

Development patterns in India: Spatial convergence or divergence?

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Abstract The impact of globalization has led some nations to attain higher rates of growth while others have shown declining growth, along with widening regional disparities within nations. The regional convergence (RC) thesis addresses this issue of measuring inequality among sub-national economies of a nation, and across nations over a long period of time. This thesis utilizes two measures beta and sigma convergence to analyze if poor nations catch up with developed nations, and if regions within a nation close the gap with developed regions. The Indian economy has witnessed increasing economic inequality since independence. Given this overview the objective of this paper is to review recent literature on RC and address the following four questions: (1) What insights do recent studies provide on convergence debate? (2) What are the various explanations and tools to understand and measure regional convergence? (3) What is the role of geography in explaining spatial convergence/divergence analysis of economies? (4) What are the trends of regional inequality in India during the 1961–2011 periods? Domestic Product of States in India (1960–1961 to 2006–2007) and Reserve Bank of India publications provide data for the past

fifty years on per capita net state domestic product. Simple measures of dispersion reveal increase in regional inequality during the study period with moderate drops during 1970–1971 and 1980–1981 periods. Descriptive measures indicate persistence and limited upward mobility of states. Also, prosperous regions are located in the rich agricultural and industrial states of Punjab, Gujarat and Maharashtra, and lagging regions are the impoverished agricultural states of Bihar and Madhya Pradesh.

Keywords Convergence · Spatial Analysis · India

Motivation

Globalization has led to both rapid increases in national economic growth rates as well as economic disparities across nations. Several developing economies such as Brazil, Russia, South Africa, China and India have shown rapid economic progress along with an increase in the size of the economic indicators, such as gross national product, industrial production and employment levels. However, at the global level, Pritchett (1997) posits rich countries have grown richer and poor countries have remained poorer, thereby increasing divergence in income levels; while Sala-i-Martin (2002) argues that results of several measures of inequality suggest global income inequality declined during 1980s–1990s. A particular kind of

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disparity that is often ignored in the development debate is the regional inequality. As global development takes place some nations grow faster than others, but at the same time, regions within nations grow faster relative to deprived regions within the same nation. *The Economist* (2011) reported the gap between endowed and lagging regions in the developed nations will increase during the aftermath of the financial meltdown, as government spending and sequestration measures will hurt the impoverished regions relatively more than developed regions. The budget cuts in the US will impact both local and state government and hamper spending in critical areas suggesting lagging regions long term inability to catch up with wealthier regions.

In the global arena Kharas and Kohli (2011) have discussed the existence of a group of countries that exemplify ‘*Middle Income Trap*’ nations. Among this group of countries, Brazil and South Africa demonstrate that they are unable to compete with low-income, low-wage economies in manufactured exports; and are unsuccessful in competing with developed nations in high-skill innovations. Three transition strategies have been suggested to avoid this trap. These are: (1) shifting ‘from diversification to specialization in production’, (2) changing ‘focus from physical accumulation of capital to productivity-led growth’, and (3) ‘movement away from centralized to decentralized management’.

An approach utilized to study the phenomenon of poor nations catching up with developed nations and lagging regions within a nation, and closing the gap with progressive regions is called regional convergence (RC). The RC construct posits a decrease of regional income inequality over time and across space within a nation or divergence if the reverse holds true. Sala-i-Martin (1996) estimated RC in US, Japan and a selected set of five nations from the European Union. He observed regions to converge at surprisingly similar speed of 2 % across sample regions. Martin and Sunley (1998) did a critical survey of the convergence debate and observed that new empirics of RC is much slower than suggested by neoclassical growth theory. This led to the emergence of endogenous growth theory which stressed upon increasing returns, human capital and technology as factors that are endogenous to the growth process.

Given the diverse global trends of convergence and divergence it is eminent to examine the nature of economic inequality in an emerging economy such as India. The Indian economy has witnessed economic disparities at the regional levels due to pursuance of a mix of domestic and external policies (Cashin and Sahay 1996); and economic reform policies thereby creating leading and lagging regions (Ahluwalia 2000). The Indian economy during post-1991 era has shown rapid pace in economic growth.

The gross national product (GNP) growth rate was 5.8 % (1981–1982), and 9.0 % (2005–2006) respectively during pre-reform and post-reform periods (Statistical Outline of India 2006–2007). This dramatic transformation can be attributed to the adoption of the ‘economic mantra’ by the Indian government in 1991, namely: *deregulation*, *privatization* and *liberalization*. The year 1991 is considered as a watershed in the process of economic transformation as prior to this period the Indian economy was under a ‘command economy regime’, and following this period ‘market economy approach’ was adopted by the government and policy-makers. The pre-1991 period was characterized by a focus on socialist goals and a dominant role of the public sector in every sphere of economic development; and the post-1991 period has been characterized by greater role of private-sector, liberalization in finance, trade, foreign direct investment flows and industrial sectors. Ahluwalia (2000) observed an increase in inequality among 14 major states in India. The first disaggregated analysis at the district level attributed access to credit, literacy, and roads to have an influence in understanding regional disparities in India, thereby allowing policy-makers to identify states where to focus policy attention for maximizing growth (Singh et al. 2010).

Subsequently, Bandhopadhyay (2012a) influenced by Quah (1996) utilized the ‘distributional dynamics approach’ to identify ‘twin peaks’ across Indian states. This implies the existence of persistence, immobility and polarization during 1965–1997 periods across Indian states. The Indian regional growth performance is polarized with the formation of two clubs: rich and poor. The former comprises agricultural and industrial states in Northwest and Western India and the high-technology states in south. The poor club comprises the states of Odisha (Orissa), Bihar, Rajasthan, Madhya Pradesh and Uttar Pradesh.

More recently, the Indian economy has shown debilitating performance as the rupee has devalued, current account deficit is soaring high, fiscal deficit as a percentage of gross domestic product is around 7 % and imports are high relative to exports making the balance of trade adverse (*The Economist* 2013a). The question is just a few months back India was celebrating its economic miracle, so how did this dismal failure occur? Is the failure due to a global or a local factor? Analysts argue it is partly global, since as the US Federal Reserve Bank announced its decision to taper off its vast purchase of treasury bonds, the investors started to withdraw investment from emerging markets. In addition, the local factors account for India's economic calamity as well and they are increasing subsidies, soaring fiscal deficit and unfavorable trade balance. The Indian economy is no longer the 'breakout nation' (Sharma 2013) but part of the group of breakdown nations. Many of the emerging economies, such as China, Thailand, Brazil and Malaysia are performing relatively better than India except Mexico, Indonesia, Turkey and South Africa on account of several economic indicators (*The Economist* 2013a, b). The fall out of this economic bust is that as India takes steps to adjust and make an effort to rebound how would state economies be affected? A negative outcome might be that endowed regions might not be hurt so much but the lagging economies would get hurt adversely. Indian policy makers will need to push for higher growth in the manufacturing sector, implement further economic reforms, increase exports and decrease the size of fiscal deficit.

Given this overview the purpose of this paper is to address four questions: (1) What insights do recent studies provide on convergence debate? (2) What are the various explanations and tools to understand and measure regional convergence? (3) What is the role of geography in explaining spatial convergence/divergence analysis of economies? (4) What are the trends of regional inequality in India during the 1961–2011 periods? To answer these questions the paper is divided into five sections. The second section examines the literature and discusses the tools of convergence. The third section summarizes Indian studies on convergence analysis. The fourth section describes the space time trends in per capita net state domestic

product (PCNSDP) variations in India and the last section concludes with directions for future studies.

Convergence debate: review, explanation and measurement

Literature review

Globalization has impacted the rate of growth of different nations in the world leading to core and periphery patterns of global development; and inverted-U-curve relationship discovered by Kuznets (1955) for various countries. It was further observed that regions within nations experienced growth at uneven rates as national development took place. It is postulated that inequality first increases, then decreases over time. This thesis has long drawn attention of development analysts and economic geographers for explaining trends, developing methodological tools for measuring it and providing empirical verification. Several economists, such as Baumol (1986), and Barro (1991) analyzed a cross section of countries and determined convergence among developed countries and divergence among less developed countries. Romer (1986) observed the lack of convergence across nations in the world and argued for an alternative framework to understand modern growth. Sala-i-Martin (1996) in a study of US, Japan and European regions concluded that the speed of convergence across these economies were similar. Most of these economies were converging at a speed of 2 % per year. This implies that 50 % of the distance between an economy's initial level of income and its steady state vanishes in about 35 years. The explanation of this slow speed of convergence was due to rather limited diffusion of technology and partial capital mobility across nations.

Rey and Montouri (1999) applied exploratory spatial data analysis (ESDA) methods in an innovative way, to provide insights to the geographical dynamics of US regional income growth patterns during 1929–1994. They observed that regional income distribution showed a pattern of convergence in the US, and this distribution showed co-movements relative to spatial neighbors of individual states in the nation. Two strong clusters were observed: the Northeast-Mid Atlantic cluster of rich states, and the low income cluster spread in the Southeast US. Rey

(2001) further integrated the local spatial statistics and Markov chain modeling in a regional context to provide insights to space–time evolution of income distribution in the US during 1929–1994. His findings suggested that geography does matter in the evolution of income distribution in the US. The relative mobility of states within a distribution was sensitive to their positions with the neighbors in the same distribution. This trend has spatial policy implications. If the objective of regional governments were to minimize disparities, then the marginal effectiveness of investment in a poor area neighboring a rich area will be higher relative to a poor area neighboring another poor area.

Janikas and Rey (2005) studied the relationship between spatial clustering and inequality at the state and county levels in the US during 1969–2000 for the 48 coterminous states. Their salient findings were the following: (1) income change at the national level does not manifest change that occurs at the state level and disaggregated data analysis revealed income inequality increased at the state level during 1969–2000, (2) spatial clustering masks important internal socio-economic dynamics and was concluded that there was a negative relationship between internal level of clustering and relative income of the state economy, (3) the relationship among clustering and inequality is positive at the national level and negative at the sub-national level, and (4) the examination of type and magnitude of correlation between relative income inequality and clustering, and its temporal changes led to deciphering of a regional cohesion among US states across many of the processes uncovered. Further, Drennan et al. (2004) utilized data at the metropolitan areas for US during 1969–2001 to test for sigma income convergence for per capita personal income and metropolitan average wage per job. They observed that dispersion among both variables was not decreasing over time.

Regional convergence analysis has been studied both at the regional level for the European Union and at the individual country level. The spatial Markov approach was applied to examine the evolution of regional disparities in Europe for the period 1980–1995 (Gallo 2004). Her findings stated regional disparities persisted in Europe, with a relative absence of regional mobility in income distribution. The location and physical attributes of regions played a role in the European convergence process.

Dall’erba and Gallo (2008) analyzed the impact of structural funds on the regional development process during the periods 1989–1999 for a sample of 145 regions. They observed a sizable proportion of funds were invested in transport infrastructure with the expectation that it will induce industrial relocation, which in turn will lead to regional development, thereby reducing regional inequality. The findings suggested lack of any minimization in income inequality and spatial spillover effects. Further, Dall’erba et al. (2008) studied the European Union with a larger data set comprising 244 regions for 1991–2003 periods. The data set included states from the east, and thus the regional growth process could not be observed in terms of core-periphery dichotomy. The purpose of the analysis was to detect for convergence clubs with the inclusion of spatial effects. An implication of the analysis was detecting regional disparity and the policy implication was to invest in new regions for attaining higher levels of regional development.

Maza and Villaverde (2009) analysis of provincial income convergence for Spanish regions studied the effects of space on relative per capita income distribution during 1985 and 2003. Their analysis determined three conclusions. First, exploratory spatial data analysis (ESDA) confirmed a positively increasing spatial dependence on per capita income distribution. Second, utilizing two sample data sets (actual and filtered) it was observed that higher the spatial dependence the larger the speed of convergence between the actual and filtered data; and third, the spatial distribution of per capita income is concentrated around national average with filtered data relative to actual data. In sum, spatial dependence will not generate a homogenous per capita income distribution across Spanish provinces.

Rey and Sastré-Gutiérrez (2010) analyzed Mexican states for the periods 1940–2000. They addressed the overarching theme of spatial clustering and heterogeneity and its role in the evolution of regional inequality. Two conclusions were determined. First, an ESDA analysis suggested drops in income inequality during the first two decades since 1940, with no further decline in later periods; and second, the share of global inequality attributable to interregional inequality is significantly dependent upon the regionalization scheme. In sum, geography matters in the analysis of income inequality.

Several scholars have examined regional convergence in Asia and emerging economies at macro and micro geographical scales (Aroco et al. 2008; and Wei and Ye 2009). Both conventional regression and geographically weighted regression approaches provided distinct insights to the regional development and inequality trends in Zhejiang Province in southeast China. Wei and Ye (2009) reported that regional inequality is sensitive to geographical scales and spatial organization of economic activities. In particular, regional inequality increased during the reform era in the rural inter-county and overall inter-county region. They determined the formation of spatial concentration in three clusters: coastal Wenzhou-Taizhou cluster, central Zhejiang cluster which adjoins the traditional Hangzhou-Shaoxing-Ningbo cluster. A division of coastal and interior Zhejiang emerged as well which was characterized by weak linkages and location of non-state enterprises. A density function and Markov chain analysis of Chinese Provinces showed an increase in spatial dependence in the past two decades. Data analysis for the period 1952–1999 suggested regional income distribution to move from convergence, to stratification, to polarization and a widening inequality among the coastal and inland regions of China (Aroco et al. 2008).

Theoretical explanation

There are four theoretical explanations to the relationship between inter-regional inequality and regional convergence or divergence. These are *neoclassical growth theory*, *endogenous growth theory*, *new economic geography* and *spatial analytical approaches*. The first explanation is the *neoclassical growth theory* (Malecki and Varaiya 1986; Martin and Sunley 1998) which posits if the national space economy is well integrated; than there will be strong tendencies towards regional convergence of income. As the national economy develops the country will experience regional disparities, but this trend will unleash market forces leading to the movement of prices, wages, labor and capital which will equalize income across regions leading to minimization of disparity among leading and lagging regions. This is reflective of the thinking where lagging regions will catch up with the fast growing regions by implementing balanced regional development strategies. These ideas have been tested in early studies for US by Borts and

Stein (1962) and Williamson (1965) for developed economies in Needleman (1968). An alternate view was professed by Perroux (1950), Myrdal (1957), and Kaldor (1970) arguing that regional incomes will not converge during the long-run, and the outcome of national economic development will be divergence among regions. This will be the outcome since if left unfettered market forces will lead to spatial disequilibrium. Economies of scale and agglomeration will lead to cumulative causation of skilled labor, wages, output and capital in large metropolitan areas at the expense of smaller areas, thereby perpetuating uneven regional development. Policy makers will attempt to intervene with balanced development strategies but it will not be able to overcome regional divergence (Martin and Sunley 1998). The neoclassical growth theory was marred with a limitation, i.e. it assumed diminishing returns to capital in the production function, and thus the model predicted decline in per capita output growth in the long-run. The fix to this problem was the inclusion of the exogenous technological progress factor in the model. Empirical evidence suggested a large proportion of the growth was attributed to the unexplained or exogenous technological progress. This trend was at variance with the convergence/divergence explanation posited earlier.

A central tenet of the second explanation *endogenous growth theory* brought to the center the factors that were relegated as exogenous in the economic development process, and thereby modified the neoclassical production function. The modification exemplified the inclusion of such factors as human capital, innovation, increasing returns and spatial spillover in the production function in order to determine the long term growth rate in the national economy (Aghion and Howitt 1998). These ideas have been utilized by economic geographers to analyze regional patterns of growth and decline.

The third explanation is the *new economic geography* approach exemplifying importance to the geography of a region in terms of a core periphery regional pattern of development. However, the explanatory emphasis relies on the increasing returns to scale and the concomitant agglomerative effects to economic activities (Fujita et al. 2001). This explanation contrasts with the convergence thesis, as it suggests that regions with natural advantage will grow faster relative to other regions due to increasing returns and

agglomeration. There is accumulating evidence of empirical research which examines the relationship between economic growth and income inequality. Aroco et al. (2008) analyzed the regional convergence process in China and determined that income distribution has moved away from convergence towards ‘polarization’. This is manifested by the fact that income disparities between coastal (core) and inland (periphery) has widened in recent years.

Finally, *spatial convergence approach* utilizes tools developed in spatial analysis to measure the impacts of mechanisms like technology diffusion, factor mobility and transfer payments that perpetuate regional convergence and epitomize explicit geographical roles of the underlying processes. In particular two types of spatial effects are important, i.e. spatial dependence and spatial heterogeneity. Spatial dependence is defined as the causal spatial relationships across different locations. An example of this could be a state’s per capita income being related to the weighted income of the neighboring states in a nation. Spatial heterogeneity refers to the presence of instability of a behavioral relationship across the observational units. An example of this could be where states converge with respect to their relative incomes but also, show movements similar to their regional neighbors. Several scholars have developed and extended this approach to incorporate the notion of spatial dependence in regional convergence analysis (Rey and Montouri 1999; Rey 2001; and Janikas and Rey 2005).

Measurement of regional convergence

Sala-I-Martin (1996) proposed two concepts of convergence: *Beta convergence* and *Sigma convergence*. The former is defined as the negative parametric relationship observed between the growth rate of income per capita and the initial level of income. In other words, if lagging regions grew faster than prosperous regions, then, Beta convergence is said to be observed. Further, if the dispersion of real per capita income across a sample of regions within a nation tends to decrease over time, then, Sigma convergence is concluded. *Conditional convergence* is defined as regions tending to converge to their common steady state which is determined by conditioning variables. If sub-groups of regions within a regional system have a common steady state, then,

club-convergence is said to be observed in the midst of an overall convergence among the regions. Yet, another variant of *club convergence* is polarization where regions converge towards two basins of attractions and end up with two clubs (Barro and Sala-i-Martin 2004). Quah (1993, 1996) developed the distribution dynamic approach. The approach utilizes stochastic kernel to identify specific regions of the distribution that are more prone to transitions, and hence polarization and convergence club formation. In addition, ‘persistence and mobility’ of a region within the regional system can be identified and measured. ‘Persistence’ is defined as the stability of a region’s position in the regional income distribution within the nation. ‘Mobility’ refers to the change of a region’s position in the income distribution. Persistence and mobility can be measured by two non-parametric tools commonly used to study the distribution of a random variable and its transition across time. These tools are named the Markov transition matrix approach and the stochastic densities (Silverman 1986). The former measures persistence or mobility among a discrete number of states, and the latter estimates the probability density function in a continuous framework.

Convergence or divergence in Indian economy

An examination of sub-national economies in India using PCNSDP as an indicator shows that Maharashtra was twice as large as Bihar during 1961. This difference magnified during 2000–2001 as states from the North (Punjab and Haryana), South (Tamil Nadu) and West (Maharashtra) became four times larger relative to Bihar (Statistical Outline of India 2006–2007). To mitigate the regional inequality and implement an ‘inclusive growth strategy’ the regional income distribution dynamics needs to be fully understood. Recent studies on regional inequality in India utilizing the convergence approach can be classified into five typologies: *convergence*, *divergence*, *conditional convergence*, *club convergence*, and *spatial convergence*. The major theme addressed in these studies is the identification of the patterns and causes of temporal and inter-regional inequality in India.

The first two groups of studies include *convergence and divergence* patterns of economic indicators. Two initial studies set the stage of analysis for India with

respect to convergence analysis. Cashin and Sahay (1996) made the seminal study on regional convergence and observed slow convergence among state economies due to transfer of grants from the central government to states. However, Marjit and Mitra (1996) observed divergence among state economies in terms of their per capita income. Bhattacharya and Sakhivel (2003) found no evidence of convergence in growth rates of state domestic product in India during 1980s–2000s. Chakravorty's (2003) district level analysis for India posits inter-regional divergence and intra-regional convergence. His analysis suggested investor's preference of new locations on the fringe of high growth areas not leading to a 'polarization reversal' but a 'concentrated decentralization'. This outcome is not necessarily the result of the economic reforms of 1991. In addition, Patel (2003) observed convergence among 14 Indian states for the period 1980–1999 and identified six significant growth variables namely high quality governance, human capital stock, job creation, literacy rates, percentage of total population working, and infrastructure. Baddeley et al., (2006) made two observations in their analysis of Indian economy. First, in absolute terms the poor states grew at slower rates than wealthier states; and second, there was evidence of dispersion of income across states during the period 1970–1997. The study by Ghosh et al. (1998) points towards a divergence during 1960–1961 and 1994–1995 since regions with high capital-labor ratio will attract more capital and grow at a faster pace. In addition, the public intervention and market forces have strengthened the divergence. Further, Abler and Das (1998) observed gross inconsistencies in the resultant patterns, i.e. convergence in eastern India, divergence in northwestern India, and a lack of any tendency towards convergence in central, south or India as a whole during the time period 1961–1990. The analysis by Sachs et al. (2002) attribute to the importance of urbanization in accounting for cross state variations in Indian growth, and find an overall divergence during the pre and post-reform periods. The reason for increased divergence has been attributed to factors such as state variations in production structures, human capital and infrastructure during the post-reform period (Ghosh 2008). Further, Das et al. (2010) observed regional convergence of per capita consumption at the urban and divergence at rural scales. Also, Jayanthakumaran (2010) explored convergence/divergence utilizing

stochastic convergence and beta convergence tests. He deciphered majority of states in India did not show pre-break income convergence (before 1990s), but 14 of the 27 states in the sample showed evidence of positive income convergence during post mid-1990s. The remaining states such as Bihar, Madhya Pradesh, Manipur, Odisha and Uttar Pradesh were impoverished and lagging in important indicators of development during both pre-break and post-break periods.

The third group of studies observed *conditional convergence* in India. Singh et al. (2010) examined regional inequality in India at the district (equivalent to county) and found evidence for conditional convergence. Their study recommends increasing literacy and road connectivity can be influential factors in economic growth. Baddeley et al. (2006) observed conditional convergence during 1970–1997 and the factors attributed to this are mainly the value of state level investment in economic and social sectors and the promotion of agricultural productivity. Also, Nagaraj et al. (2000) observed conditional convergence across Indian states during 1970–1994. They attribute a strong impact of the differences in physical, social and economic infrastructure endowments across states on the lack of convergence in India. In addition, the differences in production structure across states account for the variations in economic performance as well. They suggest targeting public investment in infrastructure in selected states for improving the economic prosperity of lagging states in India.

The fourth group of studies determines the existence of *club convergence* in India. Recent studies have shown that regional economies that are similar with respect to economic structure, rates of growth and institutional set up show RC. It is possible that during the process of development, regions evolve into two separate clubs of high growth performers and low growth performers exemplifying twin peaked dynamics. Several scholars have utilized a distributive income dynamics approach to identify the polarization and stratification in the evolution of income distribution in India. Bandhopadhyay (2011) and Kar et al. (2011) identified twin-peaked dynamics and bimodal distribution during the periods 1965–1997 and post-reform period, i.e. 1993 and 2005. The former observed the income distribution of states polarizing into two income convergence clubs, i.e. rich and poor states in India. The rich states comprised of Gujarat, Maharashtra, Punjab and Haryana; and recent

additions of Andhra Pradesh and Karnataka. The poor states included Odisha (Orissa), Bihar, Rajasthan, Madhya Pradesh, and Uttar Pradesh. The latter observed some of the middle income regions move up the hierarchy of income levels and several others move down towards lower income regions. The regions that have moved up the income hierarchy are the coastal states and those that have moved down are the states constrained by political unrest and are the inland states. Bandhopadhyay (2012a) analysis suggests lack of any ‘neighborhood effects’ implying that states do not share similar growth trajectories. For instance, Punjab, Haryana, Maharashtra and Gujarat are located in Northwestern India but the first two states were agriculturally developed and latter two industrially developed during 1960s. Also, Tamil Nadu, Andhra Pradesh and Karnataka during post-1980s have been successful due to high technology and software industry boom serving the international market. These states apparently are not well connected by transportation that could have enhanced spatial interaction in the southern region, thereby suggesting lack of neighborhood effects in these states. This stream of analysis has been further explored to analyze polarization in India’s distribution dynamics. In particular, three economic variables fiscal deficit, capital expenditure, and education expenditure have been associated with the formation of upper convergence club in India during 1965–1997 (Bandhopadhyay 2012b). Kalra and Sodsriwiboon (2010) investigated the theme of convergence and spillover among Indian states during 1960–2003. They noted overall divergence for the entire sample and convergence during sub-periods. Also, their study posited strong evidence of conditional-clubs among the low and high income states and a mixed outcome in the middle tier states.

The fifth set of studies utilizes *spatial convergence* approach. Koornik-Mina (2009) developed a model based on the classical Lotka-Volterra predator–prey system to analyze the dynamics of regional economies in India. A major finding of her analysis is the effect of state’s growth due to spatial neighbors is less influential than from neighbors with similar economic structure. Though this is conditional upon the differences in structural and geographical matrices. The application of spatial analytical approaches reveals divergence with respect to income and economic structure dimensions. The ESDA analysis of gross

state domestic product (GSDP) for 30 states show divergence during 1993–2004 periods. A spatial clustering reveals these progressive states are located in western and southern regions of India and lagging states are located in central and eastern regions. The structural divergence analysis shows the sector’s contribution to the aggregate divergence led by industry and services while agriculture sector has an offsetting role in aggregate divergence (Khomiakovo 2008). The analysis tests and confirms three spatial hypotheses: first, the distribution of GSDP per capita values was spatially correlated during 1993–2004 periods and the increasing value of Moran’s I suggested an increase in the number of lagging states; secondly, spatial dependence in GSDP per capita is characterized by persistence in progressive and lagging states; and third, there is spatial dependence in GSDP with regional economic structure focusing on industry and services and negative spatial autocorrelation among GSDP and agriculture sector. The analysis reveals the identification of a Southern India growth cluster and Central and Eastern India lagging region clusters. The study suggests three policy initiatives: geographical agglomerations of industries aids export markets and international competitiveness, agriculture-led growth is necessary to offset regional divergence, and central and eastern regions need a growth impulse such as the ‘*Golden Quadrilateral highway network connecting India’s four largest cities, i.e. Delhi, Mumbai, Kolkata, and Chennai*’ (author’s emphasis) (Khomiakovo 2008). A majority of the studies have dealt with interstate convergence or divergence in India. It is quite possible that states might be converging or diverging, yet the intrastate level income patterns may show an opposite trend. Shaban (2006) analyzed the developed industrial state of Maharashtra at the district level identifying a pattern of spatial convergence. A larger proportion of state per capita income and tertiary sector activities were attributed to the two developed regions Konkan and Western Maharashtra and the share of secondary sector were stagnating and primary sector declining across districts. The lagging regions were Vidarbha and Marathwada regions both in Western Maharashtra.

In sum, the plurality of analytical approaches provides economic geographers a range of alternative frameworks to select an approach or several that suits the problem under investigation. This allows for

Table 1 Summary statistics of per capita net state domestic product for Indian States (in Rupees.): 1960–1961 to 2010–2011

	PC Net SDP (1960–1961)	PC Net SDP (1970–1971)	PC Net SDP (1980–1981)	PC Net SDP (1990–1991)	PC Net SDP (2000–2001)	PC Net SDP (2010–2011)
Range (Rs.)	514	592	3113	4,250	32,435	91,527
Average (Rs.)	322.1	366.6	1748.6	2423.8	17137.3	41519.3
SD (Rs.)	117.9	137.4	696.2	1078.2	7680.82	22233.4
SD (Log of PC NSDP)	0.333	0.35	0.331	0.387	0.399	0.483
CV (%)	273.2	266.9	251.2	224.8	32,435	91,527
IQR (Rs.)	280	178	522	1324.5	7,762	24,261

Source Calculated by Author

comparison of results utilizing disparate methodologies to the same problem which provides manifold perspectives towards understating regional distribution dynamics.

Spatial distribution of PCNSDP for India

There are several measures of inequality such as Gini coefficient and Theil index/entropy analysis but this research utilizes simple measures of dispersion like range, standard deviation (SD), natural logarithms of PCNSDP, coefficient of variation (CV) and inter-quartile range (IQR) and average values for each data series (Table 1). The purpose of using these simple measures is to provide an indicative measure of dispersion with respect to PCNSDP variations across time and space for the Indian economy. The number of states varies during different periods due to non-availability of data and fragmentation of large states into smaller ones resulting in mismatch. The data was collected at the state level for the periods 1960–1961 (15 states), 1970–1971 (16 states), 1980–1981 (25 states), 1990–1991 (25 states), 2000–2001 (28 states), and 2010–2011 (28 states). The PCNSDP has been compiled using 1960–1961 constant prices for 1960–1961 and 1970–1971 data series, 1980–1981 constant prices for 1980–1981 and 1990–1991 data series, 1999–2000 constant prices for 2000–2001 data series and 2004–2005 constant prices for 2010–2011 data series. Data were obtained from *Domestic Product of States in India* published by Economic and Political Weekly Research Foundation, Mumbai

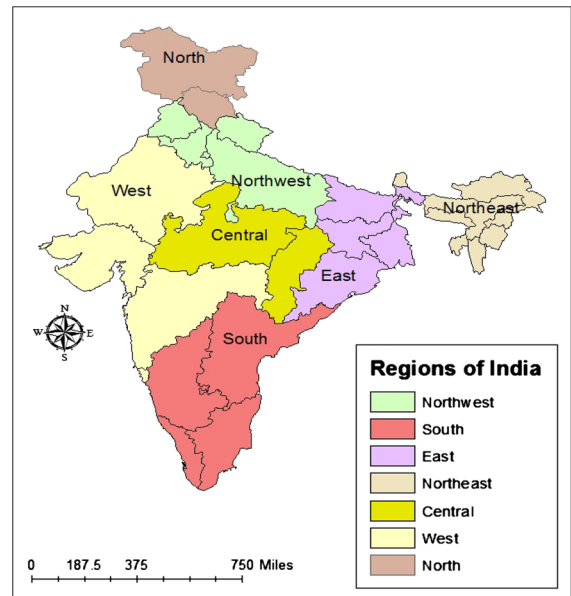


Fig. 1 Regional divisions of India. Source Author

and *Handbook of Statistics for Indian Economy 2011–2012*, from Reserve Bank of India.

India can be classified into seven regional divisions (see “Appendix 2”). Figure 1 shows the map of regional divisions in India. A comparison of state variations in PCNSDP during 1960–1961 versus 1970–1971 and 1980–1981 versus 1990–1991 are shown in Figs. 3, 4. In addition, two choropleth maps have been prepared in Arc Map 10.2.1 to visually interpret spatial variations in PCNSDP during 2000–2001 and 2010–2011 (Figs. 5, 6). The table in

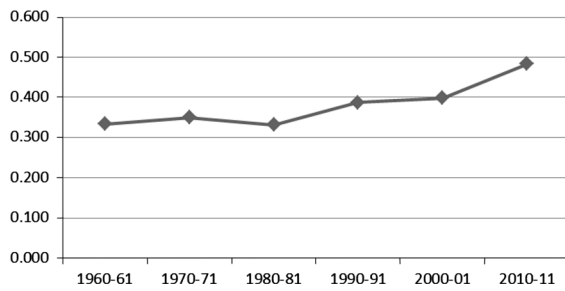


Fig. 2 Standard deviation of the logarithms values of per capita net state domestic product for Indian States: 1960–1961 to 2010–2011. *Source* Author

“Appendix 1” provides the data on PCNSDP for various years mapped in Figs. 3, 4, 5 and 6. The range for PCNSDP increased over the periods 1960–1961 and 2010–2011 manifolds. But this increase also masks changes in price levels. The highest PCNSDP was observed in Delhi and lowest in Manipur during 1960–1961 and 1970–1971, and Bihar during the remaining 4 years 1980–1981, 1990–1991, 2000–2001 and 2010–2011.

The standard deviation utilizes all the data in the variable being studied. This measure has consistently increased during all periods, moderately during 1960–1961 and 1980–1981 but rapidly during the remaining post-1990s economic reform periods. This trend implied that in relation to the average PCNSDP variable the extent of dispersion has magnified suggesting larger inequality across states. Large states became economically prosperous and poor states became further impoverished. Since the states vary in population size and the values of the variable change due to changes in price levels it is appropriate to examine the dispersion in the distribution by taking the natural logarithms of the values in the variable (Rey and Montouri 1999).

Table 1 and Fig. 2 depict standard deviation of the natural logarithmic values have increased during 1960–1961 and 1970–1971, followed by a slight decrease till 1980–1981 and an increase during 1990s. The dispersion increased even more widely during 2000–2001 and 2010–2011 reaching maximum levels during the entire period of five decades.

This pattern clearly suggests that prosperous states have gained more than poor states from national economic growth during post-1990s under the implementation of structural reform policies. Generally

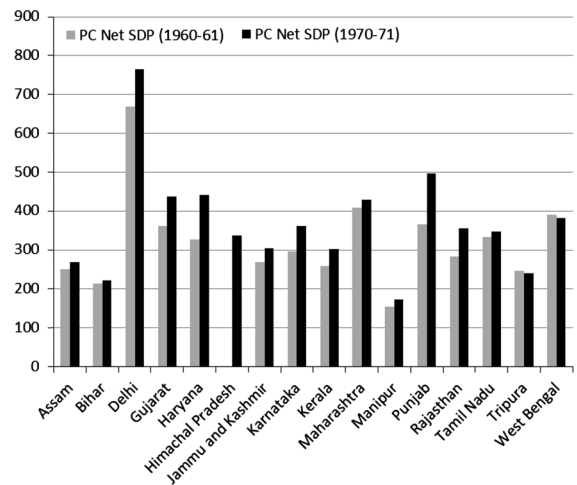


Fig. 3 Regional distribution of per capita net state domestic product: 1960–1961 and 1970–1971. *Source* Domestic Product of State of India (2009), EPW Research Foundation, Mumbai

speaking, the economic reforms era of 1990s led to higher growth in the Indian economy but regional inequality has widened at the same time. Several examples of information and communication technology-led boom in the Indian economy during post-1990s era can be found in the states of Karnataka, Andhra Pradesh, Tamil Nadu, Delhi and Maharashtra explaining the reason of widening disparities.

The coefficient of variation (CV) declined in all periods. In 1960–1961 the CV was 273 % of the value of the sample mean which declined to 186.7 % during 2010–2011. The IQR declined 1.5 times during 1960–1961 and 1970–1971; increased 2.5 times during 1980–1981 and 1990–1991; and increased almost 5.8 times during 1990–1991 and 2000–2001 and 3.1 times during the intervening periods 2000–2001 and 2010–2011. This trend suggests an increase in regional disparity across states during all periods on account of PCNSDP.

A closer examination of Figs. 3, 4, 5 and 6 reveals spatial patterns of PCNSDP variations in India during the periods 1960–1961, 1970–1971, 1980–1981, 1990–1991, 2000–2001 and 2010–2011. Three clusters of states can be delineated for all years: high, medium and low. During 1960–1961 of the 15 states the highest PCNSDP were observed in Delhi, Punjab, Maharashtra, Gujarat, and West Bengal. The medium cluster states were located in Tamil Nadu, Karnataka, Jammu Kashmir, Haryana and Rajasthan. In the low

Fig. 4 Regional distribution of per capita net state domestic product (in Rs.): 1980–1981 and 1990–1991. *Source* Domestic Product of State of India (2009), EPW Research Foundation, Mumbai

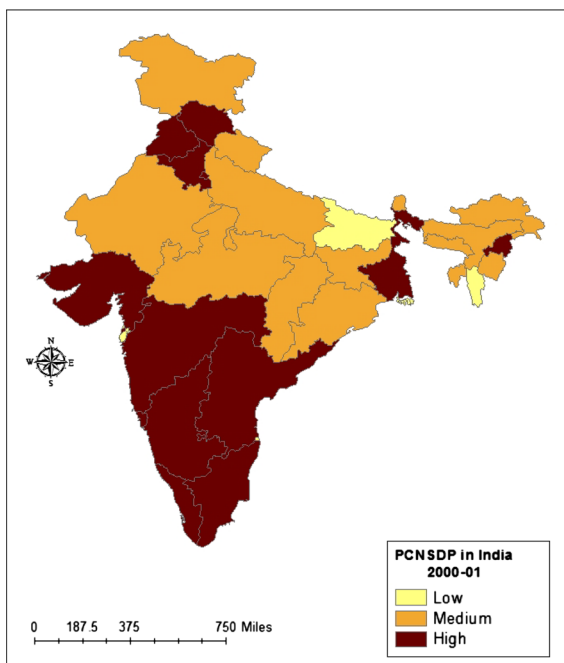
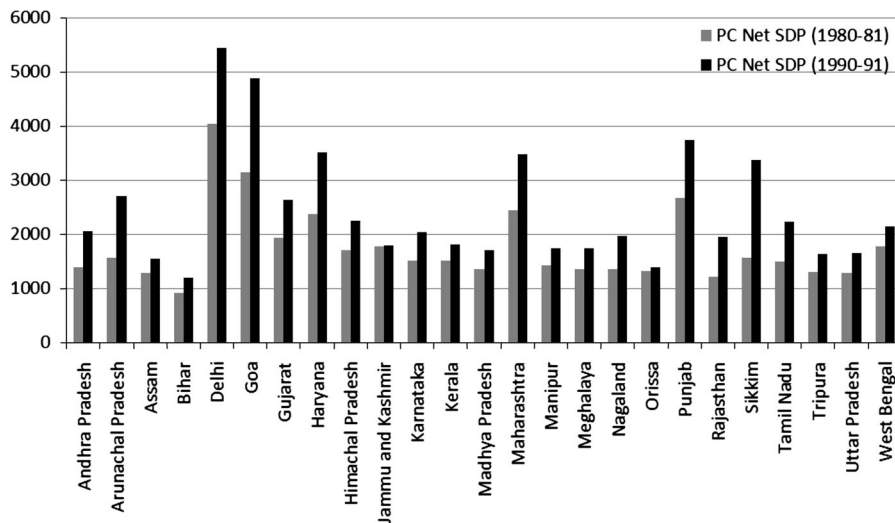


Fig. 5 Regional distribution of per capita net state domestic product (in Rs.) for India: 2000–2001. *Source* Domestic Product of States in India, 1961–2007

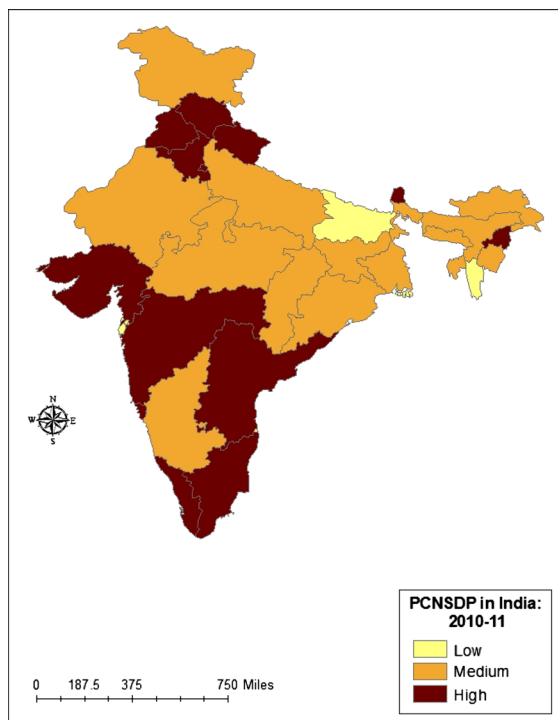


Fig. 6 Regional distribution of per capita net state domestic product (in Rs.) for India: 2010–2011. *Source* Domestic Product of States in India, 1961–2007

cluster category several states were identified as lagging and impoverished states with low PCNSDP. These states were Assam, Tripura, Bihar, Manipur, Jammu and Kashmir and Kerala. During 1970–1971 the same pattern continued with Tamil Nadu slipping its relative position from 7th to 9th in a decade. In the high cluster Delhi, Punjab, Haryana, Gujarat and

Maharashtra continued to dominate among the highest PCNSDP states. All of these states are located in northwestern and western regions of India. The medium cluster had the same composition of states as 1960–1961. The low cluster showed the same

pattern during 1960–1961 along with the addition of Himachal Pradesh. The 1960s and 1970s were periods of the implementation of new agricultural technology to maximize agriculture output and a focus on heavy industrialization. The outcome of these strategies was that it favored large agricultural and industrial states which performed well relative to poor and lagging states in India. During 2nd and 3rd Five Year-Plans (1956–1961 and 1961–1966) removal of regional disparity was acknowledged as a goal of development for the first time whose effect has not been realized till date.

During 1980–1981 the data set was enlarged with more information for various states. The high cluster comprised the same states during previous decades along with Goa, Haryana and Jammu and Kashmir. Haryana and Jammu and Kashmir shifted its relative position from medium to high cluster thereby leap-frogging with respect to PCNSDP growth, while Rajasthan shifted down from medium to low cluster. The composition of low cluster states remained intact during the past two decades except for Kerala and Manipur moving its relative position to medium cluster. The state of Bihar has perennially remained stuck in the low cluster during the past two decades suggesting persistence in its lack of upward mobility relative to other states in India. The state although rich in natural resources, water availability for agriculture but has been under a ‘resource curse’ (Auty 2001) besides facing infrastructure, education bottlenecks and high population growth.

During the 1990s similar spatial pattern can be observed with a few new states moving up to the high cluster such as Haryana, Sikkim and Arunachal Pradesh along with the northern, northwestern and western states. The medium cluster consists of a few sporadic states such as Nagaland, Rajasthan and Himachal Pradesh and the southern states such as Andhra Pradesh, Karnataka, and Tamil Nadu. The low cluster during this period was a collation of eastern, northeastern, central states of which a representative few are Bihar, Orissa, Tripura, Assam, Madhya Pradesh and Uttar Pradesh.

The 1960s–1980s were a period when the Indian economy was experiencing ‘structural retrogression’ where national planning effort was a failure. The savings and investment in the public sector were curtailed and funds for the maintenance of past

projects were not allocated sufficiently and deficit financing seemed to be resorted vehemently.

Also, a significant proportion of public sector outlays were siphoned off in non-development expenditure such as subsidies, transfer payments to state government like drought relief and payments of overdrafts (Shetty 1978). This phenomenon also contributed to the accentuation of regional disparity in India. The uneven regional growth has not abated in India since the unfettered rule of the central government in misallocating planned expenditure, centrally sponsored projects and investment has worsened the situation (Prasad 1988).

During the period 2000–2001 the high cluster consisted of the states of Delhi, Haryana and Himachal Pradesh from Northwestern and Northern regions of India; Goa and Maharashtra from western region; and Tamil Nadu, Kerala and Karnataka from southern region. The medium cluster comprised of predominantly states from northeastern region and one state from west, south, east and northwest regions. The northeastern states consisted of Nagaland, Sikkim, Tripura, Meghalaya and Arunachal Pradesh. Majority of the states in the low cluster comprised Madhya Pradesh, Chhattisgarh and Uttar Pradesh in the central and northwest regions; and Assam, Manipur, Odisha, Jharkhand and Bihar in the northeast and eastern regions of India. The additional two states in the cluster were Jammu and Kashmir and Rajasthan (Fig. 5). During the post-reform era the level of regional disparity has increased (Fig. 2). Chakravarty (2000) in his seminal work provides evidence for the return of the cumulative causation where the prosperous regions became wealthier relative to the lagging regions. The macro spatial pattern remains the same relative to previous periods but with restructuring at three different levels. First, during the post-reform period the developed regions, coastal areas and metropolitan areas have received favorable investment bias by the foreign investors; second, by sources of capital investment there is variance in geographical bias; and third, in the metropolitan areas the edge of the city is favored over the central business district for receiving investment.

During 2010–2011 the dominant states in all three categories remained intact with several changes in relative positioning of states suggesting upward or downward mobility both within the group and among the groups. The high cluster consisted of the following

states: Delhi, Maharashtra, Gujarat and Tamil Nadu. Within the high cluster category Maharashtra was the only state that moved up its relative position from fifth to third in the group during the intervening period 2000–2001 and 2010–2011. Two other states that shifted down its relative positions within the group were Himachal Pradesh; and a move from high cluster to medium cluster was Karnataka. The medium cluster consisted of states such as Punjab, Arunachal Pradesh, Tripura, West Bengal, Andhra Pradesh and Karnataka. Surprisingly Karnataka, shifted from high cluster to medium cluster during the decade 2000–2001 and 2010–2011. Also, West Bengal moved down relatively within the medium group from 3rd to 9th position. The low cluster comprised the state of Bihar and perhaps should include many other states at the bottom within the medium cluster like Uttar Pradesh, Odisha, Madhya Pradesh and Chhattisgarh.

Conclusion

Globalization has led to increasing prosperity for some nations while others have declined in economic performance leading to economic inequality. Further, global development has led to increasing inequality within regions among nations. Sala-i-Martin (1996) coined the term RC to study the phenomenon of less developed nations catching up with developed nations; and lagging regions within nations closing the gap with progressive regions. In this context this paper addresses four questions. The first question seeks to identify the salient contributions of recent research on convergence debate. Since the initial discussion by Baumol (1986), Romer (1986), Barro (1991) and Sala-i-Martin (1996) a plethora of literature has addressed the empirical examination of income divergence and convergence for economies with various levels of development. Sala-i-Martin (1996) in a comprehensive analysis of US, Japan and European Union concluded that the speed of income convergence across regional economies were at 2%. This implied 50% of the distance between an economy's initial level of income and its steady states will vanish in about 35 years.

The second question addresses the identification of alternative explanations of convergence and the tools utilized to measure it. There are four explanations: *neoclassical growth theory*, *endogenous growth*

theory, *new economic geography and spatial analytic approaches*. The neoclassical growth theory predicts both convergence and divergence. If the national economy is well integrated and the market economy reins, then, regional disparity will persist. This would generate corrective actions, such as interregional movements in capital, labor and their rates of return to equilibrate across regions, thereby generating RC. Similarly, during the same process of development regional inequality may be the outcome since economic forces such as agglomeration, scale economies and cumulative causation will attract labor and capital to large urban areas. This will perpetuate disparity relative to small areas creating regional divergence. The neoclassical approach has a limitation as it assumes diminishing returns to capital, and thus a decline in the per capita output growth in the long run. This limitation can be addressed by bringing to the core the factors that has been relegated to the background. *Endogenous growth theory* holds that investment in human capital, technological change and knowledge spillovers are important factors for explaining modern economic growth. The third explanation is the *new economic geography* approach. This approach exemplifies the importance placed on the geography of a region in terms of a core-periphery regional pattern of development. This approach argues that regions with natural advantage tend to grow faster relative to other regions over the long run due to increasing returns to scale and agglomeration effects. In terms of the convergence debate this will result in a long period of regional disparity between the core and peripheral regions. The fourth approach is called the *spatial convergence approach*. Two types of spatial effects can account for mechanisms such as diffusion and transfer payments. These are spatial dependence and spatial heterogeneity. The former is defined as the causal spatial relationships across different locations, and the latter as the presence of instability of a behavioral relationship across the observational units. An example of the former could be a state's per capita income defined as a function of the weighted income of the state's neighbors. Similarly, an example of spatial heterogeneity could be where states converge with respect to their relative incomes but also, show movements similar to their regional neighbors. The convergence analysts have developed four tools to measure relative growth of per capita state domestic income in relation to initial level of income. These

tools are: *Beta convergence*, *Sigma convergence*, *conditional convergence* and *club convergence*. Beta convergence is defined as negative parametric relationship observed between the growth rate of income per capita and the initial level of income. If the dispersion of real per capita income declines across a sample of nations, states or counties within nations, then, Sigma convergence is observed. Conditional convergence is defined as regions tending to converge to their common steady state (long term) which is determined by conditioning variables. Also, if a subgroup of regions within a regional system have a common steady state then club convergence is noticed. The plurality of approaches and tools suggests the availability of alternative approaches which can provide a rich and deeper understanding of the issue of spatial divergence or convergence.

The third question addresses the spatial effects of the analysis of regional convergence. Rey and Montouri (1999) and Rey (2001) pioneered the spatial analysis of regional convergence. They utilized ESDA and spatial statistics methodologies to show that geography and scale of analysis matters a lot in the analysis of spatial distribution of income. They observed for US that relative mobility of states within an income distribution is sensitive to its location with the neighbors in the same distribution. The exploratory spatial data analysis maps the distribution of income into four quadrants which is pairing of high and low income states: high–high, high–low, low–low, and low–high regions. It would be prudent for local governments to invest in a poor region that neighbors another poor region instead of investing in a poor region that is bordering a rich region, although the latter might be an attractive option.

The fourth question addresses the spatial analysis of PCNSDP in India. Four measures of dispersion analysis have been summarized: range, standard deviation, standard deviation (logarithm of PCNSDP), coefficient of variation and interquartile range. The standard deviation measures the spread in the distribution around the mean value. The standard deviation of the natural logarithms of PC NSDP for the periods during 1960–1961, 1970–1971, 1980–1981, 1990–1991, 2000–2001 and 2010–2011 showed a slight increase during first decade, followed by a moderate decrease during 1970–1971 and 1980–1981. The standard deviation increased sharply during 1980–1981 and

continued to increase moderately during the post-reform era in the 1990s with steep increase during the intervening periods 2000–2001 and 2010–2011. A visual interpretation of PCNSDP distribution in India during the post-independence period shows three clusters of states: high, medium and low. The states with highest PCNSDP have been categorized as high cluster located in northwestern and southern regions. The medium cluster comprised states located in west and south region and sporadic states located in eastern regions. The low cluster comprised states located in eastern region. In particular, the three states of Bihar, Uttar Pradesh and Odisha and Assam have been recurrently placed in the low cluster and bottom of medium cluster with miniscule changes in their relative location in intra-cluster positioning.

This review suggests several future directions of research: first, to analyze if the inter-regional differences in income within India has disappeared, converged, and or diverged in the two sub-periods, 1961–1991 and 1991–2012; second, to identify the determinants of inter-regional inequality; third, to examine if the distribution of spatial inequality affects the relationship between economic growth and inequality; and fourth, to analyze the ergodic (long-run) distribution in regional dynamics to detect for crisscrossing, leap-frogging, persistence or poverty-traps among regions. Finally, apply exploratory spatial data analysis and spatial statistics methodologies to analyze whether geography and location of states matter in further deepening the understanding of relative distribution dynamics in space and time.

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Appendix 1

See Table 2.

Table 2 Regional distribution of per capita net state domestic product (in rupees): 1960–1961 to 2010–2011

State	PC Net SDP (1960–1961)	PC Net SDP (1970–1971)	PC Net SDP (1980–1981)	PC Net SDP (1990–1991)	PC Net SDP (2000–2001)	PC Net SDP (2010–2011)
Andhra Pradesh	na	na	1,380	2,060	16,574	40,366
Arunachal Pradesh	na	na	1,571	2,709	14,726	37,417
Assam	251	270	1,284	1,544	12,447	21,406
Bihar	215	222	917	1,197	6,554	13,632
Chhattisgarh*					10,808	27,156
Delhi	668	765	4,030	5,447	38,975	108,876
Goa	na	na	3,145	4,883	38,989	102,844
Gujarat	362	437	1,940	2,641	17,227	52,708
Haryana	327	441	2,370	3,509	24,423	59,221
Himachal Pradesh	na	338	1,704	2,241	21,824	47,106
Jammu and Kashmir	269	304	1,776	1,784	13,859	27,607
Jharkhand					9,980	21,734
Karnataka	296	361	1,520	2,039	17,352	39,301
Kerala	259	302	1,508	1,815	19,809	49,873
Madhya Pradesh	na	na	1,358	1,696	11,150	22,382
Maharashtra	409	430	2,435	3,483	21,892	62,729
Manipur	154	173	1,419	1,739	12,157	23,298
Meghalaya	na	na	1,361	1,733	14,910	35,932
Nagaland	na	na	1,361	1,976	15,699	40,957
Odisha	na	na	1,314	1,383	10,208	25,708
Punjab	366	496	2,674	3,730	25,986	44,752
Rajasthan	284	356	1,222	1,942	12,840	26,436
Sikkim	na	na	1,571	3,369	15,305	47,655
Tamil Nadu	334	348	1,498	2,237	20,319	51,928
Tripura	248	241	1,307	1,642	14,933	37,216
Uttar Pradesh	na	na	1,278	1,652	9,721	17,349
Uttarakhand					14,932	44,723
West Bengal	390	382	1,773	2,145	16,244	32,228

Source Domestic Product of States of India (2009) and Reserve Bank of India

na not available

Appendix 2

See Table 3.

Table 3 Regional division of India

North	Jammu and Kashmir and Himachal Pradesh
Northwest	Delhi, Punjab, Uttarakhand, Haryana and Uttar Pradesh
West	Goa, Gujarat, Maharashtra and Rajasthan
Central	Madhya Pradesh and Chhattisgarh
Northeast	Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland, Sikkim, Tripura and Mizoram
East	Bihar, Jharkhand, Odisha and West Bengal
South	Andhra Pradesh, Karnataka, Kerala and Tamil Nadu

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