated area as a percentage of net cultivated area, road length per 1000 square km, primary school enrollment rate as well as ratio of bank deposits to the SDP. Preliminary analysis pointed at positive relationship between the variables and SDP growth.

The study noted that there might be the presence of high level of multicollinearity between different variables used to capture the impact of infrastructure on economic growth and therefore, Principal Component Analysis (PCA) was employed. A set of 14 indicators of physical, social and economic infrastructure were taken and subjected to PCA. The first four principal components (accounting for 84% of the variation) were then included in the growth equation. Also to avoid possible endogeneity in the model, two stage least square dummy variable (2S-LSDV) method was employed. The results suggest that targeting public investment in infrastructure for states of Assam, Orissa, Madhya Pradesh, Rajasthan, Jammu and Kashmir and Himachal Pradesh could translate into better growth performance. The study also found that the production structure and infrastructure explained just two-thirds of the steady-state output gap while the rest was accounted by the difference in the fixed effects. Fixed effects are supposed to reflect the differences in institutional and political environment, in technology, in the availability of natural resources, as well as in other factors that may exert an influence on productive efficiency, and thus on growth (Nagaraj et al., 1998; p.47). Another important result was the evidence of high rate of convergence of per capita SDP across Indian states, which was interpreted to mean that the states were close to their steady state level of per capita SDP in the period 1970 to 1994.

Pal (2011) in his study focused on impact of infrastructure penetration, labour market rigidities and outreach of banking sector on industrial growth across 14 Indian states in the period 1991-92 to 2002-03 for 16 manufacturing groups. Firstly, He stressed that in a financially liberalized country with developed capital markets sub-national regions would be financially integrated which would imply that the financial development of sub-national regions will not really have a significant impact on industrial growth across regions. On the other hand if national capital markets are not properly integrated, firms would be left to search for financing in the region of their location (usually true for small and medium scale firms). Hence, the study attempted to examine the role of outreach of banking services on inter-regional inequalities in the industrial sector across Indian states. Secondly, the study also focused on inadequate infrastructural facilities, like in transportation networks, power supply, telecommunications, etc., raise costs of both production and distribution. And thirdly, the impact of firms' degree of flexibility in terms of utilization of labour services (which in turn crucially depends on the nature of labour market institutions) on industrial performance was also analyzed. Lack of adequate infrastructure facilities, poor access to banking services and labour market rigidities can adversely impact industrial growth.

The study employed following explanatory variables;

a. Outreach of Banking sector across states: To test the impact of outreach of banking sector on industrial growth a composite index of different indicators of access to banking services was constructed. Also, credit to income ratio and share of banking sector to SDP were employed.

b. Infrastructure Penetration: Availability of roads was taken as a measure of availability of adequate infrastructure.

c. Labour Market Rigidity: Extent of man-days lost due to industrial disputes was employed as a proxy for labour market rigidity.

The empirical analysis concluded that firstly, outreach of banking services has had a positive impact on the growth of manufacturing sector across the Indian states. Secondly, infrastructure penetration significantly facilitates industrial growth and thirdly, labour market rigidities don't have a significant impact on industrial performance and therefore, inter-regional disparities among Indian states.

Some of the aforementioned studies have considered labour market flexibility as an important factor determining the industrial performance in a state. In this regard a seminal study by Besley and Burgess (2004) charged that by granting excessive bargaining power to organized labour adversely affected investment incentive and gave India 'a generally unfavourable business environment'. They studied the Industrial Disputes Act, 1947 which defines the conciliation, arbitration, and adjudication procedures to be followed in the case of an industrial dispute. Since 1947 this act has been extensively amended by state governments giving it either a business-friendly or worker-friendly tones. The study analyzed each amendment in Indian states, coded them as neutral (value of zero), pro-worker (value of 1) and pro-employer (value of -1) and divided the states into categories of pro-employer, pro-worker and control states (neutral amendments). Different dependent variables, output of registered manufactured sector and output of unregistered manufactured sector were employed determine the impact of labour market rigidity on industrial performance. The results showed that a pro-worker regulatory environment didn't bode well for investment, employment, productivity and output in registered manufacturing. Such regulation also leads to an increase in activity in informal sector. The study found that the pro-worker regulation hadn't improved the well being of labour and had actually proven to be barrier to poverty alleviation and growth.

Another empirical study in this area of labour market inflexibility, by Sanyal and Menon (2005) employed two categories of explanatory variables; firstly, indicators of labour conflict (number of strikes and lock-outs as well as percentage of unionized workers) and state level amendments to IDA, 1947. The study reached the same conclusion as Besley and Burgess (2004) that a high number of strikes and man-days lost due to industrial disputes in a state relative to other states as well as a high percentage of unionized workers act as disincentives to new private investment in the state. The study also found that the variables of literacy, workforce participation, input costs and infrastructure availability have had insignificant impact on private investment once labour conflict is controlled for.

Chapter 2: Research Objectives, Empirical Framework and Methodology

2.1 Research Objectives

The extensive Literature Review aided in establishing the need and scope of the thesis. Firstly, there is a need to test the convergence hypothesis for industry GSDP and TFP across Indian states over the relatively unexplored time period of 1991-2012. The empirical methodology needs to be updated as well to obtain accurate results. Secondly, it follows from the previous chapter that it is essential to identify and study the impact of various institutional factors on industrial development across India.

Therefore the underlying aim of this thesis is to carry out a detailed inquiry into the direction and speed of industrial growth across major Indian states in the post-reform period. The hypothesis is that varying speeds of industrial growth across Indian states can be explained by differences in institutions at the individual state-level. Therefore following are the three research objectives of this thesis:

(a) The first research objective of the thesis is to test the convergence hypothesis for per capita industry gross state domestic product (GSDP) and total factor productivity (TFP) levels across 14 major Indian states in the post-reform period (after 1991).

(b) The second research objective is to identify the institutional factors influencing the industrial output in Indian states in the post-reform period and test the convergence hypothesis after controlling for these institutional factors.

(c) Create an institutional quality index (IQI) to analyze the change in quality of institutions over a period of time in different states.

The thesis will proceed accordingly studying and analyzing each research objective systematically. The 14 Indian states are; Andhra Pradesh, Bihar (Jharkhand included), Gujarat, Karnataka, Maharashtra, Madhya Pradesh (Chattisgarh included), Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh (Uttarakhand included), Haryana, West Bengal, Orissa and Kerala.

2.2 Empirical Framework and Methodology:

In order to test the research objectives and reach an empirically verifiable conclusion, empirical models need to be specified. This section will focus on defining the methodology and empirical framework so employed to test the three specified research objectives.

2.2.1 Testing of Convergence Hypothesis:

The concept of convergence is derived from the neo-classical model of economic growth given by Robert Solow. According to the model out of two countries, the country with lower per capita capital stock, hence lower per capita income, will grow at a faster rate. However, over a period of time the two countries would converge in terms of their per capita income levels as well as the growth rates which are assumed to be the same in the long run. Therefore after controlling for parameters such as saving rates and population growth rates, poorer countries will tend to grow faster and hence will catch up, converge to the levels of well-being enjoyed by their richer counterparts. This is an outcome borne out of the diminishing marginal productivity of capital assumption made in the Solow model. The concept has been explained mathematically and in considerable detail in Appendix I.

Further, there are three concepts of convergence; sigma (σ) convergence, unconditional beta (β) convergence and conditional beta (β) convergence. Firstly, sigma convergence refers to cross-sectional dispersion of per capita income (or any other variable like productivity) over time. A reduction in the dispersion of regional income over a period of time is termed as sigma convergence. Presence of this type of convergence implies that there is a tendency of equalization of per capita incomes across regions or economies. Secondly, presence of beta convergence indicates tendency of poor regions to grow at a faster rate than the richer regions. Thirdly, Barro and Sala-i-Martin (1991), termed the kind of convergence in which, the regions have the same steady state growth path for per capita income and the income gap between the regions decline irrespective of the technologies, institutions, policies and investment behavior, as Unconditional Beta Convergence. In case of Conditional Convergence, two or more countries with similar observable characteristics experience convergence in per capita incomes, after controlling for technologies, institutions, policies and investment behavior.

Further, measures of regional disparities can be classified into static and dynamic measures. While the former measures the state of inequalities at a point in time, the latter captures the historical trends of the inequalities. The thesis has employed following static measures of regional disparities:

(a) **Coefficient of Variation**: It is a measure of dispersion around mean. It is a relative measure of dispersion while standard deviation is an absolute measure of dispersion. The series or group which has the least value of Coefficient of variation is said to be less variable or more consistent relative to other series or group. Coefficient of variation (CV) is mathematically expressed as follows:

$$CV = \left(\frac{\sigma_t}{\overline{y_t}}\right)$$

Where the Standard Deviation,

$$\sigma_t = \sqrt{\left(\left(\frac{1}{n}\right)\left(\sum_{i=1}^{n}[(y_{it} - \overline{y_t})^2]\right)\right)}$$

And, y_{it} = Per capita Income of ith region at point of time t

n = number of regions

$\overline{y_t}$ = Mean of per capita income of n regions at point of time t

(b) **Theil Index**: Theil defined an inequality measure based on information theory as follows;

$$TI = \log n - \sum y_i \log\left(\frac{1}{y_i}\right)$$

Where,

$y_i =$ share of aggregate income accrued to a region or person i

n = total number of regions or people

The measure satisfies the Dalton-Pigou condition and is a relative measure that is it remains unaffected by proportional changes in all incomes. It is bounded from above by log n, so the larger is n the greater is the amount of possible inequality. However, Theil Index is an arbitrarily defined measure of income inequality. For example, transformations other than logarithm would be equally satisfactory in the definition of T and there is no real reason to choose one such transformation over another.

As for the dynamic measures, the thesis employs the concepts of sigma and beta convergence;

(a) **Sigma Convergence:** As earlier explained sigma convergence refers to cross-sectional dispersion of per capita income over time. Regression equations with time variable (t) as the independent variable and the inequality indicators (I) as dependent variables are estimated.

$$I = \alpha + \beta t + e_t$$

Where,

I = Inequality Indicator (CV or Theil Index)

In the above model, the null hypothesis is taken to be 'no sigma convergence' and which holds the value of β to be zero while significant negative (positive) values of these coefficients denote absolute convergence(divergence) under the alternative hypothesis. One major limitation of sigma convergence is that this formulation does not include any dynamical consideration.

(b) **Beta convergence:** According to Barro and Sala-i-Martin (1991), transitional growth process in the neoclassical model can be approximated as;

$$\left(\frac{1}{T}\right)\log\left(\frac{y_{it}}{y_{i,t-T}}\right) = x_i^{*} + \frac{\log\left(\frac{\widehat{y_i^{*}}}{\widehat{y_{i,t-T}}}\right)\left(1 - e^{-\beta T}\right)}{T} + u_{it}$$

Where,

i indexes the economy and t indexes time

y_{it} = per capita output

x_i^{*} = steady-state per capita growth rate

$\widehat{y_{it}}$ = output per effective worker (the number of workers adjusted for the effect of technological progress)

$\widehat{y_i^*}$ = steady-state level of output per effective worker

T = length of observation interval

β = convergence coefficient or the rate of convergence

u_i = error term. (The error term is a distributed lag of disturbances between dates t - T and t.)

Thus, the β coefficient (convergence coefficient) indicates the rate at which $\widehat{y_{it}}$ approaches $\widehat{y_i^*}$.

Recent research, following Islam (1995), has focused on employing the panel data model to test the convergence hypothesis which can be expressed as;

$$\log\left(\frac{y_{it}}{y_{i,t-T}}\right) = \alpha_i + \beta log(y_{i,t-T}) + u_{it} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Where,

y_{it} = per capita income in region i

u_i = error term

$y_{i,t-T}$ = lagged per capita income in region i

β = convergence coefficient or the rate of convergence

It follows from (1) that if $\beta < 0$, that is the value of β is negative in value then convergence is taking place. Also as described by Islam (1995) the implied speed of convergence (λ) can be calculated as;

$$\lambda = \left(\frac{1}{T}\right)(Ln(1+\beta))$$

In equation (1) above the intercept α_i is the fixed effect intercept, which varies over the cross-sectional units (in this case the Indian states) and is time-invariant. Theoretically, α_i depends on the initial level of labour productivity but differences in productivity may stem from other diverse factors, like the characteristics of the production function, natural resource endowments, or the quality of institutions. The fixed effects model helps to avoid the downward-biasness in the estimate of convergence speed due to the failure to account for country-specific variables that do not change over time (i.e. fixed effects) by the equation.[7] According to Aghion et al. (2006); Ahluwalia (2000); Nagaraj et al. (1998) and Pal (2011), Indian states depict large variation in institutional environments due to a significant degree of political and policy autonomy thus, warranting a need for fixed effects model.

However the thesis will employ the dynamic panel data model to test the conditional convergence hypothesis for Industrial SDP and TFP.[8] Problem with static panel is that it does not take into account the proper dynamics of the model. Also it cannot handle the issue of endogeneity between the lagged variable ($y_{i,t-T}$) and the error term (u_{it}) which leads to inconsistent estimators. Therefore the Arellano and Bond (1991) estimators for the dynamic panel model based on generalized method of moments (GMM) of the first differenced values are used. Equation (1) can also be written as;

$$Ln(Y_{it}) = \alpha_i + bLn(Y_{i,t-1}) + u_{it}$$

Where, b = 1+ β

The GMM first difference takes following form:

$$\Delta Ln(Y_{it}) = b\Delta Ln(Y_{i,t-1}) + \Delta u_{it}$$

Assuming, $E(u_{it}, u_{is}) = 0$ for i=1, 2,…., n; $t \neq 0$

Using conventional panel estimators- fixed or random effects- usually result in inconsistent estimators and misleading inference, depending on the extent of cross-sectional dependence and on whether the source generating the cross-sectional dependence (such as an unobserved common shock) is correlated with explanatory variables.

[7] See Mcquinn and Whelan (2007), and Islam (1995) for a thorough understanding of the problems associated with panel estimation of growth equation.

[8] Dynamic Panel Data models incorporate lagged values of the dependent variable as (one of the) explanatory variables.

The aforementioned static and dynamic measures of inequality are estimated for industrial state domestic product and total factor productivity to test for presence of convergence across the Indian states.

2.2.2 Construction of Total Factor Productivity series:

To test for the convergence hypothesis for TFP across Indian states, the TFP time series for Indian states would have to be constructed. In order to compute the TFP levels, decisions have to be taken at following levels of calculation:

(a) Value Added or Gross Output: Value added is preferable as the measure is useful to avoid double counting of intermediate inputs in national income and usage of gross output leads to an inclusion of raw materials which might diminish the role of capital and labour productivity growth. Since the TFP levels are being computed for the aggregate industry (registered manufacturing), value added is the ideal measure as it allows comparison over different firms employing heterogeneous inputs.

(b) Capital Stock Series: Capital stock series are available at book value and need to be converted at replacement cost. Trivedi et al. (2011) note that many studies have attempted such conversions adhering to the various assumptions about the capital stock in the benchmark year, the rate of depreciation and the rate of inflation deemed relevant to capital goods which have been proxied either by investment deflator or the Wholesale Price Index of machinery and transport equipment. Mostly the perpetual inventory accumulation method (PIM) has been used which requires the estimates of capital stock for the benchmark year and capital formation for the successive years. However, many of the studies have had simply used the capital stock series at book values, which is inappropriate and gives inaccurate estimates of TFP.

(c) Choosing between different methodologies to estimate TFP levels: Following the discussion in Chapter 1.2.2, it has been decided to employ the Growth Accounting Framework. The framework measures TFP as the difference between the rate of growth of output and weighted rates of growth of factor inputs. The Divisia-Tornqvist approximation has been employed to compute the TFP growth rates which are then converted into corresponding indices. The Divisia-Tornqvist approximation or simply the Translog Index is the discrete version of the continuous Divisia Index.

The continuous Divisia Index can be obtained by taking aggregate production function with two factors of production:

$$Y = F(K, L, T) \quad \text{.........(1)}$$

Where Y denotes aggregate output, K aggregate capital, L aggregate labour and T time. It is assumed that F is continuous, twice differentiable and characterized by constant returns to scale. These aggregates are taken as functions of their components and similar assumptions about continuity, differentiability and homogeneity are made for these functions;

$$Y = Y(Y_1, Y_2, \ldots \ldots . Y_m) \quad \text{.........(2)}$$

$$K = K(K_1, K_2, \ldots \ldots K_n) \quad \text{.........(3)}$$

$$L = L(L_1, L_2, \ldots \ldots . L_q) \quad \text{.........(4)}$$

Corresponding to them, there are m output prices, n capital prices, and q labour prices, denoted respectively by

$p_1, p_2, \ldots . p_d; r_1, r_2, \ldots \ldots, r_n; w_1, w_2, \ldots \ldots . w_q$

Also, the corresponding aggregate prices are denoted by p, r and w. Assuming perfect competition and profit maximization, the conditions of producer's equilibrium require that the shares of the factors be equal to their elasticities, so that,

$$V_K = \left(\frac{rK}{pY}\right) = \frac{\partial \log Y}{\partial \log K} \quad \text{.........(5)}$$

$$V_L = \left(\frac{wL}{pY}\right) = \frac{\partial \log Y}{\partial \log L} \quad \text{.........(6)}$$

Assumption of constant returns to scale yields, $V_K + V_L = 1$. Similarly, for individual components the conditions of producer's equilibrium require,

$$SY_i = \frac{p_i Y_i}{pY} = \frac{\partial \log Y}{\partial \log Y_i}, i = 1, \ldots \ldots, m \quad \text{.........(7)}$$

$$SK_j = \frac{r_j K_j}{rK} = \frac{\partial \log K}{\partial \log K_j}, j = 1, \ldots \ldots, n \quad \text{.........(8)}$$

$$SL_u = \frac{w_u L_u}{wL} = \frac{\partial \log L}{\partial \log L_u}, u = 1, \dots \dots, q \qquad \dots\dots\dots(9)$$

Where, SY_i is the share of the i'th output component in aggregate output. Similarly, SK_j and SL_u are the share of the j'th capital input and the u'th labour input in aggregate capital and aggregate labour, respectively. Further, linear homogeneity requires;

$$\sum_i SY_i = \sum_j SK_j = \sum_u SL_u = \mathbf{1}$$

Differentiating equation (1) with respect to time and substituting values from equation (5),

$$\frac{dlog\ Y}{dlog\ T} = V_K\left(\frac{dlog\ K}{dlog\ T}\right) + V_L\left(\frac{dlog\ L}{dlog\ T}\right) + V_T \qquad \dots\dots\dots(10)$$

This expression 'V_T' is called the Divisia quantity index of technological change. It should be noted that in the above expression;

$$\frac{dlog\ Y}{dT} = \sum_i SK_i\left(\frac{dlog\ Y_i}{dT}\right) \dots\dots\dots(11)$$

$$\frac{dlog\ Y}{dT} = \sum_j SK_j\left(\frac{dlog\ K_j}{dT}\right) \dots\dots\dots(12)$$

$$\frac{dlog\ L}{dT} = \sum_u SL_u\left(\frac{dlog\ L_u}{dT}\right) \dots\dots\dots(13)$$

Thus, a weighted average of growth rates of individual components gives the growth rate for the aggregate. These are respectively called the Divisia quantity indices of output, capital and labour.

For application to data at discrete points of time, an approximation to the continuous Divisia Index, known as translog index, has to be used. This assumes that a translog fucntion describes the relationship between Y, K, L and T (production function) and also the relationships between the aggregates and components. Assumption of constant returns to scale is maintained for all these functions. The translog production function is written as;

$$\log Y = \alpha_0 + \alpha_K \log K + \alpha_L \log L + \alpha_T T + \left(\frac{1}{2}\right)(\beta_{KK})(\log K)^2$$
$$+(\beta_{KL})(\log K)(\log L) + \left(\frac{1}{2}\right)(\beta_{LL})(\log L)^2 + (\beta_{KT})(\log K)(T)$$
$$+(\beta_{LT})(\log L)(T) + \left(\frac{1}{2}\right)(\beta_{TT})(T)^2 \quad \text{.........(14)}$$

Constant returns requires;

$$\alpha_K + \alpha_L = 1; \beta_{KK} + \beta_{KL} = 0; \beta_{KL} + \beta_{LL} = 0$$

Corresponding to equation (10), we get here

$$\Delta \log Y = \overline{V_K}(\Delta \log K) + \overline{V_L}(\Delta \log L) + \overline{V_T} \quad \text{........(15)}$$

Where,

$$\Delta \log Y = \log Y(T) - \log Y(T-1) \quad \text{........(16)}$$
$$\Delta \log K = \log K(T) - \log K(T-1) \quad \text{.........(17)}$$
$$\Delta \log L = \log L(T) - \log L(T-1) \quad \text{.........(18)}$$

And,

$$\overline{V_K} = \left(\frac{1}{2}\right)[V_K(T) + V_K(T-1)] \quad \text{.........(19)}$$
$$\overline{V_L} = \left(\frac{1}{2}\right)[V_L(T) + V_L(T-1)] \quad \text{.........(20)}$$

This espression for V_T in equation (15) is termed the average translog quantity index of technological change. ΔlogY, ΔlogK and ΔlogL are obtained as weighted averages of the rates of growth in their components. Thus, we get

$$\Delta \log Y = \sum_i \bar{S}\bar{Y}_i(\Delta \log Y_i) \quad \text{.........(21)}$$
$$\Delta \log K = \sum_j \bar{S}\bar{K}_j(\Delta \log K_j) \quad \text{.........(22)}$$
$$\Delta \log L = \sum_u \bar{S}\bar{L}_u(\Delta \log L_u) \quad \text{.........(23)}$$

Where, just like equations (19) and (20), we have;

$$\overline{SY_i} = \left(\frac{1}{2}\right)[SY_i(T) + SY_i(T-1)]$$
$$\overline{SK_j} = \left(\frac{1}{2}\right)[SK_j(T) + SK_j(T-1)]$$

$$\overline{SL_u} = \left(\frac{1}{2}\right)[SL_u(T) + SL_u(T - 1)]$$

Therefore, TFP can be calculated from rearranging the equation (15);

$$\overline{V_T} = \Delta \log Y - \overline{V_K}(\Delta \log K) + \overline{V_L}(\Delta \log L)$$

According to Goldar (1986), the approximation provides index numbers which are symmetric in data of different time periods and also satisfy the factor reversal test.

Therefore, the TFP growth rates are computed after taking decisions on various levels of analysis. The empirical model discussed here will be used to calculate TFP growth rates for the aggregate industry. Such an analysis will have to be taken with a pinch of salt as each industry in the registered manufacturing sector is different with regards tocapital labour ratio and resource requirements. However, what is necessary here is an aggregate analysis of TFP which will give an overall idea about the technological and organizational efficiency of the registered manufacturing sector in Indian states.

2.2.3 <u>Factors determining Industrial SDP:</u>

One major impediment in empirically verifying the role of institutions in economic growth has been the difficulty in quantifying the performing institutions in an economy. Usually employing a proxy in the form of a policy variable or a policy outcome is one of the best options to quantify the quality of institutions. To adjudge the change in quality of institutions over a period of time, a composite indicator of all proxy variables can also be used.

The empirical model incorporating the institutional factors that might have an impact on industrial growth is loosely based on Rodrik's (1999) classification of five types of market-supporting institutions; Property Rights, Regulatory Institutions, Institutions for Macroeconomic Stabilization, Institutions for Social Insurance and Institutions for conflict management. However, all of the aforementioned types of institutions can't be included in the present analysis for the lack of appropriate data at the state-level. For instance, institutions that stabilize markets are usually present at the central level and not state level. Therefore, what is attempted here is an analysis of the quality of registered manufacturing sector's market supporting and creating public institutions. Hence, the different types of Public Institutions considered in this thesis have been clubbed as following on the basis of their economic functions:

a. **Institutions that Regulate Markets**: In face of some kind of market failure and/or non-fulfillment of other social objectives such as income distribution (that is, markets do not deliver what is socially desirable) then the public institutions take charge. For instance, banks and other financial institutions need to be regulated to ensure that they do not take on excessive risk, which can lead to socially costly bank runs or collapses. Also, the private sector may not deliver education and water to the most needy because they cannot afford to pay for these services.

b. **Institutions that Stabilize Markets**: Under this head public institutions that smoothen the volatilities in business cycle and which create a healthy macroeconomic environment, are analyzed.

c. **Institutions that Legitimize Markets**: Third party enforcement of property rights and conflict management are important functions carried out by public institutions.

Even though it is extremely difficult to find proxy variables to capture accurately the institutional environment in states, an attempt has been made to be as comprehensive as possible while selecting the indicators. These indicators are essentially institutional outcomes which among other things give an insight into the institutional environment of a state. Following is a list of these variables and for an illustrative and brief view, refer to Figure 2.1:

a. Installed capacity of electricity by state electricity boards (IC): This particular variable is a proxy for public institutions regulating the market. It is taken as a yardstick for quality of bureaucracy and overall governance. State electricity boards (SEBs) in India have been running in losses, forced by political pressure to supply electricity at cheap tariff rates. The inefficient bureaucracy and the populist policies of the state governments adversely impact the functioning of SEBs. The SEBs aren't able to expand their operations and their efficiency is compromised in absence of incentives. Since in India it is the government which supplies the electricity, it being a public good, the sector has become unattractive for private players. Therefore installed capacity of electric power is the best indicator of institutional quality of bureaucracy and overall governance. It is assumed that there is a positive relation between this variable and the industry output.

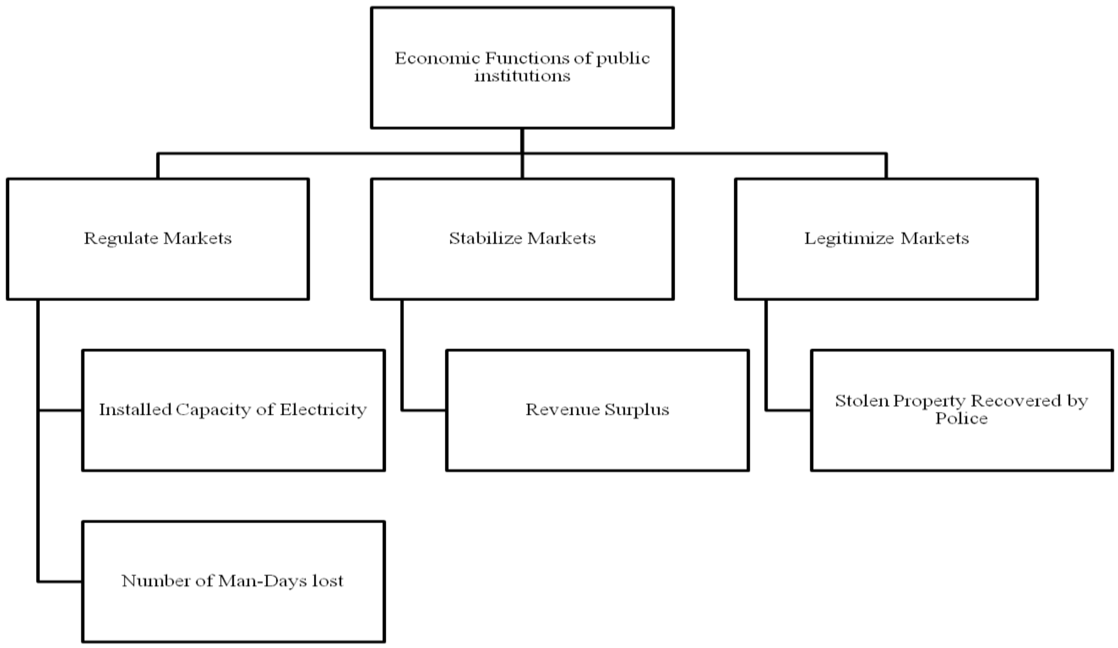
b. Number of Man-days lost due to industrial disputes annually (MD): This institutional outcome variable is perfect for capturing the regulatory function of institutions, specifically in the labour market. It is taken that there is a negative relation between number of man-days lost annually and industrial output.

c.Pendency of criminal cases in courts in a state (PPC): Judiciary an important conflict management institution needs to be adjudged for its quality at the state-level. The variable, pendency of criminal cases in courts in Indian states, expresses whether the state-level judiciary machine is overwhelmed or not. The backlog of cases might be due to corruption of inefficiency or just the fact that there is has been an increase in such criminal cases in the state. However for the lack of any other accurate variable, this variable will be incorporated in the analysis, with a larger value implying inefficiency and corruption in state-level judiciary. The premise is that the institutional outcome variable of percentage of pending criminal cases in courts in different states has a negative relation with industrial output.

d. Percentage stolen property recovered by the police (PR): This variable captures another important conflict management institution or rather the organization responsible for the implementation of the institution of law, the Police. It is assumed that the variable has a positive relation with industrial output. The variable is also a proxy for the level of security of property rights in a state.

e.Revenue Surplus (RS): The fiscal health of state governments is an important proxy for institutions for macroeconomic stabilization at the state level. It is taken to have a positive relation with industrial output. At the central level the fiscal health of the government and the autonomy and quality of central bank would be important proxies for the same.

Figure 2.1: Illustrative Description of Institutional Variables taken in the Thesis



Source: Author's Illustration

Institutional variables, as cautioned by a number of studies suffer from the problem of endogeneity. To handle this problem and also to see the impact of these variables on the convergence of industrial output, Arellano Bond estimation method is employed. This regression analysis will determine the speed of convergence across Indian states after taking into account or controlling for different institutional variables. Therefore the equation to be estimated is;

$$Ln(Y_{it}) = \alpha_i + bLn(Y_{i,t-1}) + cPPC_{i,t} + dLn(MD_{i,t}) + eRS_{i,t} + fIC_{i,t} + gPR_{i,t} + u_{it}$$

Where, $Y_{i,t}$ is the per capita registered manufacturing output.

Besides using the above equation to gauge the impact of institutional variables on industrial output, a comparison of quality of institutional environment in different Indian states is also carried out. To compare the quality of institutional environment an index is constructed, quantifying the quality of institutional environment for Indian states on the basis of which they can be ranked over the years.

In Indian context, studies by Dash and Raja (2009) and Debroy et al. (2011) have covered a number of variables in order to arrive at a composite index to measure some form of institutional quality in different states. However, inclusion of a number of variables doesn't always ensure accuracy in measurement. The much quoted Human Development Index has been praised for its simplicity and choice of a few but significant indicators. In building a composite index, following sequence of important decisions has to be taken:

a. **Choice of indicators**: Firstly, a theoretical framework is required on the basis of which the selection of feasible indicators can be carried out. Secondly, the indicators selected should be based on the analytical soundness, measurability, coverage, and relevance to the phenomenon being measured and relationship to each other.
b. **Normalization of Values**: Since each indicator is measured in different units, it is essential to normalize the values. Some of the important methods to do that have been given in detail in Table 1.
c. **Weighting and Aggregating**: Most of the composite indicators or indices rely on equal weighting which involves assigning equal weights to indicators in the index. Usually this technique is helpful when there is insufficient knowledge of the causal relation between indicators (which is the case here). Statistical models such as principal components analysis (PCA) or factor analysis (FA) could also be used to group individual indicators according to their degree of correlation.

   As for aggregating, the linear aggregation method is useful when all individual indicators have the same measurement unit, provided that some mathematical properties are respected. Also, linear aggregations reward base-indicators proportionally to the weights. Geometric aggregation is better suited if some degree of non compensability between individual indicators or dimensions is required. Further, geometric aggregations reward countries that have higher scores.

<u>Table 2.1: Methods of normalizing values[9]</u>

Method of Normalizing Values	Description	Formula
Ranking	This method is not affected by outliers and allows the performance of countries to be followed over time in terms of relative positions. Country performance in absolute terms however can no longer be evaluated as information on levels is lost.	$I_{qc}^{t} = rank(x_{qc}^{t})$
Standardization (z-scores)	Converts the indicator values into a common scale having a mean of 0 and standard deviation of 1.Indicators with extreme values have a greater effect on the composite indicator.	$I_{qc}^{t} = \frac{x_{qc}^{t} - \overline{x}_{q}^{t}}{\sigma_{q}^{t}}$
Categorical Scores	Assigns scores to each indicator value. Calculating Percentiles is one of the ways the indicators can be assigned categorical values. For instance, the top 5% receive a score of 120, the units between the 85th and 95th percentiles receive 100 points, the values between the 65th and the 85th percentiles receive 80 points, all the way to 20 points, thereby rewarding the best performing countries and penalizing the worst. Since the same percentile transformation is used for different years, any change in the definition of the indicator over time will not affect the transformed variable. However, it is difficult to follow increases over time. Categorical scales exclude large amounts of information about the variance of the transformed indicators. Besides, when there is little variation within the original scores, the percentile bands force the categorization on the data, irrespective of the underlying distribution.	$I_{qc}^{t} = \begin{cases} 20 & x_{qc}^{t} < P15 \\ 40 & P15 \leq x_{qc}^{t} < P25 \\ 60 & P25 \leq x_{qc}^{t} < P65 \\ 80 & P65 \leq x_{qc}^{t} < P85 \\ 100 & P85 \leq x_{qc}^{t} < P95 \\ 120 & P95 \leq x_{qc}^{t} \end{cases}$

[9] Taken from Table 3, Pg 30, *Handbook on Constructing Composite Indicators* (2008).

Where, x_{qc}^{t} = value of indicator q for region/state c at time t.

$\overline{x}_{q}^{t}$ = mean value of indicator q at time t.

The theoretical framework and the institutional outcome variables have already been discussed and chosen earlier in this sub-section. However, in order to simplify the interpretation of the index, the inverse of number of man-days lost due to industrial disputes and number of pending criminal cases in courts in states, was taken. This allows for the easy interpretation of higher value of index to imply higher quality of institutional environment.

Also, normalization of data is carried out by assigning categorical scores on the basis of percentiles and calculating z or standardized scores. As for aggregating, both linear and geometric aggregation methods are employed to arrive at an appropriate Index of Institutional Quality. For the standardized scores geometric aggregation couldn't be carried out as a number of values were negative in sign. After taking decisions for the three aforementioned steps, the composite indicator or index is ready to be built for 14 Indians states over a period of 17 years.

This section has described the appropriate empirical models for the given research objectives, keeping in mind the availability of data, feasibility of the study and the method. The next section provides the details of data sources and the computation of variables.

2.3 <u>Data Source and Construction of Variables</u>

This section focuses on the data sources and construction of different variables considered. Firstly, 14 major Indian states on the basis of greater population have been taken.[10] Secondly, states of Uttarakhand, Jharkhand and Chattisgarh have been clubbed with states of Uttar Pradesh, Bihar and Madhya Pradesh respectively. The bifurcation of these states is not taken into account

[10] The 14 Indian states are; Andhra Pradesh (AP), Bihar, Gujarat, Karnataka, Maharashtra, MP, Punjab, Rajasthan, Tamil Nadu (TN), Uttar Pradesh (UP), Haryana, West Bengal (WB), Orissa and Kerala.

in the thesis as it is not possible to construct separate time series of Industrial GSDP and TFP for the aforementioned states.

2.3.1 Industrial State Domestic Product:

The gross state domestic product series (GSDP) is published by Central Statistical Office at both market and constant prices. The time series of registered manufacturing GSDP at current prices for 14 Indian states was obtained from the CSO published data. The series was then deflated by the Wholesale Price Index for manufactured products published by RBI at 2004-05 prices. The Wholesale Price Index published by RBI is available at the base years of 1981-82, 1993-94 and 2004-05. The base of the WPI series was shifted to 2004-05 so as to get a continuous series extending from 1991-92 to 2012-13 at constant prices.

2.3.2 Total Factor Productivity:

The TFP growth rates were computed by employing the Divisia-Tornqvist Approximation. The two databases used extensively in the construction of TFP series are that of Annual Survey Industries and RBI. Following are the details of the sources and characteristics of the data used:

a. Output: Net Value Added available for each year and state in the Principal Characteristics by major states, Annual Survey of Industries has been used as a measure of output.

b. Labour: For the variable L, Total Workers is used. The same is available in Principal Characteristics by major states, Annual Survey of Industries for each year in the time period 1991-92 to 2012-13.

c. Capital Stock series: The methodology to create capital stock series has been borrowed from Balakrishnan and Pushpangadan (1994), Ahluwalia (1991) and Trivedi (2004). The Perpetual Inventory Accumulation Method has been followed to create the capital stock series with a base of 1990-91. The time series on capital stock at current prices has been computed using the following equation:

$$K_t = K_0 + \sum_{i=1}^{t} I_i$$

Where,

I = net fixed capital formation

K_0 = Capital stock in the benchmark year in 2004-05 prices

t = time

Data on fixed capital stock available in Annual Survey Industries (ASI) reports is the historical data on book value and it is inappropriate to use this data as it does not reflect the replacement cost. Therefore, data on capital stock was obtained from Reserve Bank of India's database for the period 1991-2012. Following Trivedi (2004) and RBI, the proportion of capital stock for each state has been obtained from the ASI data on fixed capital and then these proportions have been applied to the RBI data on capital stock. The time series of capital stock so obtained is at current prices and would need to be deflated. This has been achieved by using the Wholesale Price Index for machinery and machine tools.

d. Factor Shares: The Divisia-Tornqvist approximation to total factor productivity growth requires information on the share of each primary factor in the value added. The share of total emoluments in the value added is taken as the share of wages while under the assumption of constant returns to scale, the capital share is equal to one minus the share of wages.

e. TFP growth rates: The Divisia-Tornqvist approximation is expressed as;

$$TFPG = (\ln Q_t - \ln Q_{t-1}) - \sum_{i-1}^{n} \frac{1}{2(s_{it} - s_{i,t-1})(\ln X_{it} - \ln \mathbf{X}_{i,t-1})}$$

Where,

TFPG = Total factor productivity growth

Q = Quantity of output

s_i = share of factor i in the output

X_i = Quantity of input i

n = number of inputs

t = subscript representing a point in time

t-1 = subscript representing lag in time

Since value added is being taken as the measure of output, only labour and capital are taken as inputs. Therefore, the Divisia-Tornqvist approximation can now be expressed in two-input case scenario;

$$TFPG = \ln\left(\frac{Q_t}{Q_{t-1}}\right) - \left(\frac{w_t + w_{t-1}}{2}\right)\ln\left(\frac{L_t}{L_{t-1}}\right) - \left(\frac{1 - (w_t + w_{t-1})}{2}\right)\ln\left(\frac{K_t}{K_{t-1}}\right)$$

Where,

TFPG = Total factor productivity growth

Q = Value Added

w = share of wages in output

L = Labour input

K = Capital input

In the equation above, the share of capital has been obtained as a residual fulfilling the constant returns to scale assumption. From the growth rates of TFP so obtained, the TFP levels can be obtained by assuming TFP at time = 0 or TFP_0 as unity so that for the base year (1991) the TFP index is 100. The time series of the TFP levels can be constructed by;

$$TFP_t = (TFP_{t-1})(e^{TFPG_t})$$

This is how, the TFP levels for the panel of 14 states and time period 1991-92 to 2012-13 is obtained.

2.3.3 Institutional Variables:

The institutional outcome variables have been taken from various sources. Since the data for all variables wasn't present since 1991, the period from 1996 to 2012 has been taken for further analysis. A balanced panel for the regression analysis has been undertaken. Following are the details of the sources of the variables and the transformation carried out for the analysis:

a. **Installed Capacity of Electricity by SEBs:** The data on this indicator was compiled from different editions of All India Statistics, General Review, Central Electricity Authority. The installed capacity of electricity is in the unit of Mega Watts and to make it comparable across states it was transformed into installed capacity of electricity per 10,000 persons.

b. **Number of Man-Days lost in Industrial Disputes:** Data was obtained from the annual editions of Statistical Abstract of India published by Central Statistical Office of India. For the construction of the index, the inverse of this indicator was taken so that higher value of the variable contributes to greater value of index implying higher quality of institutional environment.

c. **Pendency percentage of IPC crimes in state level courts and Percentage of stolen property recovered by police:** The data on these two variables were taken from the publication of crime statistics, National Crime Records Bureau of India. For the computation of the index, the inverse of pendency percentage of IPC crimes in state level courts was taken.

d. **Revenue Surplus:** The data on Revenue Surplus was compiled from the annual publication of State Finances by the Reserve Bank of India. The data was available in level form which was then converted into a percentage of Revenue Surplus to gross state domestic product.

Chapter 3: Empirical Results and Analysis

3.1 Introduction:

The first chapter established the need and scope of the study while the second chapter outlined the research objectives, methodology and empirical framework. In this section firstly the results of convergence hypothesis testing of Industrial per capita SDP and TFP across the Indian states will be presented and discussed. Secondly, the determinants of the disparities in industrial growth will be identified and their impact on the output in the Industry across Indian states will be analyzed. Data sources for the empirical analysis conducted in this section has been sourced from ASI, CSO, RBI, Statistical Abstract of India, General Review of Central Electricity Authority and Crime Statistics by National Crime Records Bureau (refer section 2.2 for more details).

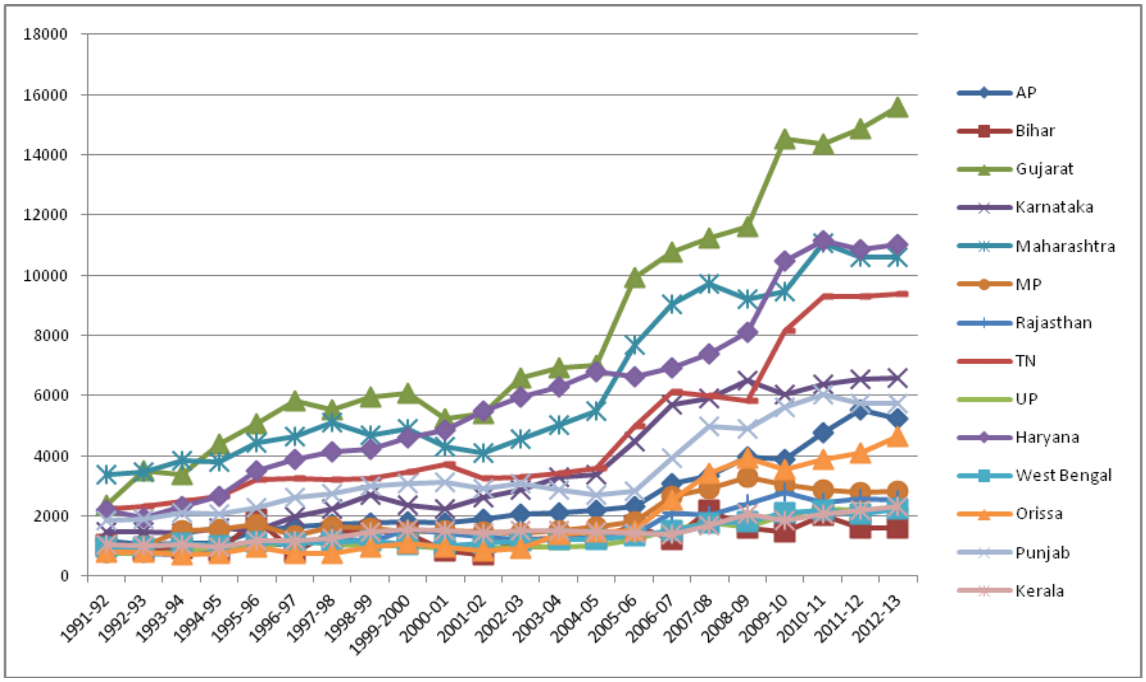
3.2 Brief overview of the Analysis:

Figure 3.1 plots the trends of absolute values of Industrial per capita SDP for 14 Indian states over the time period 1991 to 2012. This gives an idea as to where things are going as far as industrialization is concerned. For states of Orissa, Andhra Pradesh, and Karnataka and also to some extent Madhya Pradesh (MP), the industry per capita SDP has been steadily increasing. Overall, the industry incomes for the 14 states seem to have risen over the period of time. However to gauge the speed and direction of movement in industrial incomes, the sigma and beta convergence hypothesis will have to be looked at.

Another important indicator or proximate cause of growth is the Total Factor Productivity in Industry. Figure 3.2 plots logarithmic values of TFP levels for the Indian states. It can be clearly observed that the Industry TFP levels have declined in the period 1994 to 2012.

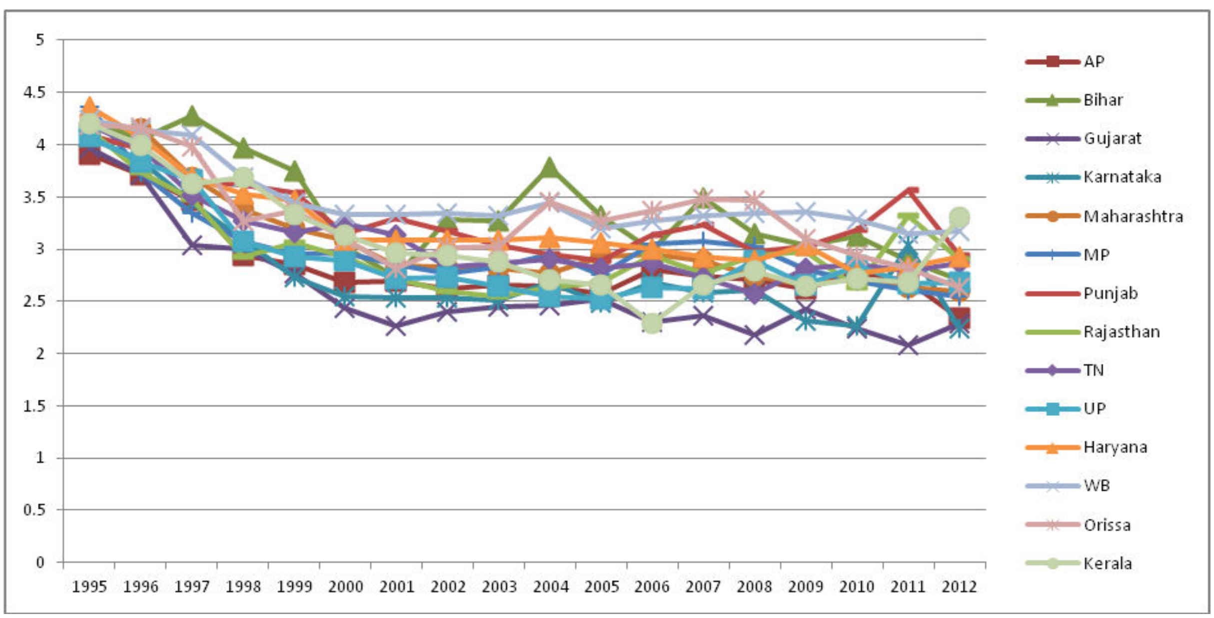
An important question to be raised here is that whether the variation in the two indicators of growth for Indian states in the post-reform period has increased or not is a question that needs to be answered. The first two sub-sections will attempt to answer this question while the final sub-section tries to unearth the determinants of the Industrial growth in Indian states.

Figure 3.1: Plot of Industry per capita state domestic product (at 2004-05 prices) for Indian states



Source: Author's calculations

Figure 3.2: Plot of Industry Total Factor Productivity levels for Indian states

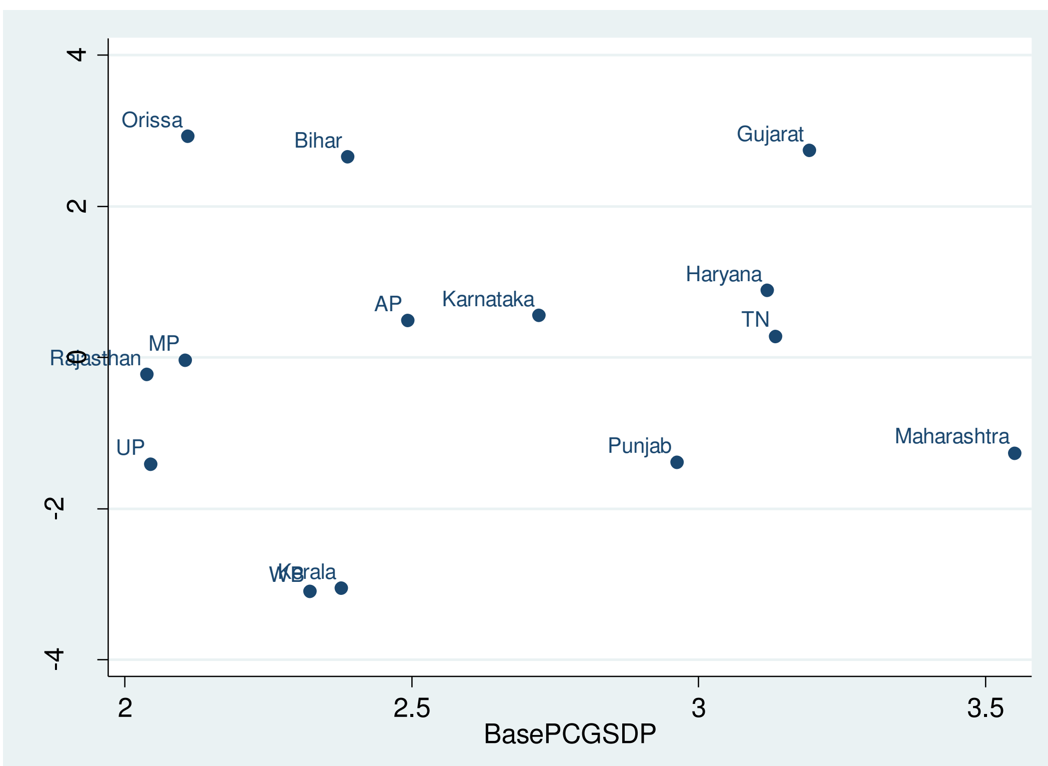


Source: Author's calculations

3.3 Convergence of Industrial SDP:

In order to better comprehend the data a preliminary analysis is requisite. Here, Figure 3.3 gives very important insights into the kind of data being dealt with. States of Bihar, Kerala and West Bengal started from the same low base of per capita industry SDP, however only Bihar picked up over the span of 22 years. Similarly, Orissa seems to have done relatively well as compared to Rajasthan, Madhya Pradesh (MP) and Uttar Pradesh (UP), even though all four of them started from a low base of industry SDP. Also, even though Punjab and Maharashtra started from a high base, they couldn't pick up as much as states of Gujarat, Haryana and Tamil Nadu (TN) did. The scatter plot here doesn't provide concrete evidence of convergence or divergence in per capita industrial incomes so that further empirical tests are required.

Figure 3.3: Plot of annual growth rate of Industry Gross State Domestic Product of Indian States



Where,

PCGSDPgr stands for deviation of average annual growth rate of per capita gross Industry SDP for each of the 14 Indian states for the period 1991 to 2012 from the mean annual growth rate of per capita gross Industry SDP of 14 Indian states.

BasePCGSDP stands for deviation of logarithmic value of per capita gross Industry SDP in the base period 1991 of each state from mean of per capita gross Industry SDP for all the states in 1991.

Source: Author’s calculations

To determine whether there has been any reduction in inequalities in industrial growth and whether industrial incomes are converging, tests were conducted for sigma convergence and beta convergence. Firstly the inequality measures of per capita industrial SDP were computed. The coefficient of variation (CV) and Theil Index for the period 1991 to 2012 for 14 Indian states are tabulated in Table 3.1. It becomes clear at a cursory look that the inequality measures of CV and Theil Index have been increasing over the said time period.

Table 3.1: Coefficient of Variation and Theil Index for Industry per capita GSDP

Year	CV	Theil Index
1991	6.704	0.123
1992	7.232	0.153
1993	7.571	0.168
1994	7.608	0.169
1995	7.496	0.165
1996	8.506	0.210
1997	7.999	0.182
1998	7.625	0.173
1999	7.626	0.177
2000	8.291	0.188
2001	8.761	0.207
2002	8.465	0.214
2003	8.242	0.211
2004	8.272	0.217
2005	8.894	0.261
2006	8.664	0.231

Year	CV	Theil Index
2007	7.703	0.196
2008	7.731	0.188
2009	8.169	0.230
2010	8.113	0.222
2011	8.387	0.226
2012	8.303	0.226

Source: Author's calculations

As already discussed sigma convergence refers to cross-sectional dispersion of per capita income (or any other variable like productivity) over time and a reduction in the dispersion of regional income over a period of time is termed as sigma convergence. Running the regression on sigma convergence equations yield the results that have been tabulated in Table 3.2 under the headings of Models 1 and 2. The estimated coefficients of the trend are positive and significant at 1% level for both CV and Theil Index (TI).

Table 3.2: Regression Results for Sigma Convergence for per capita industry GSDP

Model 1: $CV = \alpha + \beta t + u$

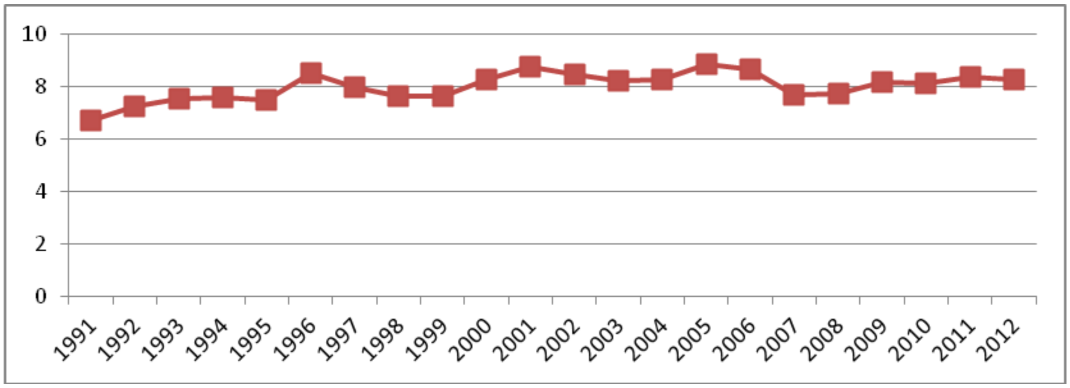
Variable	Coefficient	Standard Error	t value	P value
t	0.048	0.015	3.18	0.005
Adjusted R^2	0.302			

Model 2: $TI = \alpha + \beta t + u$

Variable	Coefficient	Standard Error	t value	P value
t	0.0039	0.0007	5.80	0.000
Adjusted R^2	0.609			

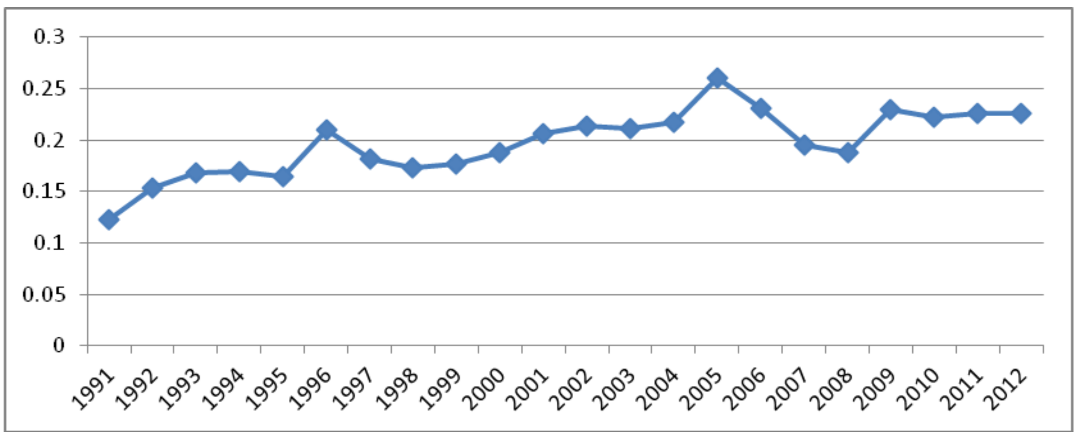
This implies that over the time period 1991 to 2012 the disparities in industrial growth have widened or simply that divergence has taken place in industrial incomes of Indian states. A pictorial depiction of the same can also be observed in Figures 3.4 and 3.5. The plot of CV surely and steadily has risen over the 22 year time period while Theil Index's rise has been more rapid over the same period. The trend regression results therefore point towards sigma divergence implying that there doesn't seem to be any equalization of per capita industrial incomes across Indian states.

Figure 3.4: Plot of coefficient of variation for per capita industry GSDP (1991 to 2012)



Source: Author's calculations

Figure 3.5: Plot of Theil Index for per capita industry GSDP (1991 to 2012)



Source: Author's calculations

As for Beta convergence, Table 3.3 presents the results of the Arellano-Bond dynamic panel data estimation. It can be readily concluded that the panel of 14 states over a time period of 22 years shows beta convergence. The coefficient on the lagged variable of per capita industrial SDP is significant and less than 1 which makes β negative in value. However the implied speed of convergence comes out to be very low pointing at the need for being cautious in interpreting the regression results. Even though a significant negative β would necessarily imply convergence in industrial incomes across states, the low value of speed of convergence puts a question on the effectiveness of this 'convergence'.

Table 3.3: Arellano-Bond dynamic panel data estimation results for per capita industry GSDP

Variable	Coefficient	Robust Standard Error	z	p-value
$Ln(Y_{i,t-1})$	0.95	0.036	26.78	0.000
Constant	0.44	0.27	1.62	0.038
β = b-1	-0.0499			
Implied Annual Speed of Convergence = (1/22)(Ln(1+β))	0.0023			

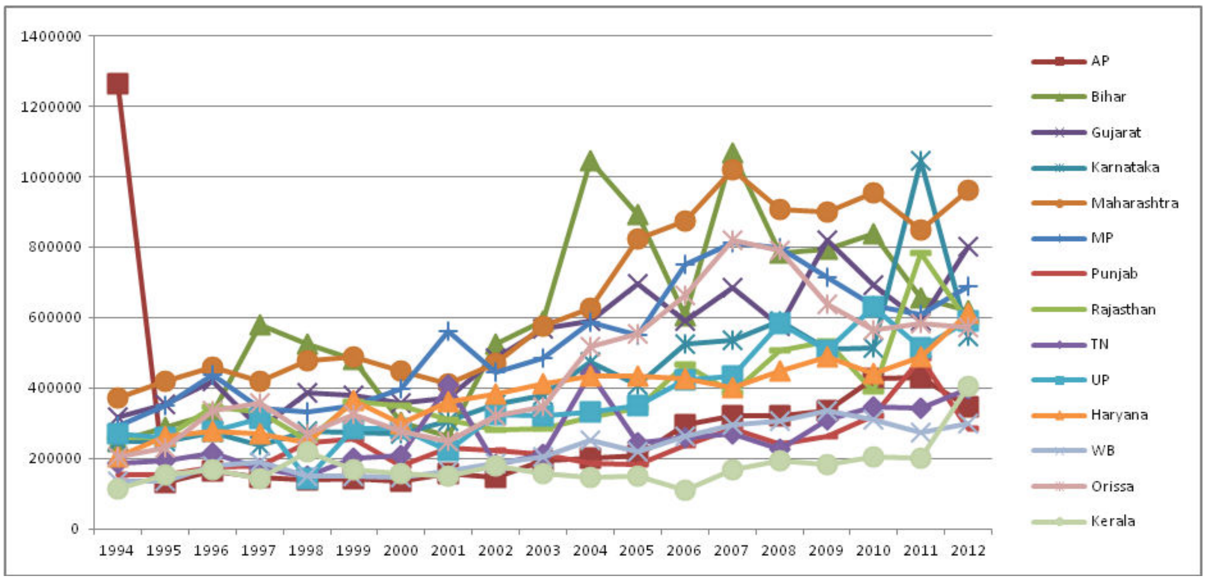
Therefore, even though it can be said that the low performing states (those with lower per capita industrial GSDP) are growing faster than the high performing states or catching up, the dismally low annual speed of convergence has to be taken into account along with the evidence of sigma divergence. The regional disparities in industrial per capita incomes don't seem to be reducing at a fast enough speed to make a difference, as can be accounted for by the sigma convergence test and the static measures of dispersion computed and analyzed earlier.

The results so obtained are in concurrence with the results arrived at by Bhattacharya and Sakhtivel (2004). Their study concluded for the period extending from 1990-91 to 1999-2000 that the regional disparities had widened in terms of SDP growth rate and per capita SDP. Also Nair (2004) had found that in the period 1994 to 1999 there was no convergence or divergence in the per capita value added in registered manufacturing sector. Even, Jena et al. (2011) concluded that in the post-reform period (after 1991-92) the tendency of divergence had risen in growth rates of manufacturing GSDP. In this regard, it can be concluded that there has been no tendency towards reduction in inequalities in industry per capita GSDP across Indian states and also, even though there is evidence of convergence, since the speed is extremely low, it implies that there has been no significant catch-up by low performing states with high performing states.

3.4 Convergence of Industrial Total Factor Productivity:

To understand the trend of Industrial TFP levels for Indian states in the post-reform period extending from 1994 to 2012, a detailed analysis of partial productivities and capital-labour ratio is required.[11] Figures 3.6, 3.7 and 3.8 clearly bring out the trend of labour productivity, capital productivity (inverse of capital output ratio) and capital labour ratio, respectively. While Labour productivity and capital-labour ratio have risen in the given time period, the capital productivity has declined consistently for all the Indian states.

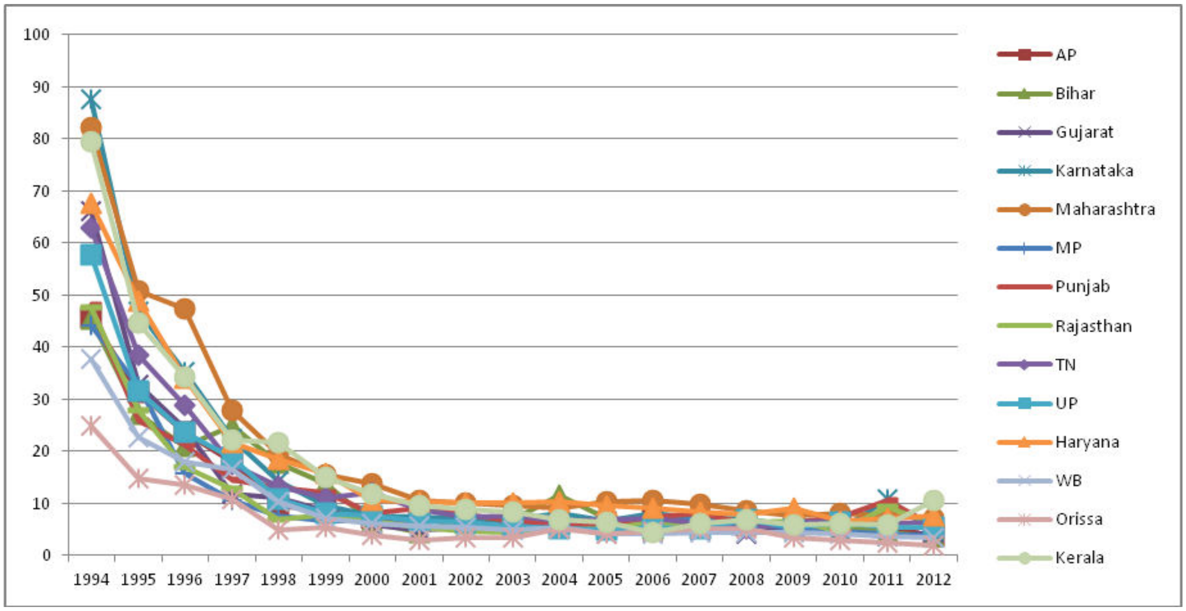
Figure 3.6: Plot of Labour Productivity values for 14 Indian states over the time period 1994 to 2012



Source: Author's calculations

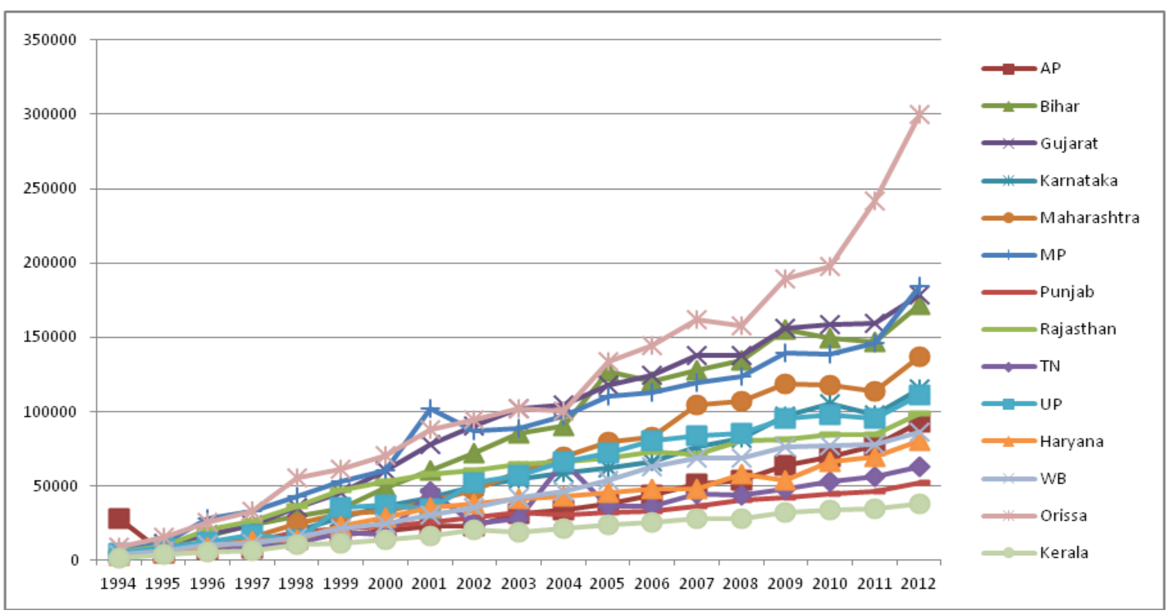
[11] The partial or single factor productivity (SFP) is defined as the ratio of the volume of output (or net value-added) to the quantity of the factor of production for which productivity is to be estimated (for instance labour productivity and capital productivity).

Figure 3.7: Plot of Capital Productivity values for 14 Indian states over the time period 1994 to 2012



Source: Author's calculations

Figure 3.8: Plot of Capital-Labour ratio for 14 Indian states over the time period 1994 to 2012



Source: Author's calculations

This observation along with the declining TFP levels (refer Figure 3.2) can be taken to imply that the industry across the 14 Indian states have had experienced declining returns to capital or in other words the inefficient use of capital has been rising. Also, rising labour productivity and capital-output ratio point towards a structural shift in the Industry towards a capital-intensive industry or capital deepening. According to Reddy (2006), labour productivity comprises of two components; firstly, productivity due to capital deepening (improvements in physical capital available per labour unit) and secondly, to talfactor productivity (TFP). TFP is the contribution other than that emanating from the increased use of inputs (capital and labour). The increased substitution of labour through mechanization can translate into higher labour productivity without translating into a commensurate increase in TFP levels. Overall, it seems that even though the process of capital deepening has occurred in the industrial sector in Indian states, the efficiency levels (as reflected by the TFP levels) have been steadily declining.

The next question that needs to be answered is whether the dispersion in the industry TFP levels amongst Indian states widened or narrowed. Again, both sigma and beta convergence tests were carried out. Table 3.4 can be referred for the values of Theil's Index and coefficient of variation presenting the evidence of increasing dispersion of TFP levels amongst Indian states. Figures 3.9 and 3.10 present a clearer picture of the same.

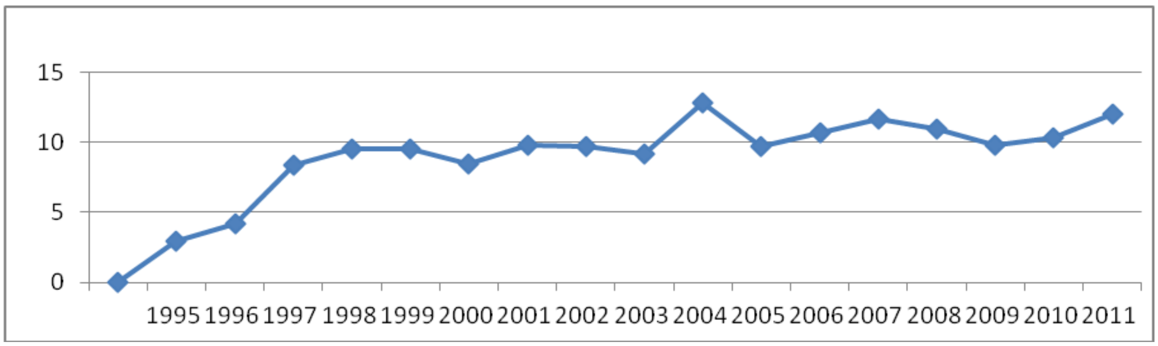
Table 3.4: Theil Index and Coefficient of Variation for industry TFP levels

Year	CV	Theil Index
1995	2.973	0.007
1996	4.164	0.013
1997	8.402	0.050
1998	9.534	0.054
1999	9.484	0.045
2000	8.439	0.027
2001	9.809	0.038
2002	9.673	0.039
2003	9.192	0.035
2004	12.808	0.085
2005	9.747	0.040
2006	10.643	0.042

Year	CV	Theil Index
2007	11.637	0.060
2008	10.922	0.048
2009	9.763	0.038
2010	10.363	0.039
2011	12.027	0.060
2012	11.241	0.047

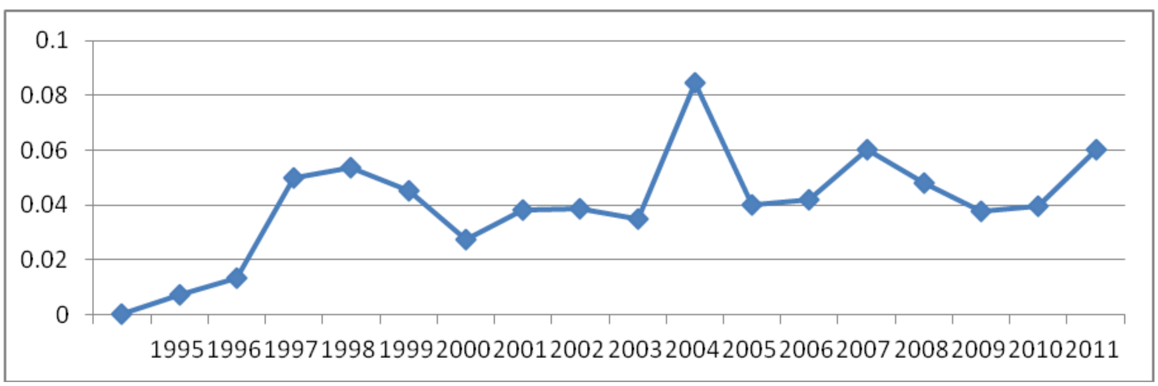
Source: Author's calculations

Figure 3.9: Plot of coefficient of variation for industry TFP levels (1995 to 2012)



Source: Author's calculations

Figure 3.10: Plot of Theil Index for industry TFP levels (1995 to 2012)



Source: Author's calculations

Further, Table 3.5 presents the results of sigma convergence equation. Even though the estimated coefficients of the trend for both the measures of dispersion – CV and Theil Index – are positive, only coefficient of CV comes out to be significant. This implies that there is an absence of tendency of reduction in dispersion of TFP levels or that there has been divergence in the TFP levels of 14 Indian states over the time period 1995 to 2012.

Table 3.5: Regression Results for Sigma Convergence of Industry TFP level

Model 1: $CV = \alpha + \beta t + u$

Variable	**Coefficient**	**Standard Error**	**t value**	**P value**
t	0.340	0.078	4.39	0.000
Adjusted R^2	0.546			

Model 2: $TI = \alpha + \beta t + u$

Variable	**Coefficient**	**Standard Error**	**t value**	**P value**
T	0.0015	0.0007	1.99	0.064
Adjusted R^2	0.199			

As for the beta convergence test, the results have been tabulated in Table 3.6. The coefficient on the lagged variable of per capita industrial SDP is significant and less than 1 which makes β negative in value.

Table 3.6:Arellano-Bond dynamic panel data estimation results for industry TFP levels

Variable	**Coefficient**	**Robust Standard Error**	**z**	**p-value**
$Ln(TFP_{i,t-1})$	0.714	0.031	23.22	0.000
Constant	0.802	0.096	8.34	0.000
β = b - 1	-0.286			
Implied Speed of Convergence = (1/17)(Ln(1-β))	0.015			

However, the implied speed of convergence so calculated comes out to be very low, approximately 1.4% annually. This doesn't suggest any effective catching up by the states with low industry TFP levels to states with high industry TFP levels.

Trivedi (2004) and Goldar (2004) had established in their studies that the TFP levels and growth rates declined in the post reform period across Indian states. This study corroborates these findings, albeit for a longer time period.

Ray (2002) and Kumar (2006) had concluded in their respective studies that there has been a tendency of TFP levels to converge for Indian states in the post-reform period (after 1991-92). However the time span taken by these studies to test the presence or absence of convergence in TFP levels has been small, 5 to 9 years in the post reform period. For better and accurate results, the time span needs to be increased and therefore in this study, the time period taken is 17 years. Therefore, over a longer period of time it becomes clear that there has been no tendency towards reduction in inequalities in the TFP levels and due to low convergence speed it can be concluded that there has been no effective catching-up by lower TFP states with higher TFP states.

3.5 Institutional Outcome Variables and the Institutional Quality Index (IQI):

Firstly, to estimate the impact of various institutional outcome variables on convergence of per capita GSDP, regression analysis using panel data is employed. To tackle the issue of endogeneity of the variables and to carry out an analysis of conditional convergence hypothesis, the Arellano-Bond dynamic panel data estimation was carried out.

The results of the regression analysis have been tabulated in Table 3.7. The coefficients of variables revenue surplus (RS) and installed capacity of electricity per 10000 persons in a state (IC) came out to be significant at 5% significance level. Also, the sign of the coefficient PPC came out to be positive which on interpretation implies that a 1% increase in percentage pendency of IPC crimes in a state's courts results in a 0.71% increase in industry gross state domestic product. This result doesn't meet the expectation of obtaining a negative sign implying an inverse relation between the variables IPC and industry gross SDP.

Table 3.7:Arellano-Bond dynamic panel data estimation results

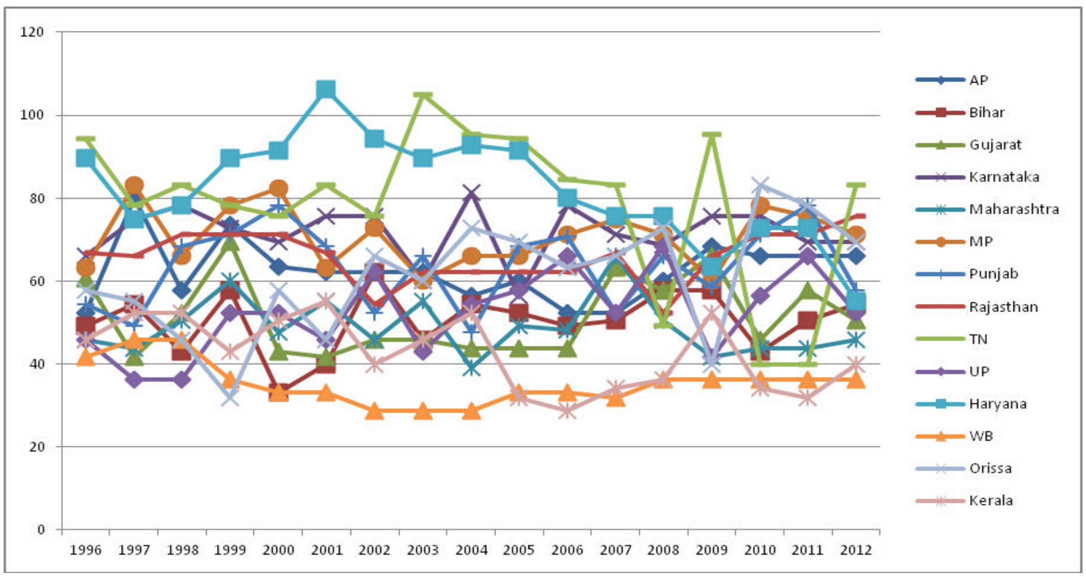
Variable	Coefficient	Robust Standard Error	z	p-value
$Ln(output_{i,t-1})$	0.77	0.04	19.15	0.000
PPC	0.0071	0.004	1.85	0.065
lMD	-0.008	0.005	-1.62	0.105
RS	0.037	0.0063	5.83	0.000
IC	0.227	0.097	2.35	0.019
PR	0.0006	0.001	0.59	0.553
Constant	1.24	0.37	3.40	0.001

However, the coefficients of rest of the variables show appropriate signs with respect to their relations with industry gross SDP. A 1% rise in loss of man-days to industrial disputes in a state leads to a fall in industry gross SDP by 0.008%. Even though the variable lMD isn't significant, the relation with the dependent variable meets the expectation. The Revenue Surplus variable, as expected, has a positive sign implying that for a 1% rise in revenue surplus, there is 3.7% rise in the industry gross SDP. The other significant variable is IC or installed capacity of electricity per 10,000 persons (in Mega Watts). The regression analysis deems that a unit rise in Installed Capacity per 10,000 persons by a SEB leads to 22.7% rise in industry output. Even though the variable PR did not come out to be significant, the sign of its coefficient meets the expectation of existence of a positive relation between improvement in law and order to industrial output. A 1% increase in recovery of stolen property by police leads to 0.06% rise in industrial output.

Since the coefficient of percentage pendency of IPC crimes in a state's courts (PPC) came out unexpectedly to be positive in sign and non-significant, it is dropped from construction of index. Also, even though the coefficient of variable percentage of stolen property recovered by Police came out with the expected sign, it wasn't significant. However, for the lack of any other suitable indicator for capturing the quality of public institutions carrying out the function of legitimizing the market, this variable is incorporated in the construction of the index.

Second step in the analysis of institutional outcome variables was to construct a composite indicator or an index of Institutional Quality. The first type of Institutional Quality Index considered was computed by assigning categorical values to indicators on the basis of percentile values and aggregating by geometric and linear methods. Figure 3.11 plots the trend of the geometrically aggregated Index from 1996 to 2012 for 14 Indian states. As can be clearly observed the worst performers over the years are states of West Bengal, Bihar, Kerala, Maharashtra and UP, while the top performers are Karnataka, MP, Tamil Nadu (TN) and Haryana.

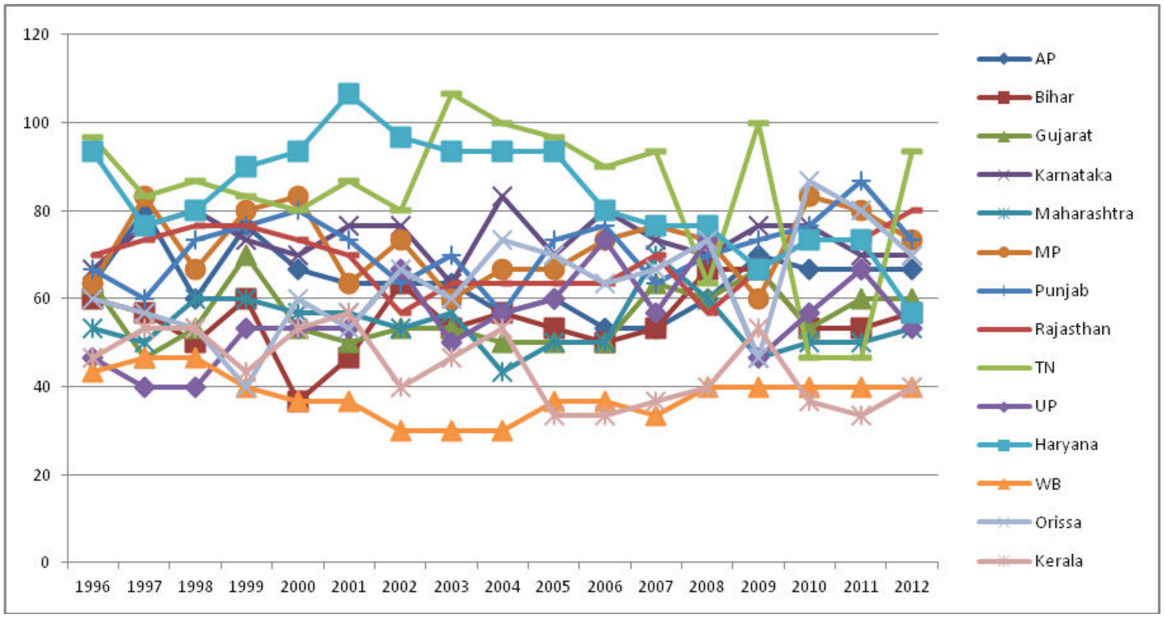
Figure 3.11: Trend of Institutional Quality Index (Geometrically aggregated Categorical Scores) for 14 major Indian states (1996-2012)



Source: Author's calculations

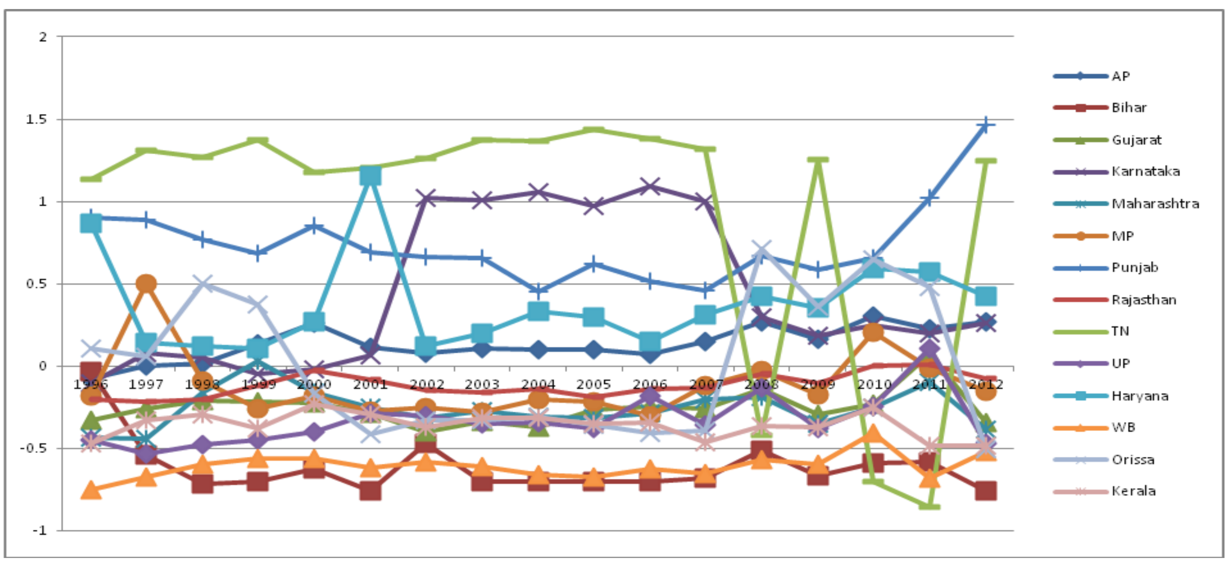
On the other hand, Figure 3.12 plots the trend of the arithmetically aggregated Index from 1996 to 2012 for 14 Indian states. Similar trends are observed for this Index as well. The worst performers over the years are states of West Bengal, Bihar, Kerala, Maharashtra and UP, while the top performers are Karnataka, MP, Tamil Nadu (TN) and Haryana. Further, Figure 3.13 plots the trend of the Institutional Quality Index based on standardized or z scores over the period 1996 to 2012. Same as before, the worst performers are states of West Bengal, Bihar, Kerala and UP while the top performers are Karnataka, MP and Haryana.

Figure 3.12: Trend of Institutional Quality Index (Arithmetically aggregated Categorical Scores) for 14 major Indian states (1996-2012)



Source: Author's calculations

Figure 3.13: Trend of Institutional Quality Index (Z scores) for 14 major Indian states (1996-2012)



Source: Author's calculations

On comparing the ranks on the basis of IQI scores for both standardized scores and categorical scores at two points in the time period 1996 and 2012 , interesting results are obtained . According to the table, states of Gujarat and Maharashtra, the two 'industrial states' since 1996 haven't scored well on the index and their ranking hasn't improved over the time period 1996-2012. On other hand, states of West Bengal, Kerala and Bihar have been the bottom three states on the Index in the given time period. Madhya Pradesh has shown remarkable improvement on the index.

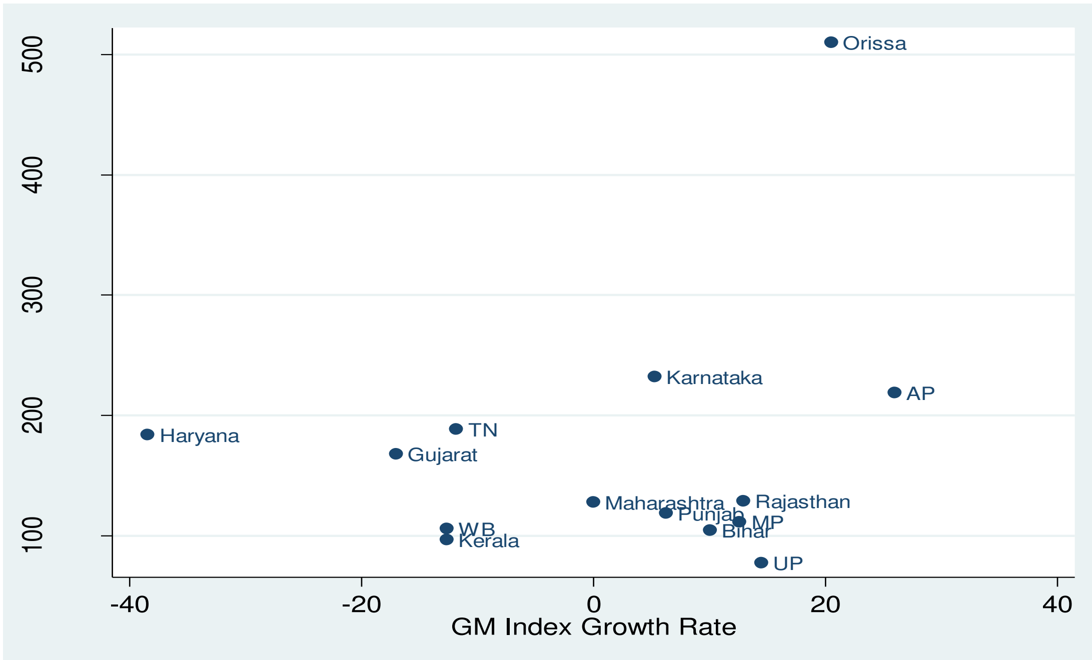
Table 3.8: Ranks of Institutional Quality Index based on standardized scores (z scores) and categorical scores

	Standardized or Z scores			**Categorical Scores (Arithmetic Aggregation)**			**Categorical Scores (Geometric Aggregation)**		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	
Andhra Pradesh	6	5	Improvement	6	6	Status Quo	9	7	Improvement
Bihar	13	13	Status Quo	9	9	Status Quo	10	9	Improvement
Gujarat	10	11	Setback	7	11	Setback	6	8	Setback
Karnataka	7	6	Improvement	4	4	Status Quo	4	5	Setback
Maharashtra	14	12	Improvement	11	12	Setback	11	11	Status Quo
Madhya Pradesh	8	7	Improvement	8	3	Major Improvemen	5	3	Improvement

	Standardized or Z scores			Categorical Scores (Arithmetic Aggregation)			Categorical Scores (Geometric Aggregation)		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	
						t			
Punjab	3	2	Improvement	5	7	Setback	8	4	Improvement
Rajasthan	4	4	Status Quo	3	2	Improvement	3	2	Improvement
Tamil Nadu	1	1	Status Quo	1	1	Status Quo	1	1	Status Quo
Uttar Pradesh	9	8	Improvement	12	10	Improvement	12	12	Status Quo
Haryana	2	3	Setback	2	8	Major Setback	2	10	Major Setback
West Bengal	11	10	Improvement	14	14	Status Quo	14	13	Improvement
Orissa	5	9	Major Setback	10	5	Major Improvement	7	6	Improvement
Kerala	12	14	Setback	13	13	Status Quo	13	14	Setback

Source: Author's calculations

Figure 3.14: Scatter Plot of Industry GSDP growth rate and Categorical Score (Geomteric Mean aggregated) based Index growth rate

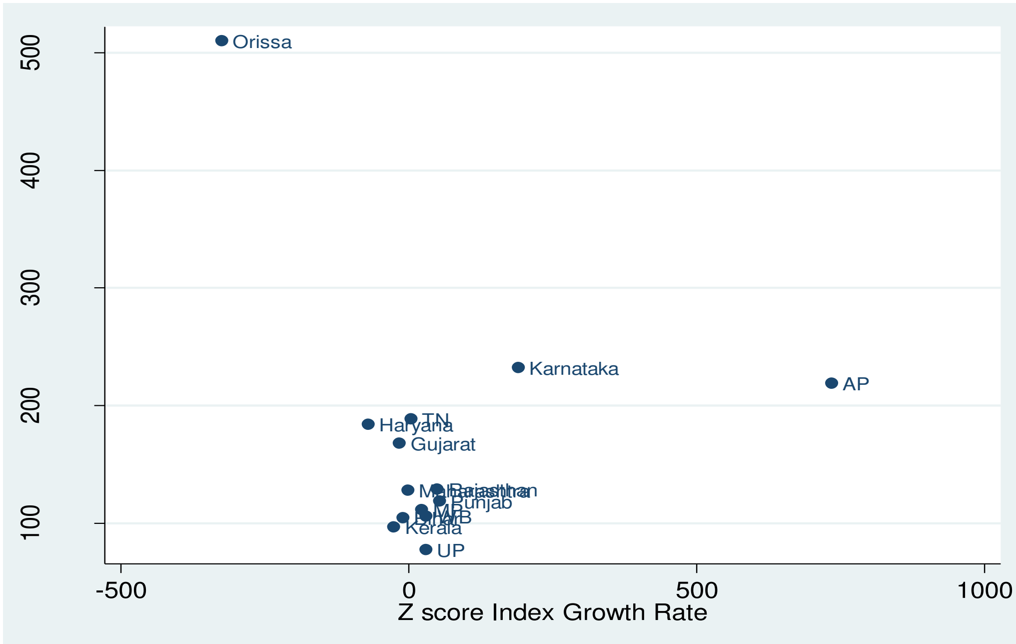


Source: Author's caculations

Figure 3.15: Scatter Plot of Industry GSDP growth rate and Categorical Score (Arithmetic Mean aggregated) based Index growth rate

Source: Author's caculations

Figure 3.16: Scatter Plot of Industry GSDP growth rate and Z score based Index growth rate



Source: Author's caculations

On creating scatter plots for the growth rates industry GSDP and the IQI (all three measures), a positive relation between quality of institution and industry income is obtained. Relatively better results are obtained by using categorical scores rather than Z scores. For the state of Orissa, conflicting result is obtained for categorical and Z score based Index. States like Gujarat, Maharashtra, Haryana and Punjab, the traditional industrial states though still have higher per capita industrial incomes but it is seen here that with improving quality of institutions in other states, the growth in their incomes is lagging. On other hand, Karnataka, Andhra Pradesh (AP) and Orissa have performed exceptionally well in industrial growth commensurating with improvement in the index growth rate. Even though states of Rajasthan and Madhya Pradesh have improved considerably on the quality of institutions front they haven't been able to achieve a very high industrial growth rate as states of Karnataka, AP and Orissa. Here, an important question arises that what explains the growing industrial incomes in states of Gujarat, Maharashtra and Haryana where the quality of institutions is lower relative to other Indian states. A closer look (refer Appendix II) at the individual institutional variable scores provides some explaination. Gujarat and Maharashtra are top performers in the scores for inverse of loss of man days due to industrial disputes, for installed capacity of electricity per 10,000 people and for ratio of revenue surplus to GSDP in percent, in 2012. However, they perform badly, getting low scores for percentage of stolen property recovered by police variable. However, nothing really explains the persistence of high industrial growth in Haryana as it scores low and has in fact deteriorated in ranking over the period 1996-2012 for all institutional indicators. Perhaps, no new industrial projects have been started in the state and it is just the old projects generating higher revenue. But this is purely conjecture and requires a further detailed study.

Chapter 4: Summary, Conclusion and Limitations

4.1 Summary:

The three research objectives that were set out in the beginning of the study were thoroughly analyzed in the previous chapter. Firstly, it was deemed necessary to test the convergence hypothesis for per capita GSDP and TFP levels across 14 major Indian states in the post-reform period (after 1991).[12] The second research objective was to identify the institutional factors influencing the industrial output in Indian states in the post-reform period and test the convergence hypothesis after controlling for these factors. While the third objective was to create an institutional quality index (IQI) to analyze the change in quality of institutions over a period of time in different states.

The thesis employed the Arellano Bond GMM methodology to the panel data for 14 Indian states to test the convergence hypothesis. This was done in order to obtain consistent estimates of the convergence speed. Also, the longer and updated time period of 1991-2012 helped to gain important insights into the changing contours of industrial sector in Indian states.

4.2 Conclusion:

The thesis aimed to test the convergence hypothesis for industrial gross state domestic product and total factor productivity levels for aggregate industry as well as identify the institutional factors that affect the industrial output. It is important to emphasise here that the fact that states grow at different rates should not be viewed as a failure of policy. Given the size and diversity, some may grow faster than others at certain times because they may be particularly well placed to exploit some new opportunity that arises. What is important is that there be a sustained reduction in disparities in industrial growth across Indian states.

That being said it was found during the preliminary analysis of the trends of the per capita industry state domestic product during the period 1991 to 2012 for 14 Indian states that there has

[12] The 14 Indian states are; Andhra Pradesh , Bihar (Jharkhand included), Gujarat, Karnataka, Maharashtra, Madhya Pradesh (Chattisgarh included), Punjab, Rajasthan, Tamil Nadu , Uttar Pradesh (Uttarakhand included), Haryana, West Bengal, Orissa and Kerala.

been a gradual rise in the industry output. However, states of West Bengal, Kerala and Bihar have had experienced negligible growth in industry output. Whereas the plot of TFP levels indicated that over the period 1995 to 2012, the TFP levels have declined for all Indian states. The declining TFP levels along with the evidence of declining capital productivity point towards declining returns to capital and rampant inefficiency. Despite the declining returns to capital there has been a gradual capital deepening and a shift to capital intensive industry. Therefore, even though the registered manufacturing sector has experienced growth in a few states, the commensurate rise in TFP levels hasn't been experienced pointing at gross inefficiency.

Secondly, on testing the sigma convergence hypothesis for per capita industry gross state domestic product it was found that there has been divergence in the output in the time period of 1991 to 2012. As for the beta convergence hypothesis, the empirical evidence suggested that there has been convergence in industry output across Indian states however the annual convergence speed was found to be very low. The same observation can be made for the TFP levels. Even though sigma convergence hypothesis was tested negative, the beta convergence hypothesis was found to be significant and positive for both TFP levels and per capita Industry GSDP. However, as before with per capita industry state domestic product, the convergence speed for TFP levels was very low. Thus, it can be concluded that there hasn't been any effective catching-up by the poor states (states having low industry gross state domestic product) to the richer states (states having high industry gross state domestic product).

Thirdly, the main purpose of this study was to identify the institutional factors explaining the industrial output gap between Indian states. After employing the Arellano-Bond estimation it was concluded that the institutional outcome variables of Revenue Surplus and Installed Capacity of electricity per 10,000 persons were significant and have a positive relation with industry output. This implies that institutions for macroeconomic stabilization, proxy for which is Revenue Surplus have a significant impact on industry output in a state. The results also indicate that the quality of bureaucracy and governance, proxy of which is Installed Capacity of electricity per 10000 persons also have an important role in determining the industry output. However, even though the institutional outcome variable loss of man-days due to industrial disputes came out to have the correct sign and relation with industrial output it wasn't significant. The regression analysis also provided the evidence of increase in annual convergence speed from 0.0023 to 0.0164, a rise of approximately 86%, when controlled for institutional quality implying faster growth in output once institutional factors are controlled for. Also, the analysis proved that states have been improving in terms of institutional quality and the states not performing well on this front are catching up with top performing states.

Fourthly, on computing the index of institutional quality through two different ways, it was observed that the states of Bihar, West Bengal, Kerala and UP were worst performers through the years 1996 to 2012. States of Karnataka, MP, Haryana and Punjab on the other hand were the top performers. The puzzling result however was that pertaining to states of Maharashtra and Gujarat. Both states scored low on the index all throughout the time period 1996 to 2012 but didn't experience any fall in industrial income. However, the two states did experience growth in index values commensurate with the growth in per capita industry state domestic product that is the states experienced an overall improvement in the quality of institutions during the period of industrial growth.

The thesis shed light on the all too prevalent inequalities in the industrial incomes (per capita industry GSDP) and therefore, the disparities in industrial growth. It was also highlighted that even though the industrial incomes have risen in states, the TFP levels have declined, putting the focus on the increase in inefficiency in the registered manufacturing sector. This is a serious cause of concern and requires further detailed study. The thesis also studied the impact of institutional quality on industrial incomes and found a reasonably significant evidence of the same. Majority of the states have shown considerable improvement in institutional quality over the time period 1995-2012, according to the Institutional Quality Index.

However, there is still a long way to go to reduce the inequalities in industrial growth across India states. Institutions evolve or change gradually, usually taking several years. India however doesn't have time. With a growing population in the age group of 15-65 years, the work force is swelling in numbers. Industry is the one sector which can provide employment to the expanding work force only if it is allowed to function in an institutional environment conducive to its growth.

4.3 Limitations:

Any study may have a number of limitations stemming from assumptions of its empirical methodology, data sets employed and/or concept in general. The limitations of this thesis have been enumerated as follows:

4.3.1 Convergence hypothesis is fraught with errors and it has been proven time and again that it is an inadequate concept in growth theory (Bernard and Durlauf, 1991; Quah, 1996; and Cohen, 1996).

4.3.2 Taking the aggregate industry data from ASI to calculate TFP levels ignore the structural make up of the industrial sector across different Indian states.

4.3.3 Institutions are endogenous to the system and are difficult to quantify.

Firstly, even though convergence hypothesis has been criticized widely, it has widely impacted the way economists conceptualize long-term growth relationships between different regions. And therefore, to get a picture of extent of regional inequalities among Indian states with regard to industrial sector, convergence hypothesis seemed to be a satisfactory way to go.

Secondly, the aggregate data from ASI was taken to compute TFP levels for aggregate industry to obtain a holistic picture of the productivity levels across Indian states in the industry. From a policy maker's perspective it is essential to study the distribution of different categories of industry and analyze TFP levels for each category across India using disaggregated data. However, to get a bird's eye view of the health of the industry in different Indian states, employing aggregate data is necessary.

Finally, Institutions are very difficult to quantify but following Knack and Keefer (1995) and Subramanian (2007), the thesis employed institutional outcomes as variables proxy for actual institutions. Also the institutional outcome variables were included as endogenous variables in the model to help handle the issue of endogeneity.

Appendix I

To understand the concept of convergence the section will start with the Solow model. The steady state equilibrium in the Solow model is expressed as a situation in which the capital stock grows at a constant rate and per capita capital does not grow. People save a fraction (s) of income (Y) while the capital depreciates (at the rate δ) so that the net increase in the capital stock is;

$$\dot{K} = sY - \delta K = sAK^{\alpha}L^{1-\alpha} - \delta K$$

(When, the production function is; Y= $F(A, L, K) = AK^{\alpha}L^{1-\alpha}$ and in per capita terms, $y = Ak^{\alpha}$)

And the growth rate of the capital stock is;

$$\frac{\dot{K}}{K} = sY - \delta K = sAK^{\alpha-1}L^{1-\alpha} - \delta$$

While the growth rate of the per capita capital stock is;

$$\frac{\dot{k}}{k} = \frac{\dot{K}}{K} - \frac{\dot{L}}{L} = sAk^{\alpha-1} - (\delta + n) \qquad \text{……………………….(1)}$$

(where, n is the growth rate of the population)

In order to find the long-run equilibrium, equate $\frac{\dot{k}}{k}$ to zero and solve for k.

Therefore; $sAk^{\alpha-1} = (\delta + n)$

$$k^{*} = \left[\frac{\delta + n}{sA}\right]^{1-\alpha} = \left[\frac{sA}{\delta + n}\right]^{\frac{1}{1-\alpha}} \qquad \text{…………………….(2)}$$

This steady state is stable if k is less than k*. This implies that the capital-labor ratio would increase as savings exceed depreciation of the existing capital stock plus population growth. If however, k is greater than k* then capital stock per capita would depreciate faster than being replaced until it reaches k*. At the steady state, per capita income can be expressed as;

$$y^* = A(k^*)^{\alpha} = A^{\frac{1}{1-\alpha}}\left(\frac{s}{\delta + n}\right)^{\frac{\alpha}{1-\alpha}} \quad \text{……………………..(3)}$$

Thus according to the Solow model in the long run the income differences across countries are due to differences in savings, productivity, or population growth. Since growth is only driven by capital accumulation, countries with higher savings rates will have higher income in the long run.

Now, let $\frac{\dot{A}}{A} = g$ and $\frac{\dot{L}}{L} = n$. Differentiate $y = Ak^{\alpha} = Af(k)$ with respect to time;

$$\frac{\dot{y}}{y} = g + \left(\frac{\acute{f}(k)k}{f(k)}\right)\left(\frac{\dot{k}}{k}\right) = g + t(k)\left(\frac{\dot{k}}{k}\right) \quad \text{……………….(4)}$$

Further, on first order taylor expansion of equation (1);

$$\frac{\dot{k}}{k} = (t(k) - 1)(\delta + g + n)(\log k - \log k^*) \quad \text{…………(5)}$$

Substitute (5) into (4);

$$\frac{\dot{y}}{y} = g - t(k)(t(k) - 1)(\delta + g + n)(\log k - \log k^*) \quad \text{…(6)}$$

$y^* = Af(k^*)$ is defined as the level of per capita output that would apply if the effective capital-labor ratio were at its steady-state value and technology at a point in time. y∗ (t) therefore is the steady-state level of per capita output even though it is not constant. Now taking first-order Taylor expansions of log y with respect to log k (t) around logk* gives;

$$\log y - \log y^* \cong t\,(k)(\log k - \log k^*) \quad \text{……………….(7)}$$

Substitute (7) into equation (6) to obtain;

$$\frac{\dot{y}}{y} = g - (t(k) - 1)(\delta + g + n)(\log y - \log y^*) \quad \text{……...(8)}$$

Equation (8) makes it clear that, in the Solow model, there are two sources of growth in per capita output: the first being g or the rate of technological progress and the second being convergence. This latter source of growth results from the negative impact of the gap between the current level of output per capita and the steady state level of output per capita on the rate of capital accumulation. Intuitively, the further below is a country from its steady state capital-labor ratio, the more capital it will accumulate and the faster it will grow. This is because lower is the per capita output (y) relative to steady state per capita output ($y*$), lower is the capital per worker (k) relative to steady state capital per worker ($k*$), the greater is the average product of capital [$f(k*)/k*$] leading to faster growth in the effective capital-labor ratio.

Therefore between two countries the country with lower per capita capital stock, hence lower per capita income, will grow at a faster rate. However, over a period of time the two countries would converge in terms of their per capita income levels as well as the growth rates which are assumed to be the same in the long run. This is an outcome borne out of the diminishing marginal productivity of capital assumption made in the Solow model.

Appendix II

This section gives a brief overview of the change in quality of institutions over the period of time for every state and for every institutional variable employed to construct the Institutional Quality Index in the thesis.

The following table is for the variable inverse of number of man days lost due to industrial disputes at two points in time – 1996 and 2012. States of Gujarat, Maharashtra and Punjab show improvement in both types of scores in this category.

	Standardized or Z scores			**Categorical Scores**		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**
Andhra Pradesh	13	10	Improvement	1	6	Improvement
Bihar	3	4	Setback	3	3	Status Quo
Gujarat	**12**	**5**	**Improvement**	**11**	**4**	**Improvement**
Karnataka	8	9	Setback	7	7	Status Quo
Maharashtra	**11**	**3**	**Improvement**	**12**	**5**	**Improvement**
Madhya Pradesh	4	6	Setback	5	8	Setback
Punjab	**5**	**1**	**Improvement**	**6**	**1**	**Improvement**
Rajasthan	6	8	Setback	8	9	Setback
Tamil Nadu	10	13	Setback	9	13	Major Setback
Uttar Pradesh	7	7	Status Quo	10	10	Status Quo

	Standardized or Z scores			Categorical Scores		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**
Haryana	1	12	Major Setback	2	11	Major Setback
West Bengal	14	14	Status Quo	13	14	Setback
Orissa	2	2	Status Quo	4	2	Improvement
Kerala	9	11	Setback	14	12	Improvement

The following table is for the variable RS or ratio of Revenue Surplus to GSDP in percent at two points in time – 1996 and 2012. Again states of Gujarat, Maharashtra and Punjab show improvement in both types of scores in this category.

	Standardized or Z scores			Categorical Scores		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**
Andhra Pradesh	13	10	Improvement	1	6	Setback
Bihar	3	4	Setback	3	3	Status Quo
Gujarat	**12**	**5**	**Improvement**	**11**	**4**	**Improvement**
Karnataka	8	9	Setback	7	7	Status Quo
Maharashtra	**11**	**3**	**Improvement**	**12**	**5**	**Improvement**
Madhya Pradesh	4	6	Setback	5	8	Setback
Punjab	**5**	**1**	**Improvement**	**6**	**1**	**Improvement**

	Standardized or Z scores			Categorical Scores		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**
Rajasthan	6	8	Setback	8	9	Setback
Tamil Nadu	10	13	Setback	9	13	Major Setback
Uttar Pradesh	7	7	Status Quo	10	10	Status Quo
Haryana	1	12	Major Setback	2	11	Major Setback
West Bengal	14	14	Status Quo	13	14	Setback
Orissa	2	2	Status Quo	4	2	Improvement
Kerala	9	11	Setback	14	12	Improvement

The following table is for the variable IC or installed capacity of electricity per 10,000 people at two points in time – 1996 and 2012. Only the state of Madhya Pradesh (MP) shows improvement in both types of scores in this category. States of Gujarat and Maharashtra don't show any clear trend but in both the cases their ranks lie in the top 5 of the list.

	Standardized or Z scores			Categorical Scores		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**
Andhra Pradesh	6	6	Status Quo	6	6	Status Quo
Bihar	14	14	Status Quo	13	13	Status Quo
Gujarat	4	2	Improvement	2	3	Setback

	Standardized or Z scores			Categorical Scores		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**
Karnataka	3	7	Setback	7	4	Improvement
Maharashtra	5	4	Improvement	3	5	Status Quo
Madhya Pradesh	**9**	**8**	**Improvement**	**8**	**7**	**Improvement**
Punjab	1	1	Status Quo	1	1	Status Quo
Rajasthan	8	12	Setback	11	8	Improvement
Tamil Nadu	7	5	Improvement	4	9	Major Setback
Uttar Pradesh	13	13	Status Quo	14	14	Status Quo
Haryana	2	3	Setback	5	2	Improvement
West Bengal	10	11	Setback	12	10	Improvement
Orissa	12	9	Improvement	9	11	Setback
Kerala	11	10	Improvement	10	12	Setback

The following table is for the variable PR or percentage of stolen property recovered by the police at two points in time – 1996 and 2012. States of Bihar, Karnataka, Rajasthan, Tamil Nadu and Uttar Pradesh have clearly shown consistent improvement in both categories of scores. States of Gujarat, Kerala and Maharashtra are the worst performers on this institutional variable.

	Standardized or Z scores			Categorical Scores		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**

	Standardized or Z scores			Categorical Scores		
	Rank in year 1996	**Rank in year 2012**	**Status**	**Rank in year 1996**	**Rank in year 2012**	**Status**
Andhra Pradesh	5	4	Setback	4	3	Improvement
Bihar	**13**	**11**	**Improvement**	**13**	**11**	**Improvement**
Gujarat	12	13	Setback	11	13	Setback
Karnataka	**7**	**5**	**Improvement**	**6**	**4**	**Improvement**
Maharashtra	14	14	Status Quo	14	14	Status Quo
Madhya Pradesh	8	8	Status Quo	7	6	Improvement
Punjab	4	3	Improvement	5	5	Status Quo
Rajasthan	**2**	**1**	**Improvement**	**2**	**1**	**Improvement**
Tamil Nadu	**3**	**2**	**Improvement**	**3**	**2**	**Improvement**
Uttar Pradesh	**9**	**7**	**Improvement**	**8**	**7**	**Improvement**
Haryana	1	6	Major Setback	1	8	Major Setback
West Bengal	10	10	Status Quo	9	9	Status Quo
Orissa	6	9	Setback	10	10	Status Quo
Kerala	11	12	Setback	12	12	Status Quo

Appendix III

Following are the Total Factor Productivity growth (TFPG) values for 14 Indian states over the time period 1995 to 2012.

Year	AP	Bihar	Gujarat	Karnataka	Maharashtra	MP	Punjab	Rajasthan	TN	UP	Haryana	WB	Orissa	Kerala
1995	-0.31	-0.38	-0.63	-0.54	-0.40	-0.25	-0.51	-0.46	-0.41	-0.53	-0.24	-0.37	-0.42	-0.41
1996	-0.19	-0.17	-0.26	-0.22	-0.05	-0.63	-0.14	-0.40	-0.23	-0.24	-0.30	-0.09	-0.02	-0.20
1997	-0.25	0.23	-0.68	-0.41	-0.47	-0.39	-0.31	-0.26	-0.45	-0.18	-0.38	-0.05	-0.19	-0.38
1998	-0.52	-0.32	-0.03	-0.35	-0.30	-0.27	-0.04	-0.56	-0.25	-0.59	-0.16	-0.41	-0.71	0.06
1999	-0.09	-0.22	-0.24	-0.35	-0.18	-0.12	-0.06	0.14	-0.10	-0.15	-0.07	-0.24	0.10	-0.35
2000	-0.18	-0.72	-0.33	-0.19	-0.12	0.01	-0.39	-0.15	0.08	-0.03	-0.37	-0.11	-0.27	-0.19
2001	0.02	-0.30	-0.17	-0.01	-0.24	-0.10	0.15	-0.20	-0.11	-0.17	0.00	-0.01	-0.27	-0.17
2002	-0.07	0.56	0.13	0.00	-0.02	-0.09	-0.13	-0.13	-0.31	0.01	-0.01	0.02	0.20	-0.03
2003	0.03	-0.02	0.05	-0.02	-0.01	0.07	-0.14	-0.04	0.05	-0.09	0.00	-0.03	0.01	-0.06
2004	-0.02	0.52	0.02	0.17	-0.05	0.11	-0.09	0.09	0.04	-0.09	0.03	0.13	0.42	-0.16
2005	-0.07	-0.46	0.05	-0.20	0.15	-0.19	-0.05	0.05	-0.09	-0.03	-0.05	-0.25	-0.18	-0.05
2006	0.23	-0.34	-0.22	0.20	0.02	0.29	0.24	0.25	0.05	0.10	-0.06	0.07	0.11	-0.37
2007	-0.06	0.51	0.06	-0.10	-0.05	0.03	0.10	-0.17	-0.14	-0.01	-0.07	0.06	0.11	0.37
2008	-0.03	-0.35	-0.18	0.02	-0.15	-0.05	-0.26	0.17	-0.16	0.28	-0.05	0.02	-0.01	0.13
2009	-0.09	-0.11	0.24	-0.29	-0.09	-0.22	0.05	0.04	0.25	-0.24	0.15	0.02	-0.37	-0.14
2010	0.16	0.09	-0.19	-0.06	0.06	-0.11	0.17	-0.34	0.03	0.19	-0.28	-0.08	-0.16	0.06
2011	-0.08	-0.23	-0.16	0.77	-0.09	-0.09	0.37	0.70	-0.05	-0.18	0.07	-0.13	-0.13	-0.03
2012	-0.36	-0.18	0.21	-0.79	-0.04	-0.06	-0.62	-0.42	0.07	0.01	0.10	0.03	-0.18	0.62

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