

# Regional growth policy experience in India: the spatial dimension

Biswajit Mohanty<sup>1</sup> · N. R. Bhanumurthy<sup>2</sup>

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**Abstract** New Economic Geography (NEG) literature emphasizes that growth of regions across space may show different possible patterns or clustering because of spatial agglomeration of economic activities and spatial spill over in the growth process. Using exploratory spatial data analysis, the paper explores the spatial character of outcome variables of regional growth process—per capita income, growth of per capita income and employment—and its possible determinants. The results reveal that regional growth in India has a definite spatial character, showing different clustering in space: group of rich states, group of backward states, spatial outliers where a rich state is found among poor states or a poor state is seen among rich states. Such spatial patterns are found to be matching with the spatial pattern in possible determinants such as FDI, infrastructure, manufacturing, and service sector's contribution to regional output. These findings suggest the need for differential policy treatments for different spatial cluster of states. Further, the policy-designs may also need to consider the negative spillover effects of growth process.

**Keywords** Regional growth · Spatial dimension · Exploratory spatial data analysis · India

**JEL Classification** O18 · R11 · R12

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✉ Biswajit Mohanty  
biswajitm4@gmail.com

N. R. Bhanumurthy  
nrbmurthy@gmail.com

<sup>1</sup> A.B. College, Bhadrak, Odisha, India

<sup>2</sup> National Institute of Public Finance and Policy, New Delhi, India

## 1 Introduction

A widespread perception about India's growth experience across states is the presence of wide disparity in development levels (Ahluwalia 2000, 2002; Bhattacharya and Sakthivel 2004). Since the beginning of the planning process, there were policies<sup>1</sup> by central government for promoting industrialization in backward regions, investment in infrastructure, development of irrigation, agriculture and allied activities, special area and sector-specific programmes<sup>2</sup> along with transfer of resources from centre to states through finance and planning commissions. Further, the role of sub-national policy initiatives are visible in the efforts at the state level for attracting private investment, especially after the 73rd and the 74th constitutional amendments, mandating the decentralisation of administrative power. What could be the reason for the persistent regional disparity in spite of these policies? The New Economic Geography (NEG) theories provide a possible answer in terms of role of space, spatial concentration, and spatial spillover in influencing regional growth. To the extent policies influence (or are influenced by) the spatial concentration of economic activities and spatial spillovers in growth process, they can reduce or exacerbate regional disparity. The channels through which policies affect the spatial concentration and spillovers in regional growth process are the different drivers of regional growth such as capital, labor, public expenditure, human capital and industrial clusters. Hence, it is useful to understand these channels to understand the flaws in policies and remedy them. And, more so, as off-late India has been aiming at inclusive growth in which regional balance is a crucial aspect. While a few studies on India recognized the importance of space and geography in India's economic development, they have focussed on measures of economic performance such as aggregate or sectoral per capita income or some single variable such as investment. None of the studies have looked into the spatial character of the drivers or possible determinants of regional growth.

The present study revisits the issue of regional growth and tries to understand the role of space in regional growth process. The study is the first of its kind to look into the spatial character of the outcome of regional growth such as per capita income, its growth and employment as well as the spatial character of the possible drivers of such outcomes. By pairing up of both the outcome variables and the drivers for different states, it offers a better understanding of the spatial dimension of regional growth in India. It exhibits how different spatial patterns can emerge due to spatial concentration and spillovers in regional growth process, and how policies come to acquire a spatial character because of these patterns, resulting in the persistence of regional disparity in India.

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<sup>1</sup> See Aggarwal and Singh (2014) for a detail review of these policies.

<sup>2</sup> The Special Area Programmes include Hill Area Development Programme (HADP), Western Ghats Development Programme (WGDP), and Border Area Development Programme (BADP). Sector-specific programmes are policies for promotion of small scale sector and Micro, Small, and Medium Enterprises and programmes such as Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Sarva Shiksha Abhiyan (SSA), National Rural Health Mission (NRHM), which are related to achievement of employment generation, education and health goals, especially, in backward areas.

The remainder of the paper is structured as follows. The following section discusses the literature about the nature of regional growth process. Section 3 describes the framework of the study, variables, and database used. Section 4 explains the methodology adopted in the study. Sections 5, 6, and 7 present the results and analysis of the spatial character of regional growth process. Section 8 concludes with a note on policy implication of the findings.

## 2 The nature of regional growth: an overview of the literature

What explains the nature of regional growth? The mainstream theories explaining the nature of regional growth process and influencing regional policies to date are neoclassical growth theory, export base theory, post-Fordism, social capital theory, innovative milieus and ‘learning’ regions theory, endogenous growth theory and New Economic Geography (NEG) theory (Armstrong 2002). Under diminishing returns and perfectly competitive market mechanism, interregional mobility of production factors (capital, labor), trade and technology transfers, the Neo Classical theory envisages long-run convergence in regional per capita income. In contrast, endogenous growth theory, the export base theory, post-Fordism, innovative milieus and ‘learning’ regions theory predict growing regional divergences. The endogenous growth theory ascribes regional divergence to factors such as human capital, technology, externalities—which are endogenous to the production process and generate increasing returns. Other theories, except social capital theory,<sup>3</sup> stress on industrialisation and creation of industrial clusters,<sup>4</sup> yielding increasing returns to scale for the region in question.

All these theories explain regional growth process by a set of factors (capital, labor, technological progress, public expenditure, human capital, industrial clusters) and some conditions (diminishing or increasing returns, free mobility of factors). However, the interpretation of the regional growth process also involves the role of space,<sup>5</sup> which is gaining importance with the emergence of New Economic Geography (NEG) models.<sup>6</sup> The NEG models explain the process of regional growth by spatial concentration (agglomeration) or dispersion of economic activities. Economic activities agglomerate in selected regions across space due to centripetal forces—lower transport costs, lower input prices, and spatial spillovers, i.e., technological or labor market externalities (e.g., availability of

<sup>3</sup> This theory is not opposed to mainstream growth theories as empirical works (Knack and Keefer 1997; Schneider et al. 2000) have adopted social capital (social systems, cultural differences and political tradition, network and social cohesion) as an extra production factor in the traditional neoclassical growth theory.

<sup>4</sup> While the export base theory stresses on the cluster of exporting firms, post-Fordism emphasize on the cluster of small and medium-sized firms (‘new industrial districts’), and innovative milieus and ‘learning’ regions theory highlights the need for high-tech cluster or innovative milieu which attract dynamic workers and entrepreneurs.

<sup>5</sup> For a detail review of the role of space in regional economics, see Capello (2009a).

<sup>6</sup> Based on the work of Krugman (1991), New Economic Geography (NEG) models include the work of Fujita, Krugman and Venables (1999), Martin and Ottaviano (1999), Martin (1999), Puga (1999), Baldwin et al. (2003) and Brakman et al (2009).

skilled workers). As the agglomerated regions offer higher demand, income, inter-firm linkages, higher wages and more job opportunities (Gardiner et al. 2011), the agglomeration process becomes cumulative, attracting more firms and workers, leading to divergent growth among regions. However, the emergence of centrifugal forces such as rise in factor prices due to acute competition among firms, increase in cost of living due to congestion, global technological spillovers<sup>7</sup> (Englmann and Walz 1995; Martin and Ottaviano 1996, 1999), and declining transport costs over time (Krugman and Elizondo 1996) can lead to industrial relocation to peripheral regions, fostering regional convergence.

Moreover, the nature of spatial spillovers (local or global) can give rise to different patterns of distribution of rich regions and poor regions (Gallo et al. 2003). While a cluster of rich regions and poor regions may appear in space in case of local spillovers, group of rich regions may emerge in case of global spillovers. The initial conditions of regions may lead to the persistence of any observed spatial distribution pattern of regions over time.

Following the NEG models' emphasis on the role of space in the growth process, there is a surge in empirical studies (Moreno and Trehan 1997; Rey and Montouri 1999; Fingleton 2004; López-Bazo et al. 1999; Le Gallo and Ertur 2003; Ertur et al. 2006) incorporating spatial spillovers and spatial structure in the regional growth process over the last two decades. However, the spillover effects in case of regional growth process are more general in meaning than technological and labor market spillovers. These refer to effect (positive or negative) of growth enhancing elements of a region on the growth process in other regions, which can occur through trade linkages, demand linkages, interregional mobility of production factors, and the effect tends to be spatially bounded, i.e., decreases with increasing distance (Capello 2009b). While the nature of spatial spillovers (local or global) in NEG models explains the possibility of different spatial patterns of regions, the empirical literature identifies these patterns in terms of spatial heterogeneity and spatial dependence. Spatial heterogeneity refers to the instability of economic behavior over space (Ertur and Le Gallo 2009). It characterizes the polarization (core or rich regions vis-à-vis the periphery or poor regions) phenomenon in space (Gallo et al. 2003); economic behavior in the center of a city differs from that in the periphery of a city, in an urban region from a rural region. In contrast, spatial dependence or autocorrelation among regions is observed when the observations at one location depend on the values of observations at other locations (Anselin 2001). For example, in case of positive spatial autocorrelation, regions with similar rate of growth (rich or poor regions) tend to cluster in space, while regions with diverse growth rates (rich–poor) cluster in case of negative spatial autocorrelation.

In case of India, most of the existing empirical studies have analyzed regional disparity in terms of indicators of economic performance across states or the issue of convergence or divergence in regional growth. While the studies of Krishna (2004), Chaudhuri (2004) and Sahoo and Acharya (2012, 2017) have analyzed and compared economic performance across states, they have not looked at the

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<sup>7</sup> While technological externalities generated in the agglomerated regions, in case of local spillovers, benefit the firms located in that region, it benefits firms in all regions alike in case of global spillovers.

determinants of such varied economic performance. For instance, Krishna (2004) focuses on patterns (variability and volatility) of per capita GSDP growth for 14 states, but only reviews the available studies on the determinants of economic growth of Indian states. Chaudhuri (2004) exhibits the sectoral pattern of growth and the rates of inflation measured by implicit deflators in gross state domestic product for 22 States for two decades of 1980s and 1990. While Sahoo and Acharya (2012, 2017) compute a more comprehensive macroeconomic performance (MEP) indicators scores using growth of GSDP, price stability, fiscal deficit for 15 states, they have not looked at the sources of the economic performance indicators. While the economic performance indicators are the ultimate target of policies, it is the determinants of these performances that act as channels for policies.

Some studies examine the issue of convergence or divergence in regional growth process and its determinants, using either the neoclassical or the endogenous growth framework. For example, Studies such as (Cashin and Sahay 1996; Patel 2003; Nagraj et al. 1998; Trivedi 2002; Bandyopadhyay 2011; Ghosh 2008) find evidence of convergence in per capita income and attributed it to factors such as interstate grants, high quality of governance, human capital stock and job creation, the share of agriculture in total output, infrastructure, and private investment, political and institutional factors. On the contrary, some studies (Ghosh et al. 1998; Rao et al. 1999; Marjit and Mitra 1996; Sachs et al. 2002; Ahluwalia 2002) find regional divergence in per capita income. The factors causing such divergences are unequal private investment across states (Rao et al. 1999), urbanisation (Sachs et al. 2002). Ghosh et al. (1998) finds that the observed divergence is because of the capital-rich states attracting more capital due to increasing returns resulting from too much public sector intervention which prevents the operation of neo classical convergence-mechanism, i.e., diminishing returns to capital. Other studies like Bandyopadhyay (2011) and Ghosh (2008) have found evidence of states converging to different clubs in per capita income such as rich, poor and middle income states. The explanation for the emergence of these clubs may be due to spatial spillovers in the growth process as discussed in the NEG literature. However, these studies on club convergence have failed to see the role of space in explaining the different clubs of per capita income. A few studies have focussed on the role of space and geography in regional growth; but they are confined to the analysis of a single variable. For example, Chakravorty (2003) deals with the spatial patterns of industrial investment in India. Khomikova (2008) investigates the spatial distribution of gross state domestic product at the aggregate and sectoral level to explain the continuation of regional divergence in India. Sofi and Durai (2015) examine the convergence in per capita income taking into account spatial interaction or dependence among states. However, it is essential to look into the spatial pattern of outcome variables such as per capita income as well as its possible determinants.

Using a dataset on 14 major states for two points of time, i.e., a year in the early 1990s and 2010, the present study addresses the gaps in the existing literature and offers a broader understanding of the nature of regional growth in India. Recognizing the role of space and spatial spillovers in explaining the regional growth process, it examines the spatial character of the outcome (e.g., per capita income) of regional growth process and also its different possible determinants such

as public expenditure, Centre-State grants, FDI, sectoral shares, infrastructure using the technique of exploratory spatial data analysis (ESDA). It compares the spatial pattern of both to find whether the patterns in the outcome derive from the pattern in determinants. The technique of ESDA provides valuable information about spatial dependence and spatial heterogeneity in regional growth process and its determinants which is different from the estimation of average effects across space using spatial regression methods (Patacchini and Rice 2007). The study also provides a better understanding of why regional inequality persists and has widened despite different regional development policies pursued over six decades of planning. It indicates that one or other policies in respect of different regional growth-drivers such as manufacturing, infrastructure and FDI may not be able to achieve regional balance without factoring in the spatial nature of growth process. That is, if the outcome and the drivers of growth process exhibit some spatial character, the actual and ultimate outcome of policies will be different across regions.

### 3 Framework of analysis, variables, and data sources

Given the standpoint of NEG theories that regional growth process may show possibility of different clustering of regions across space due to the existence of spatial concentration of economic activities and spatial spillovers, the study seeks to understand the spatial nature of regional growth process; whether the process of regional growth is random or has a spatial character. That is, whether states with similar level of development are clustered together or there are spatial outliers (forward states surrounded by backward ones and vice versa). Is there a single spatial pattern (clustering of either forward or backward states) or spatial heterogeneity (instances of clustering of both forward and backward states)? How do the spatial patterns of determinants compare with the spatial patterns of outcome variables?

The outcome of regional growth process is defined by per capita Gross State Domestic Product (GSDP), annual average growth rate in per capita GSDP, and employment rate (work force participation rate) per 1000 population of each state. Unlike the earlier studies, employment is included because employment creation is a necessary condition for the achievement of 'inclusive growth'.

The possible determinants of the growth process are the ones, broadly, suggested by the regional policies undertaken in India and the theories of regional growth. The variables are manufacturing sector's share in GSDP, service sector's share in GSDP, Centre-State grants, public expenditure, infrastructure index, and FDI approvals as a percentage of total approval. Infrastructure index is constructed applying Principal Component Analysis (PCA) to different components of infrastructure which include road and railway density per 1000 square km, telephone mainline per 100 populations, gross irrigated area as a percentage of gross cropped area, per capita consumption of electricity power (in kwh), literacy rate, infant mortality rate and access to drinking water. While public expenditure, Centre-State grants, and FDI approval can be considered as policy (input) variables, variables such as sectoral

shares, infrastructure index may be regarded as output variables, though these may have been the result of policies.

The dataset comprises 14 major Indian states<sup>8</sup> and they are undivided Andhra Pradesh (AP), Bihar (BR), Gujarat (GJ), Haryana (HR), Karnataka (KA), Kerala (KL), Madhya Pradesh (MP), Maharashtra (MH), Odisha (OR), Punjab (PB), Rajasthan (RJ), Tamil Nadu (TN), Uttar Pradesh (UP) and West Bengal (WB). The data on GSDP and sectoral GSDP available in different base years are sourced from CSO's National Accounts Statistics, and converted to 2004–2005 base year following the method of Bhanumurthy and Singh (2013). Information on public expenditure and Centre-states grants are from *State Finances: a Study of Budgets* and *Reserve Bank of India Bulletin*, respectively, published by Reserve Bank of India. The data on employment are from *Employment and Unemployment Situation in India* of NSSO while that on FDI approval is from *SIA Newsletter*, Ministry of Commerce, and Industry. Statistics on different components of infrastructure are gathered from several sources such as *Infrastructure*, CMIE; *Infrastructure statistics*, MOSPI; *TERI Energy Data Directory and Year Book*; *Annual Report (2001–2002) on the Working of State Electricity Boards and Electricity Departments*; *Agricultural Statistics at a Glance*, Ministry of Agriculture; *Statistical abstracts*, MOSPI for different years; and *Economic Survey*, Ministry of Finance.

## 4 Methodology

To examine the spatial character of the regional growth process in India, we have used Exploratory Spatial Data Analysis (ESDA) either for two points of time (a year in early 90s, i.e., 1991 or 1993 as per availability of data and 2010) or for two periods (1991–2000 and 2001–2010) for flow variables such as growth rate and cumulative FDI approval. ESDA would enable us to see how regional growth and its determinants exhibit different spatial patterns. As the determinants of regional growth are the possible channels through which policies can ultimately influence growth, the spatial clustering of states in determinants can demonstrate if policies can also acquire spatial characters. Adoption of any spatial regression method such as spatial lag or durbin model is inappropriate as it would show only the average effect of determinants on regional growth; it could not discover the spatial clustering of the states in regional growth and its determinants.

ESDA is used to describe spatial distribution, discover patterns of spatial associations or clusters (whether low/high growth regions are bunched with low/high growth regions), detect the existence of spatial regimes or spatial heterogeneity and figure out spatial outliers (whether low/high growth region is flanked by high/low growth regions). The tools of ESDA are as follows:

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<sup>8</sup> The 14 states account for 93% of the population and 91.5% of domestic product (NDP) of the country. The special category states, namely, north and north-eastern and the small states, such as Goa are not included because the structure of their economies is different from the rest of the states (Rao et al. 1999).

#### 4.1 Global spatial autocorrelation

This indicates overall clustering of a variable in space and is measured by Moran's  $I$  statistic. It captures the magnitude of linear association of the value of a variable at one location with the spatially lagged values, i.e., spatially weighted average of values at neighboring locations (Anselin et al. 2007; Anselin 1995). The Moran's  $I$  statistic at a year or point of time  $t$  is given by

$$I_t = \frac{N}{\sum_{i=1}^n \sum_{j=1}^n w_{ij}} \left[ \frac{\sum_{i=1}^n \sum_{j=1}^n w_{ij} (X_i - \bar{X})(X_j - \bar{X})}{\sum_{i=1}^n (X_i - \bar{X})^2} \right]$$

where  $w_{ij}$  is an element of spatial weight matrix, which contains the information about the neighborhood structure between the states  $i$  and  $j$ .  $w_{ij}$  is based on binary relationship; it equals one if  $i$  and  $j$  are neighbors and zero otherwise. In spatial econometrics, such binary weight matrices are classified into two categories: those based on distance and those based on contiguity. We have used first-order (includes only direct neighbors and not neighbors' neighbors) queen-contiguity weights, which defines neighboring states as those with common borders as well as corners or vertices. This is because the focus here is on identifying the spatial pattern of regional growth process resulting from spatial spillover in the growth process among states. The spillovers effects reflected in spatial dependence or autocorrelation are expected to be spatially bounded (Capello 2009b), i.e., between the adjacent states or states touching each other's boundary.  $X_i$  and  $X_j$  are the variables of concern in region  $i$  and  $j$ , measured as deviations from the mean value of the observations across all the 14 states. The limits for the values of Moran's  $I$  are between  $+1$  and  $-1$ . Values close to  $+1$  indicate the existence of positive spatial autocorrelation which is observed in clustering of similar values (only low values or only high values) of a random variable in space, while values close to  $-1$  show the existence of negative spatial autocorrelation manifesting in clustering of dissimilar values (low values with high values and vice versa) in space. Values close to zero indicate that the distribution of the variable is random across space.

#### 4.2 The Moran scatter plot (distribution of Moran's $I$ )

It plots spatially lagged values of a variable against the original values of the variable. It complements Moran's  $I$  by breaking up the global spatial autocorrelation among regions into four types. These are low–low (LL) groups of regions (regions with low values of the variable surrounded by neighboring regions with low values), low–high (LH) groups of regions (regions with low values of the variable surrounded by neighboring regions with high values), high–low (HL) groups (regions with high values of the variable with neighboring regions with low values), and high–high (HH) groups (regions with high values of the variable with neighboring regions with high values). Thus, it helps to identify the existence of spatial heterogeneity and spatial outliers. The slope of the scatter plot corresponds to the value for Moran's  $I$ .



### 4.3 Local indicators of spatial autocorrelation (LISA)

The LISA or local Moran's statistic captures the presence or absence of significant spatial clusters and/or outliers for each location (Anselin 1995; Anselin et al. 2007). The statistically significant spatial clusters are the most significant regions (or hot spots) among the cluster of high–high groups of regions or the most significant regions among the cluster of low–low groups of regions. In contrast, the significant spatial outliers (high–low and low–high regions) represent pockets of exceptions—to the measure of global spatial autocorrelation.

The local Moran's statistics for each region  $i$  and year  $t$  is given as follows:

$$I_i = \left( \frac{X_i - \bar{X}}{m_o} \right) \sum_{j=1}^n w_{ij} (X_j - \bar{X}) \text{ with } m_o = \sum_{i=1}^n \frac{(X_i - \bar{X})^2}{n}.$$

The average of LISA for each region is proportional to global Moran's  $I$  (Anselin 1995, 2007).

$$\text{Thus, } I = \sum_{i=1}^n \frac{I_i}{n}.$$

## 5 Spatial character of regional growth and employment

### 5.1 Global spatial autocorrelation (Moran's $I$ )

To begin with, Table 1 exhibits positive spatial dependence for the outcome variables. This can be seen by the positive values of Moran's  $I$  statistic for per capita GSDP, employment, and growth for both the years, even though the value of the statistic is not significant for growth. This means that regional growth process is not random and, hence, any attempt to promote growth in one state cannot be isolated from the growth and development in its neighboring states.

### 5.2 Distribution of spatial autocorrelation

Moran's  $I$  statistic only gives an idea about the overall clustering of the entire dataset. Moran's scatter plots can show the composition of the overall clustering and identify the states that deviate from the global pattern. These are given in Figs. 1, 2, 3. The scatter plot regresses a spatially lagged value of a variable on the original standardized variable. The horizontal-axis represents the value of the original

**Table 1** Moran's  $I$  values for per capita GSDP, growth, employment

Years	Per capita GSDP	$P$ value	Per capita GSDP growth	$P$ value	Employment	$P$ value
1991	0.316	0.023	0.0499	0.753	0.503	0.005
2010	0.282	0.054	0.006	0.967	0.395	0.031

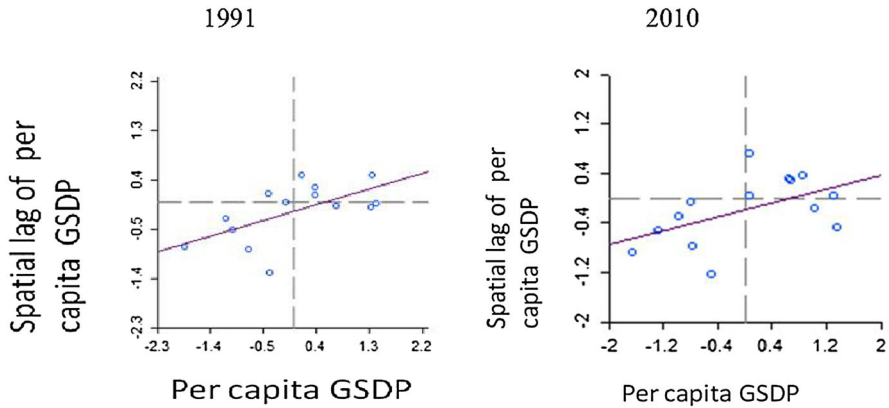


Fig. 1 Moran scatter plot of per capita GSDP

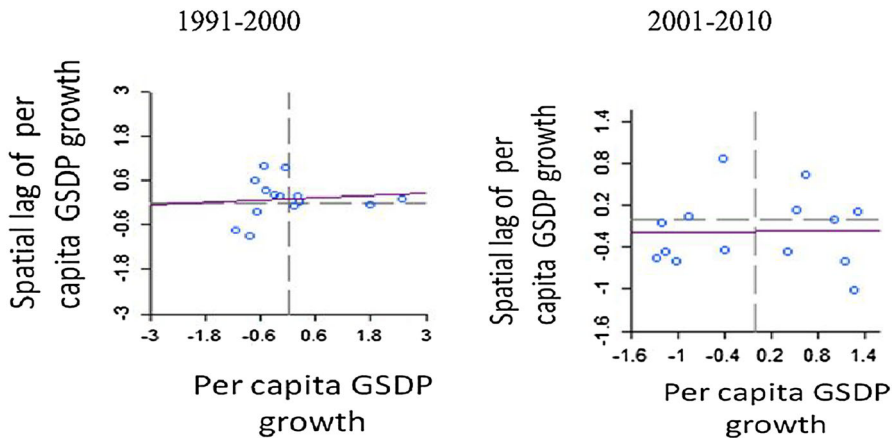


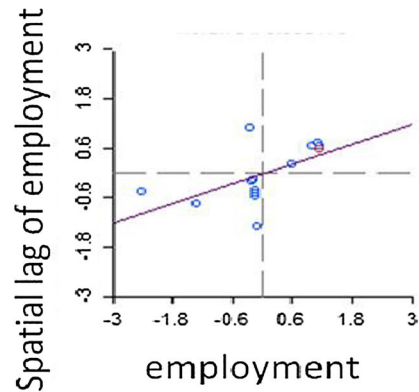
Fig. 2 Moran scatter plot of growth of per capita GSDP

standardized variable and, hence, the points falling to the right/left of the vertical line in the middle (at mean zero) pertain to the values of the variable above/below the sample’s average. Likewise, the vertical axis measures the spatially lagged values of the original standardized variable and the values above/below the horizontal line in the middle (at zero mean) correspond to high/low values. As a result, the scatter plot divides the data into four types of spatial association between a state and its neighbors. Quadrant I in top-right includes high value states with their high-value neighbors (henceforth called as high–high groups of states and abbreviated as HH), quadrant II in top-left contains states with low values surrounded by their high-value neighbors (henceforth called as low–high groups of states and abbreviated as LH), quadrant III in the bottom-left corresponds to states with low values surrounded by their neighbors with low values (henceforth called as low–low groups of states and abbreviated as LL), quadrant IV in the bottom-right includes states with high values surrounded by states with low values (henceforth

1993



2010



**Fig. 3** Moran scatter plot of employment

**Table 2** Distribution of spatial autocorrelation of outcome variables

	HH	LL	LH	HL
Panel-A-per capita GSDP				
1991	KA, KL, TN, PB	OR, WB, MP, UP, BR	AP, RJ	HR, GJ, MH
2010	AP, KL, PB, TN, KA, MH	OR, WB, UP, MP, BR, RJ		HR, GJ
Panel-B-growth				
1991–2000	BR, KL, TN	PB, RJ, HR	OR, WB, UP, AP, GJ, MH	KA, MP
2001–2010	KL, TN, AP, MH	MP, RJ, BR, WB, UP	KA, PB	GJ, HR, OR
Panel-C-employment				
1993	AP, GJ, TN, KL, MH, KA,	HR, OR, PB, WB, UP, BR		RJ, MP
2010	AP, GJ, KA, MH, TN	HR, OR, PB, WB, UP, MP, BR, RJ	KL	

called as high–low groups of states and abbreviated as HL). Table 2 classifies the states according to their distribution in the four quadrants.

The Moran's scatter plot for per capita GSDP shows evidence of spatial heterogeneity, i.e., co-existence of two distinct spatial regimes underlying the overall positive spatial association, with most of the states in the LL and HH cluster, and relatively more in the former cluster. In case of employment, there is also the existence of dual regime of high–high and low–low group of states, with only two states (Rajasthan and Madhya Pradesh) belonging in HL quadrant in 1993 and only

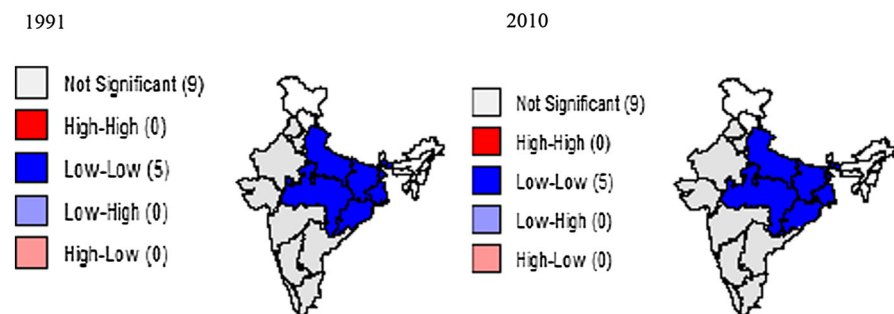
one state (Kerala) in the LH quadrant in the recent year. In case of growth rate, most states are low–high and high–low outliers during 1991–2000 but the distribution is seen to have changed in favor of low–low and high–high states in 2001–2010.

A feature of the dual spatial pattern in per capita income and employment rate is its high persistence, with the relative positions of states being unchanged. There is little improvement in spatial status of high income states (Karnataka, Kerala, Tamil Nadu, Punjab in HH group and Haryana, Gujarat in HL group) or low income states (Odisha, West Bengal, Madhya Pradesh, Uttar Pradesh, Bihar) with respect to both the variables. In case of per capita income, Andhra Pradesh is the only state improving its status from low–high outlier to high–high group of states. But in employment the states experiencing transition is for the worse—Kerala coming down to low–high group from high–high group while Rajasthan and Madhya Pradesh descending to low–low group from high–low status.

Further, it is found that high employment states (Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu and Kerala) are high per capita income states and low employment states (Odisha, West Bengal, Uttar Pradesh, Bihar) are low per capita income states. Haryana and Punjab are exceptions with high per capita income but low employment. Further, it can be noticed that the high per capita income states have high spatial status in growth and low per capita income states have low growth status. This explains the persistence of dual regimes and unchanged relative position of states in per capita income.

### 5.3 Local indicators of spatial association (LISA)

The LISA cluster maps of the three outcome variables are given in Figs. 4, 5, 6. The LISA map of per capita income shows the significance and persistence of low–low cluster formed by Uttar Pradesh, Madhya Pradesh, Odisha, West Bengal and Bihar in the dual spatial regime of high–high and low–low group of states, found in Moran scatter plot. Unlike per capita income, the LISA map for employment shows the presence of HH groups or hot spots (Andhra Pradesh, Karnataka, Kerala, Tamil Nadu in 1991 and Maharashtra, Andhra Pradesh, Karnataka in 2010) and HL outliers (Rajasthan in 1991 and Haryana in 2010), but there is LL cluster (Rajasthan, Haryana, Uttar Pradesh, Madhya Pradesh, Odisha, Bihar, West Bengal) in 2010. In



**Fig. 4** LISA of per capita GSDP

1991-2000

2001-2010

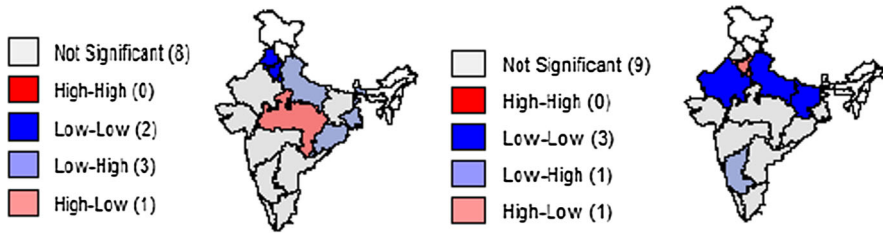


Fig. 5 LISA of per capita GSDP Growth

1993

2010

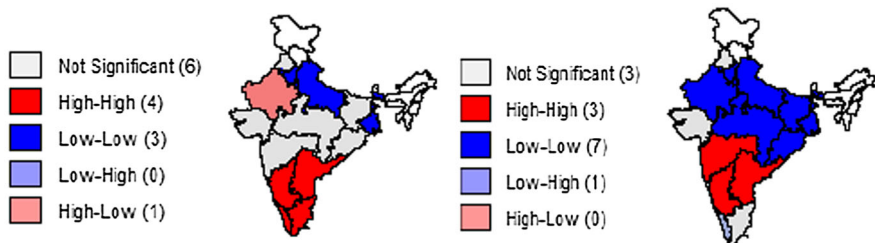


Fig. 6 LISA of employment

growth of per capita income, the spatial distribution is dominated by low-growth states, i.e., low–low and low–high categories. There are only two high–low spatial outliers, i.e., Madhya Pradesh and Haryana out of which only Haryana is the outlier in the recent year. The significance of low-growth states, especially that of low per capita income states (West Bengal, Uttar Pradesh, Rajasthan, Punjab, Bihar), explains the dominance of low–low group in per capita income.

To sum up, the outcome of regional growth process is not random but shows spatial dependence, with the dominance of LL states in a dual regime (spatial heterogeneity) of LL and HH states.

## 6 Spatial structure of the determinants of regional growth

### 6.1 Moran's $I$

What explains the spatial pattern in growth process? Does it correspond to the spatial pattern of the possible determinants of regional growth? For this, we look into the Moran's  $I$  statistic, its scatter plot and LISA statistic of the determinants. Table 3 reports the Moran's  $I$  statistic of the determinants of growth. Among the determinants, grants show positive spatial dependence in both the years, which

**Table 3** Moran's *I* of determinants

Variables	1991	2010
Grants	0.286 (0.108)	0.355 (0.0362)
Public expenditure (% of GSDP)	– 0.272 (0.002)	0.072 (0.628)
Share of manufacturing in GSDP	– 0.016 (0.337)	0.001 (0.298)
Share of services in GSDP	0.143 (0.129)	0.201 (0.076)
% of FDI approval to total FDI approval	0.248 (0.028)	– 0.097 (0.453)
Infrastructure index	0.208 (0.072)	0.127 (0.134)

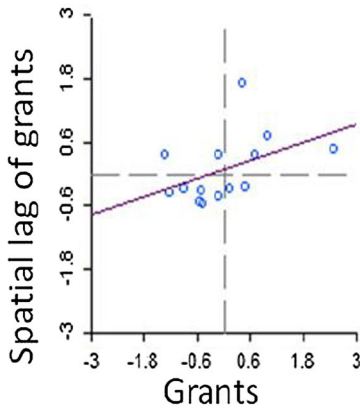
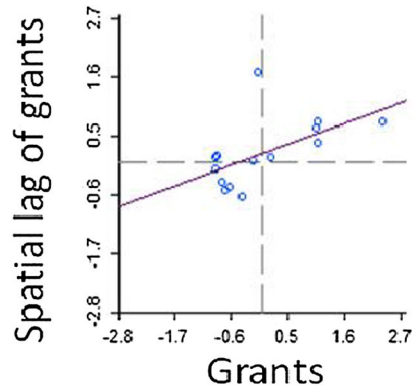
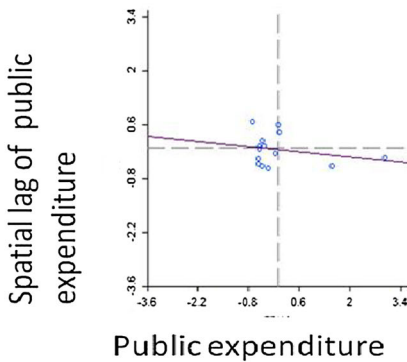
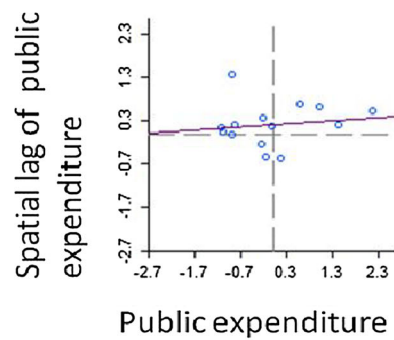
Figures in the parentheses are *P* values

suggests that the grants from the central government is favoring a group of states rather than any single state in isolation. Public expenditure across states has negative spatial association in 1991, indicating that increased or reduced public expenditure in its neighboring state is associated with decrease or increased expenditure in a state. But the correlation has turned positive and insignificant in 2010. The spatial association for the share of manufacturing output in GSDP is low and significant. In contrast, service sector's share in GSDP, which is significant only in 2010, has a positive association across space in both the years. The spatial distribution of FDI approval across states is showing significant positive spatial association during 1991–2000, which may be a reflection of competition among the neighboring states to attract foreign investment by committing themselves to a more liberalized and deregulated environment following the economic reforms of 1991. But the spatial association has become negative and insignificant during 2001–2010. In case of infrastructure index, there is positive spatial autocorrelation in both 1991 and 2010, though the association is insignificant in the latter year. A possible reason for the positive spatial association may be that some part of the infrastructure development such as construction of railways, national highways are of inter-state nature involving several states. There are also other components such as improvement in health facilities and promotion of literacy, which are usually taken up as common policies by the Centre with more or less emphasis in every state rather than in a single or a few states.

## 6.2 Distribution of global autocorrelation of determinants

Moran scatters plots are shown in Figs. 7, 8, 9, 10, 11 and 12. Table 4 lists the distribution of states in each of the four quadrants of the scatter plot.

The distribution of spatial autocorrelation for Centre-State grants across states shows that most of the states fall in the positive spatial dependence category (10 states in HH or LL), either receiving high or low level of grants. Though there were both LH and HL states in outlier categories, no state is found in the latter category in the recent year. While two high-grants receiving states, i.e., West Bengal and Andhra Pradesh, have moved to low-grants status, the relative position of most of

**1991****2010****Fig. 7** Moran scatter plot of grants**1991****2010****Fig. 8** Moran scatter plot of public expenditure

the states (Odisha, Uttar Pradesh, Bihar, Rajasthan among high-grants and Karnataka, Kerala, Maharashtra, Punjab, Tamil Nadu, Gujarat among low-grants group) has not seen much change.

The Moran scatter plot for public expenditure shows that most of the states belonged to the negative association quadrant in 1991 but the distribution has changed in favor of positive quadrant in the recent year. It can also be seen that most of the states are in low-expenditure group (LL and LH). While persistence of spatial status in expenditure is seen in some states (Andhra Pradesh, Odisha, Uttar Pradesh, Madhya Pradesh) in HH group and some states (Gujarat, Haryana, Maharashtra) in LH group, Bihar and Rajasthan are seen experiencing shifts in their spatial status, becoming high-expenditure (from LH to HL group) and low-expenditure (from HL to LH group) states, respectively.

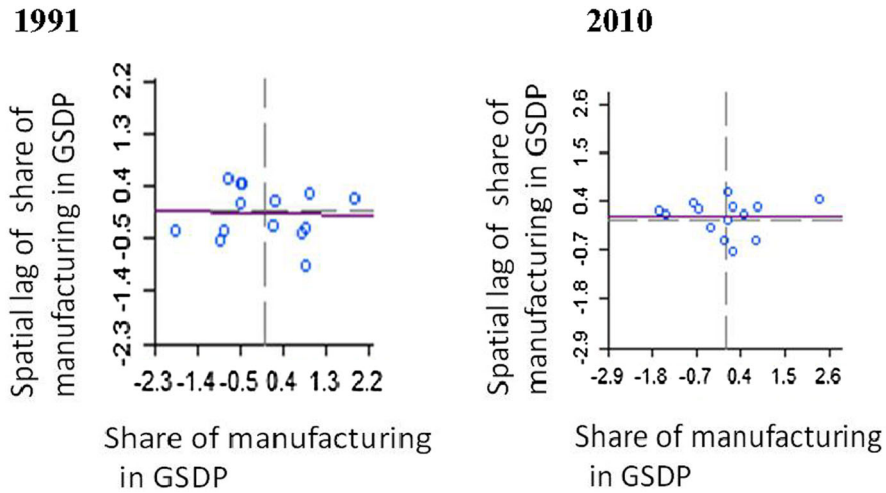


Fig. 9 Moran scatter plot of manufacturing

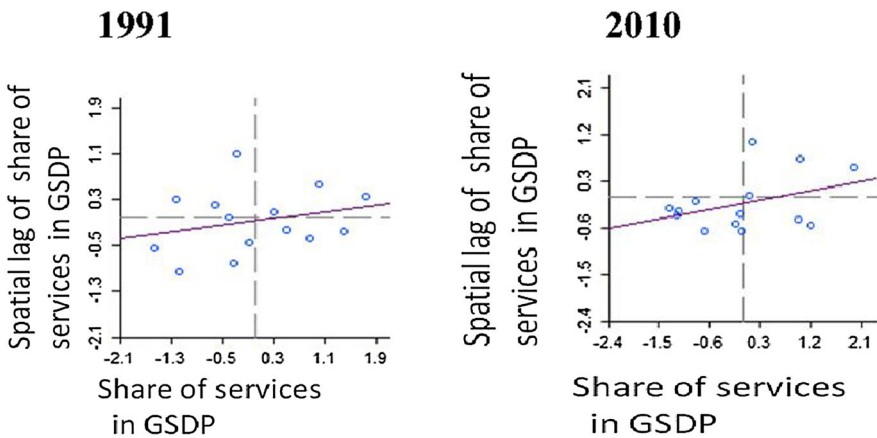
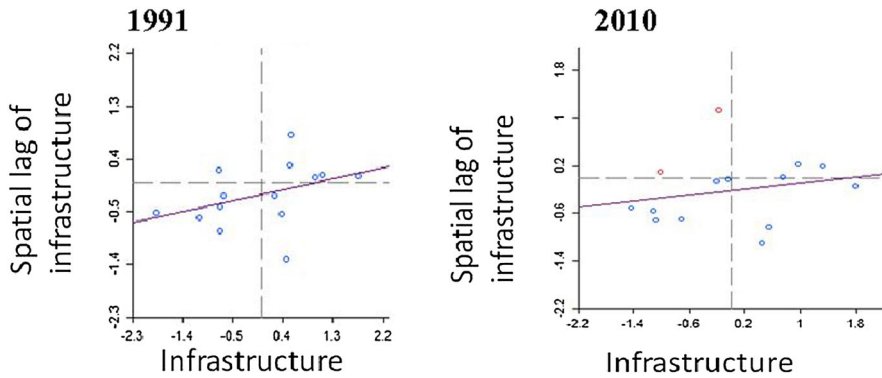


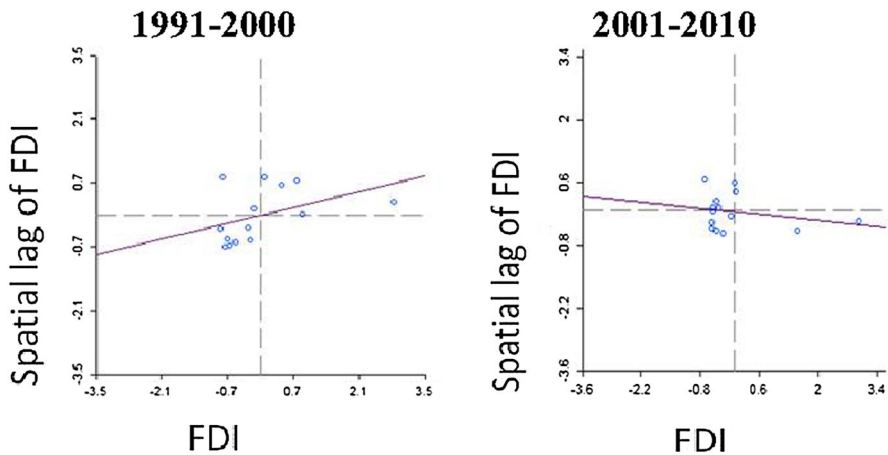
Fig. 10 Moran scatter plot of services

In the share of manufacturing to GSDP, most states (eight in 1991 and seven in 2010) are seen to be clustered in low–high and high–low groups indicating uneven industrial development. In FDI, albeit there is a dual spatial regime of high-FDI group and low-FDI group, the distribution is tilted in favor of low-FDI states (seven in LL and two in LH) and more so in 2001–2010 since only two states (Andhra Pradesh and Karnataka) are in HH group and two (Punjab and Maharashtra) are high outliers. Similar pattern is also seen in service sector’s share. There is a dual spatial regime but only a handful of states, i.e., Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu constitute the cluster of high shares in services, and only two states (West Bengal and Maharashtra) are high spatial outliers. There are eight low-status (in LL and LH in 1991, in LL category in 2010) states. In infrastructure, too, there is





**Fig. 11** Moran scatter plot of infrastructure



**Fig. 12** Moran scatter plot of FDI

a dual regime, i.e., positive spatial association of high–high and low–low states. While ten out of fourteen states belong to the cluster of positive spatial association in 1991, nine belong to the same cluster in 2010. Further, the low status states are increasing in number. While six states are found in the low-infrastructure spatial clusters (both LL and LH) in 1991, there are eight states in 2010.

The spatial distribution of all these variables also features high persistence overtime. For example, in manufacturing, Gujarat, Maharashtra, Haryana, Odisha, Rajasthan, Tamil Nadu continues to have high spatial status, whereas West Bengal, Uttar Pradesh, Bihar, Andhra Pradesh, Kerala is unable to move up from their low-status. There is no change in relative position of high status states (Andhra Pradesh, Kerala, Tamil Nadu, Maharashtra, and West Bengal) or low status states (Haryana, Punjab, Rajasthan, Uttar Pradesh, Madhya Pradesh, Gujarat, Odisha) in services. Similar is the case with high and low spatial categories in FDI and also in infrastructure—where persistence is seen among low-group states (Odisha,

**Table 4** Distribution of spatial autocorrelation of determinants

	1991	2010
<b>Grants</b>		
HH	OR, WB, UP, BR	RJ, UP, MP, BR, OR
LL	GJ, KA, KL, MH, TN, PB	KA, KL, MH, PB, TN
LH	HR, MP	AP, HR, GJ, WB
HL	RJ, AP	
<b>Public expenditure</b>		
HH	AP, OR, UP, MP	AP, OR, UP, MP, BR
LL	WB	KL, PB, TN
LH	GJ, HR, KL, PB, TN, BR, MH	GJ, HR, MH, RJ, WB
HL	KA, RJ	KA
<b>Share of manufacturing in GSDP</b>		
HH	GJ, MH, KA	GJ, MH, PB, RJ, MP
LL	WB, UP, BR	KA, BR
LH	AP, KL, PB, MP	AP, KL, WB, UP
HL	HR, OR, RJ, TN	OR, TN, HR
<b>Services</b>		
HH	AP, KL, TN	AP, KA, KL, TN
LL	HR, PB, RJ, UP, MP	GJ, HR, OR, PB, RJ, UP, MP, BR
LH	GJ, KA, OR	
HL	MH, WB, BR	MH, WB
<b>Infrastructure</b>		
HH	HR, PB, KA, KL, TN	HR, KA, TN
LL	AP, OR, UP, MP, BR	AP, MH, OR, UP, MP, BR
LH	RJ	KL, RJ
HL	GJ, MH, WB	GJ, PB, WB
FDI	1991–2000	2001–2010
HH	AP, GJ, KA, MH, TN	AP
LL	HR, OR, PB, RJ, WB, UP, BR	KL, OR, TN, WB, UP, BR
LH	KL, MP	GJ, HR, KA, RJ, MP
HL		MH, PB

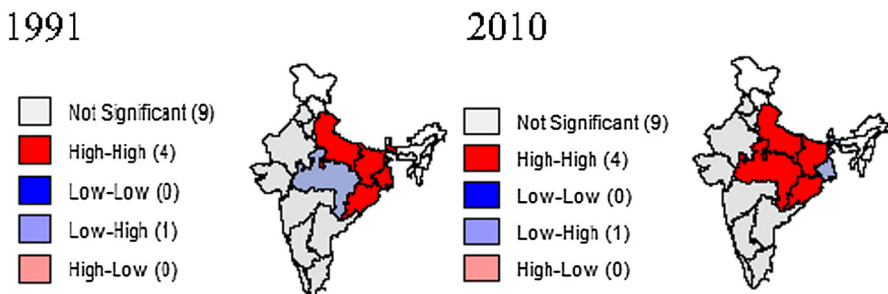
Rajasthan, Punjab, West Bengal, Uttar Pradesh, and Bihar) while only two states (Andhra Pradesh and Maharashtra) continue their high spatial status. Moreover, there are few evidences of positive transition of states in all these variables. While there is no positive transition of states in infrastructure, Karnataka is the only case in services, Punjab in FDI, Madhya Pradesh and Punjab in manufacturing are instances of states moving from low performing spatial outlier group to high performing group (HH or HL).

### 6.3 LISA cluster maps of determinants

Figures 13, 14, 15, 16, 17 and 18 give the LISA cluster maps of the determinants. The cluster map of grants shows that while Uttar Pradesh, Madhya Pradesh, Odisha, West Bengal, and Bihar are significant in HH cluster, Madhya Pradesh and West Bengal are significant low-grants outliers in 1991 and 2010, respectively. In public expenditure, no state has significant spatial status in 1991, but there are hot spots comprising Uttar Pradesh, Madhya Pradesh, Odisha and Bihar and two low–high spatial outliers such as Rajasthan and West Bengal in 2010. In the rest of the variables, at most, one or two states are centres of the high performing groups (HH or HL states). While there are two significant high performing outliers (West Bengal in 1991 and 2010) and (Gujarat in 2010) in infrastructure, there is the dominance of low–low cluster consisting of Bihar, Madhya Pradesh, Odisha in 1991 and only Uttar Pradesh in 2010. Though Odisha was a significant high–low outlier in 1991, Gujarat is the only existing hot spot or significant among HH states in manufacturing. In respect of service sector contribution to GSDP, while Rajasthan is significant in low–low cluster, Karnataka is the leading HH cluster in 2010. The spatial distribution is marked by low–low cluster of Uttar Pradesh, Punjab, Rajasthan, and Haryana during 1991–2000 with only two hot spots (Maharashtra and Andhra Pradesh) while there is only a significant low–low cluster (Uttar Pradesh) during 2001–2010.

## 7 The status of states in outcome vis-à-vis determinants

Table 5 puts together the spatial status of each state in Moran scatter plot of per capita income and the determining variables. The status in LISA cluster map is marked in bold and italics. The table shows that the spatial distribution of determining variables is compatible with the spatial distribution of states in per capita income. The high per capita income groups of states (HH or HL) which include Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab, and Tamil Nadu, have also high status in spatial distribution of one or more variables among manufacturing, services, FDI approval, and infrastructure. For example, the HH status of Karnataka, Tamil Nadu and the HL status of Maharashtra



**Fig. 13** LISA of centre-state grants

1991 2010

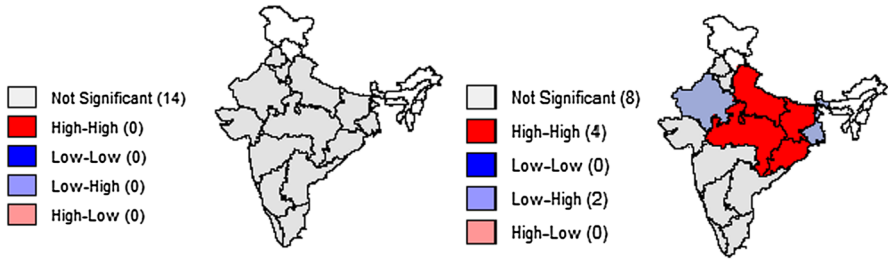


Fig. 14 LISA of public expenditure

1991

2010

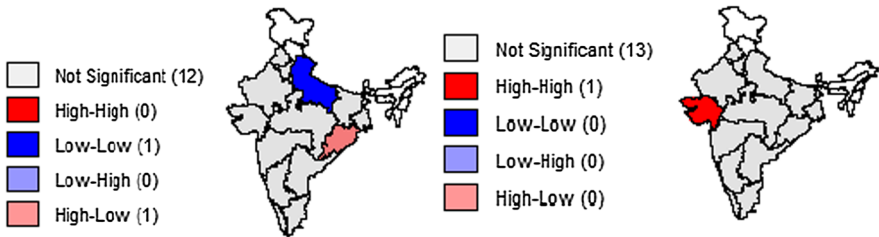


Fig. 15 LISA of manufacturing sector's share in GSDP

1991

2010

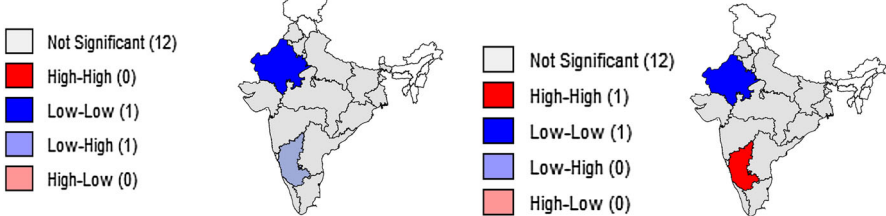


Fig. 16 LISA of services

1991

2010

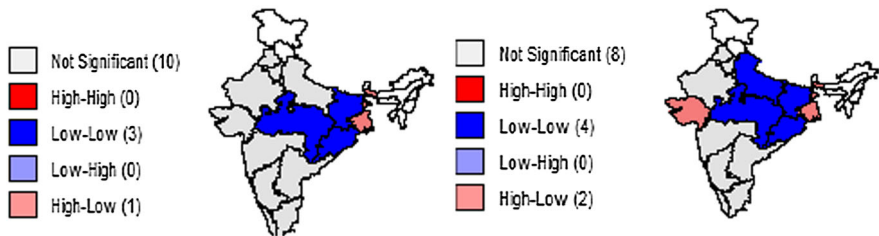
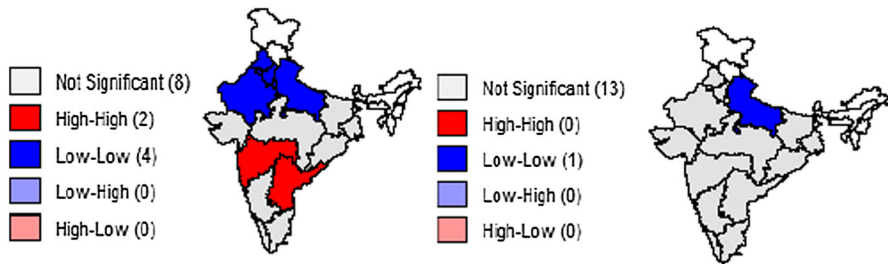


Fig. 17 LISA of infrastructure

1991-2000

2001-2010



**Fig. 18** LISA of FDI

find support in their HH or HL status in manufacturing, service sector's contribution, infrastructure in either or both the years, and in FDI approval during either or both the periods. The transition of AP from LH to HH-group seems to be explained by its HH-status in FDI approval and service sector's share. Similarly, the HH-status of Kerala in per capita income corresponds to its HH-status in infrastructure and service sector's share. While the HH-status of Punjab and HL-status of Haryana are matched by their HH or HL-status in manufacturing share and HH or HL status in infrastructure, the HL-status of Gujarat is supported by its HH status in manufacturing, HL in infrastructure and HH in FDI during 1991–2001. For low-income group (LL or LH) of states, the status in determining variables is also consistent with their status in per capita income. For example, the position of Bihar and Uttar Pradesh in manufacturing, infrastructure, FDI, and services is either LL or LH. Though Madhya Pradesh, Odisha, and Rajasthan have high spatial status in manufacturing, the states continue to be in low per capita income group, which may be because of their low spatial status in FDI approval, service sectors' share and infrastructure. WB has low status in manufacturing and FDI; its HL status in services and infrastructure has not helped it to improve its low-status in per capita income.

To the extent the existence of cluster of rich states are due to spatial concentration of industrial and service sector activities, a possible explanation for the dominance of the backward group of states over the cluster of rich states may be due to insignificant agglomeration or spatial concentration.<sup>9</sup> As seen in the previous section, in manufacturing, the performance is uneven across states as most of the states are spatial outliers. In case of FDI, services and infrastructure, although there is a dual spatial regime of high (HH) and low-performing (LL) group, most of the states belong to low-performing group (LL or LH). Thus, the spatial concentration of these sectors may not be adequate enough for the economic performance of the cluster of rich states to outweigh the dismal performance of cluster of backward states. Further, the reason for the persistence of the dual spatial pattern of per capita

<sup>9</sup> This can result if manufacturing engages a small fraction of the population, generating a small portion of demand or if suppliers of goods and services to the agricultural sector prefer to locate near their markets due to weak economies of scale and high transportation costs (Krugman 1991).

**Table 5** The status of states in different variables (Pairing up)

State	Per capita SDP	Grants	Public expenditure	Share of manufacturing in GSDP	Share of services in GSDP	Infrastructure	FDI
AP							
1991	LH	HL	HH	LH	HH	LL	<b>HH</b>
2010	HH	LH	HH	LH	HH	LL	HH
BR							
1991	<b>LL</b>	<b>HH</b>	LH	LL	HL	<b>LL</b>	LL
2010	<b>LL</b>	<b>HH</b>	<b>HH</b>	LL	LL	<b>LL</b>	LL
GJ							
1991	HL	LL	LH	HH	LL	HL	HH
2010	HL	LH	LH	<b>HH</b>	LH	<b>HL</b>	LH
HR							
1991	HL	LH	LH	HL	LL	HH	<b>LL</b>
2010	HL	LH	LH	HL	LL	HH	LH
KA							
1991	HH	LL	HL	HH	<b>LH</b>	HH	HH
2010	HH	LL	HL	LL	<b>HH</b>	HH	LH
KL							
1991	HH	LL	LH	LH	HH	HH	LH
2010	HH	LL	LL	LH	HH	LH	LL
MP							
1991	<b>LL</b>	<b>LH</b>	HH	LH	LL	<b>LL</b>	LH
2010	<b>LL</b>	<b>HH</b>	<b>HH</b>	HH	LL	<b>LL</b>	LH
MH							
1991	HL	LL	LH	HH	HL	HL	<b>HH</b>
2010	HH	LL	LH	LH	HL	LL	HL
OR							
1991	<b>LL</b>	<b>HH</b>	HH	<b>HL</b>	LH	<b>LL</b>	LL
2010	<b>LL</b>	<b>HH</b>	<b>HH</b>	HL	LL	<b>LL</b>	LL
PB							
1991	HH	LL	LH	LH	LL	HH	<b>LL</b>
2010	HH	LL	LL	HH	LL	HL	HL
RJ							
1991	LH	HL	HL	HL	<b>LL</b>	LH	<b>LL</b>
2010	LL	HH	<b>LH</b>	HH	<b>LL</b>	LH	LH
TN							
1991	HH	LL	LH	HL	HH	HH	HH
2010	HH	LL	LL	HL	HH	HH	LL
UP							
1991	<b>LL</b>	<b>HH</b>	HH	<b>LL</b>	LL	LL	<b>LL</b>
2010	<b>LL</b>	<b>HH</b>	<b>HH</b>	LH	LL	<b>LL</b>	<b>LL</b>

**Table 5** continued

State	Per capita SDP	Grants	Public expenditure	Share of manufacturing in GSDP	Share of services in GSDP	Infrastructure	FDI
WB							
1991	<i>LL</i>	<i>HH</i>	LL	LL	HL	<i>HL</i>	LL
2010	<i>LL</i>	LH	<i>LH</i>	LH	HL	<i>HL</i>	LL

income and the dominance of low per capita income group can be found in the high persistence in the dual spatial pattern in all these variables with a few evidences of positive transition. At most, one or two states have significant development in these variables: West Bengal (HL-outlier in infrastructure), Gujarat (HL-outlier in infrastructure and the only hot spot in manufacturing), Karnataka (hot spot in services) and Andhra Pradesh (hot spot in FDI).

The most usual thing observed from the table is that the LL-states are high recipient of Centre-State grants, for which they belong to HH cluster in Centre-State- grants. The opposite holds true in case of HH-states in per capita income; they are found in the LL cluster of grants. This reflects the intention of the government to reduce disparity in income across states. However, one exception among the determining variables is public expenditure. Its spatial distribution seems to have no systematic association with the spatial status of per capita income of states. High per capita income states have both low and high spatial status in public expenditure and same is observed for low per capita income states.

While the dual spatial pattern in per capita income may be attributed to the matching spatial distribution of determinants such as manufacturing, FDI, infrastructure and services, the persistence in the existing pattern may have to do with the conditions underlying the spatial clustering of these variables. The spatial character of some of the determinants such as grants seems to be explained by the spatial status of states in the outcome variable, i.e., per capita income. For other policy variables such as FDI, manufacturing, etc., the spatial clustering may be explained either by the underlying initial conditions such as coastal access or the general business or regulatory environment of particular states.<sup>10</sup> For example, coastal states having major ports (Maharashtra, Tamil Nadu, Andhra Pradesh, Haryana, etc.) have more potential for growth than interior regions. This is because the potential for growth in the latter regions tend to be more limited than the growth based on exports to the world market. It is not surprising that the former have higher inflow of FDI, higher share in manufacturing and services. Even the existence of high–low outlier such as Haryana may be traced to its proximity to the National Capital Region (NCR). This may have created a more business-friendly environment, which, perhaps, has led to high spatial status category in infrastructure and manufacturing. There are also good reasons for the backwardness of some coastal

<sup>10</sup> (Sachs and Bajpai 2002).

states. For instance, central government's prerogative to undertake investment in most of the infrastructure such as airports, national highways, power, and telecommunications has held back the state governments to undertake rapid economic reforms. The backwardness of a coastal state like Odisha may be explained by its susceptibility to floods and cyclones and, also, by its poor agricultural performance, albeit it is largely an agricultural state. The backward states such as Madhya Pradesh, Bihar, Uttar Pradesh and Odisha also include some distinctly poor regions, especially tribal areas.

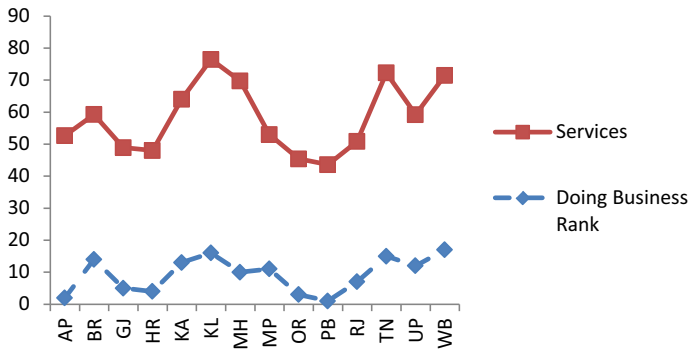
The emergence and persistence of the different spatial clusters seem to conform to the explanation of New Economic Geography in terms of spatial concentrations, spatial spillovers and initial conditions. The spatial pattern of per capita income in groups of rich and poor states, and the matching pattern in manufacturing, service sector activities and FDI approval indicates the spatial concentration of economic activities and possible existence of local spillovers, namely, availability of skilled labor and technology within the cluster of rich groups of states and also at some high outliers (Gujarat, Haryana). This can be illustrated from the association between infrastructure index with share of manufacturing and service sector activities. Infrastructure index includes components such as transports, telecommunications network which can facilitate technological externalities, and components of health and education associated with efficient and skilled labor force. It can be seen from Table 5 that states with high status in infrastructure (HH and HL states) have unambiguously high status in manufacturing and services. The dual pattern of rich and poor groups of states shows that the spatial concentration of economic activities in already rich states continues to happen at the cost of poor groups of states, i.e., by pushing productive factors and agents from the latter to the former. This is also true of the high outlier states such as Gujarat and Haryana.

The spatial patterns of determining variable of regional growth also serve to highlight how policies can acquire spatial character. For example, the spatial cluster of HH states (Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu) and HL cluster of Maharashtra and West Bengal in service sector activities exhibits that the post-reform policy changes characterized by reducing government controls and increasing reliance on market forces seem to have been favorable to some groups of states across space. This is illustrated by the positive relationship between the 'doing business ranks'<sup>11</sup> of the states and share of services in GSDP for 2009 for which the report on doing business for Indian states is available, shown in Fig. 19. That is, states with conducive 'doing business climate' have done better. Similar is the case with infrastructure policy. It can be seen from Table 5 that states with higher share of manufacturing, service sector, and high FDI approvals are the ones with higher infrastructure index both in 1991 and 2010. That is, infrastructure creation has favored some groups of states across space resulting in high and low groups of states.

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<sup>11</sup> During the study period, Sub-national Doing Business in India ranking published by the World Bank is available only for the year 2009. The ranking is based on scores on seven indicators such as starting a business, dealing with construction permits, registering property, paying taxes, trading across borders, enforcing contracts, resolving insolvency.





**Fig. 19** Doing business ranks and share of services in GSDP in 2009

## 8 Conclusion

The persistent regional disparity in India, in spite of several regional development policies pursued over six decades of planning, poses an unsolved puzzle. The emphasis on the role of space with the emergence of NEG theories offers a possible explanation to the puzzle. Analyzing the spatial character of outcome variables of regional growth process and its possible determinants, this study concludes that the outcomes—regional per capita income, growth and employment—have a spatial character, and so have the factors behind the growth process. Though, there are different clustering in space (group of rich states, group of backward states, spatial outliers), the main spatial features of the outcome variables are a dual spatial regime in per capita income, i.e., coexistence of the group of rich and backward states, the dominance of backward group, high persistence in such spatial pattern and a few positive transition from backward to rich group. These spatial features of outcome variables are found matching with the spatial distribution of determining variables such as manufacturing, FDI, infrastructure and services. So far as policies that affect regional growth and its determinants, the spatial pattern of the determining variables lends a spatial character to the regional development policies.

These findings suggest that policies aimed at promoting regional balance may have to keep in view the spatial patterns of the growth process. Hence, different spatial clusters of states need different policy treatment. For example, given that FDI is flowing to the states with already high spatial concentration of manufacturing and service sector activities and infrastructure index, the policy for liberalizing and attracting investment for low status groups of states should include strategic focus on creating knowledge and labor externalities by developing transport and communication along with focussing on improvement of human capital. While cluster of rich states are of less concern, the clusters of backward states as well as the spatial outliers may require special attention in policy. For example, the policies should be so designed for the spatial outliers that it does not benefit a state at the cost of others. In this respect, policies should be not only based on their effect on a particular state but also how it affects the growth process of the neighboring states. Further, the fact that determinants too have a spatial character needs to be recognized in relying on any

particular policy for achieving regional outcomes. Especially, as there is persistence of the same spatial pattern in these variables, policies need to address the reasons behind the spatial variation of these factors. For example, differences in business and regulatory environment of states may be responsible for the spatial clustering or variation of growth-determinants such as FDI, development of manufacturing and service sectors. The role of policies in this case is to create enabling business and regulatory environment. As this study shows the clustering of states in different groups across space, separate studies on different groups of states or individual states that are spatial outliers, at the disaggregated level, would be promising for understanding the unique growth process of different states.

### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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