Whither the Indian Federation? Regional Disparities and Economic Reforms

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Abstract

The last two decades have seen increased divergence among the states of the Indian Federation in terms of their economic performance. This paper uses spatial econometric methods to examine how the regional pattern of growth has been influenced by the economic reforms implemented since the early 1990s. The process of liberalization and increased openness to international markets has imparted a clear spatial connotation to the gap dividing low and fast growing states. Winners were those states that benefited the most from the recent process of reform and liberalization, thanks also to their geographical advantage and to the presence of a developed service sector. Losers were instead the landlocked and highly populated states with a predominant agricultural sector and a low level of innovation.

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1. Introduction

The issue of whether states and regions at different levels of development tend to converge to a common growth pattern has attracted considerable attention since the pioneering work by Barro and Sala-i-Martin in the early 1990s (see Barro and Sala-i-Martin, 2003). The original line of enquiry was mainly aimed at testing the prediction of (conditional) convergence to a common equilibrium growth path, implied by the exogenous growth model by Solow (1956), as contrasted to the prediction of no convergence that was implied by most growth models of the endogenous growth variety.

Several studies carried out on India tend to lend support to the view that the recent pattern of growth in the Indian Federation has been characterised by an increasing *divergence* across States in terms of GDP per capita. A number of possible explanations have been put forward to account for this inequality in economic performance. The ability of individual states to attract foreign investors appears to have been greater for richer states, and this could have contributed to widen the gap with the poorer states (Bhattacharya and Sakthivel, 2004, and Purfield, 2006). A further element of divergence could be traced to the heavy backwardness of rural areas, which combined with an excessive rate of population growth could have trapped them into a vicious circle of poverty (Datt and Ravallion, 2002). Under this respect, Besley and Burgess (1998) argue that poverty has decreased more markedly in States where land reform on tenancy and the abolition of intermediaries have been pursued more rigorously. Finally, divergence could have resulted from differences in the quality of infrastructures. Nagaraj, Varoudakis and Véganonès (1998) carry out a multidimensional analysis of the long-run sources of growth across Indian States to show that infrastructures are the single most important determinant of success or failure in economic performance. This could also explain why some States like Haryana and Punjab have performed relatively well when compared to other areas of the country with a similar share of agriculture.

Particular attention has been paid to the role of the economic reforms implemented since the economic recession in 1991. If at the aggregate level the reforms have unambiguously stimulated growth, at the regional level their effect has been much more controversial. Kochhar *et al.* (2006) argue that consequences of reforms and of increased decentralisation have been twofold. At the level of the overall economy, liberalisation measures have improved India's economic performance. At the state level, however, they have generated disparities in the levels of income through the differential impact of liberalisation across regions. Fast growing peninsular states appear to have

reached production standards not too far from Western ones, while states of the hinterland continue to be relatively poor.

The purpose of this paper is to explore the main determinants of long-run growth across Indian states in the last two-and-a-half decades, with special concern for the post-reform period. We find that Indian States experienced divergence across this period, but at a more pronounced pace since the reforms. We argue that the pattern of divergence has acquired a very significant spatial connotation, due to the heterogeneous impact of trade liberalisation. Coastal states have benefited the most from the increased level of openness. By contrast, landlocked rural areas have fared worse and have generally lagged behind. However, states like Haryana and Punjab have been able to attain high levels of performance despite their mainly rural production structure and their landlocked status, due to the successful implementation of rural reforms together with improved irrigation systems and high availability of arable land.

One of the main novel aspects of this paper is the attention paid to the spatial pattern of growth across Indian states. We explore the role of neighbouring states in influencing the rate of growth of individual states. It will be found that the location of states is a crucial factor affecting their performance, and that the importance of location has indeed increased in the more recent period. Another innovative contribution is the dynamics of sectoral shares during the process of reforms, and their specific role on state growth performance.

The structure of this paper is as follows. Section 2 looks at the main characteristics of Indian States, with particular regard to the process of reforms that has accompanied the acceleration in growth of the Indian economy. Section 3 analyses the pattern of convergence or divergence across Indian states both for the whole period since 1980 and separately for the pre- and post-reform periods. Section 4 explores the geographical dimension of the dynamics of divergence by introducing spatial econometric models. We can thus carry out a three-dimensional analysis of divergence patterns by considering differences over time, sectors and space. Section 5 discusses the possible role of reforms in influencing the divergence across states. Section 6 concludes.

2. Facts and Data about Indian States

2.1. The Indian States: An Overview

In order to study and interpret the process of economic convergence, it is essential to examine the specific geographic and socio-economic characteristics that could have led to different patterns of growth across Indian States. The Indian Federation is constituted by twenty-eight States and seven federally governed Union Territories, populated by more than one billion people. Due to the sheer size and complexity of its territory, together with its highly heterogeneous socio-economic and cultural background, India appears to have the characteristics of a continent rather than a single country. The Indian Federation includes more than one third of the poor people in the world. Despite this, India is the main exporter of highly-skilled software engineers, financial service analysts and pharmaceutical researchers. India is a nation with 35 towns exceeding 1 million people, but, at the same time, a country where 70% of the population live in rural areas and are still extremely dependent on the luck of the rainfall every year. Furthermore, India is the nation with the highest number of official languages in the world. Nonetheless, thanks to the young and educated generations who are fluent in English, the Indian economy is an attractive destination for global companies, which increasingly are outsourcing their customer services and technical support and have also started to channel foreign direct investment into the Federation.

It is also important to evaluate the impact of the process of economic reforms of the last three decades in a historical perspective. After the Green Revolution in the mid-1960s, that virtually eliminated famine in India, the next big push took place under the governments of Indira and Rajiv Gandhi during the 1980s, with a gradual surge in the rate of growth of the economy, and especially since the early 1990s with the process of liberalisation. The reforms produced deep transformations into the structure of the Indian economy, and the changes in the specialisation of States have played a significant role in explaining their economic performance in the more recent period.

The first difference across the states concerns their size and their population density (Table 1). The population of India amounted to 1.1 billion people in 2004, but around 450 million of them were concentrated in just 4 states: Uttar Pradesh, Maharashtra, Bihar and West Bengal. Uttar Pradesh, one of the poorest states of the Federation, is the most populated state of India, with 179 million inhabitants. The average population of the 24 states in the sample was 46 million, comparable to larger European countries. As noted by Bhattacharya and Sakthivel (2004), the size of population can impact negatively on economic growth, in particular in rural areas where the demographic growth rate is still high relative to the national average.

Numerous other differences stem from institutional, political and cultural factors. First, the nature of India's federal system assigns different taxation powers to the Central Government and to the States, depending on whether the source of income is agriculture or non-agriculture (Rao and Singh, 2006). For example, States are allowed to levy taxes on the sale and purchase of goods but not on services, and therefore this could have a different impact on economic performance depending on the regional specialization. Secondly, there are wide differences in the political composition of the state governments. Two extreme cases are represented by Kerala, where communist parties have been in power since the 1950s, and Maharashtra, where the BJP, the principal opponent to the Congress Party, has guided the state during the liberalization process in the 1990s. The nature and the quality of institutions can induce profound differences in policy choices, especially during the years of liberalisation of trade and factor markets, with significant effects on the growth process (Rodrik and Subramanian, 2004, and Purfield, 2006). Moreover, a further element of heterogeneity across States is the continued presence of caste and ethnicity systems (Gang *et al.*, 2002) that still appear to play a strong role mainly in rural states, contributing to trapping them in a persistent condition of backwardness.

Finally, economic differences can emerge from the presence of large metropolitan areas that operate as industrial districts (*e.g.* Ahmedabad, Gujarat), poles of attraction for FDI (Mumbai, Maharashtra) and sites for IT companies (Bangalore, Karnataka). The positive impact of the degree of urbanization becomes even stronger when coupled with a strategic geographic position. For example, access to the sea seems to play a key role. This was especially evident during the liberalization process in the 1990s that opened India's market to the rest of the world. In general, the presence of these centres "can serve both the internal market and the international market, and can more make logistical links with foreign suppliers and customers[1]" than interior areas.

The 1970s

A more detailed picture of the Indian federation can be obtained by looking at the process of reforms that have been implemented since the early 1970s. This process has been developed starting with the agricultural reforms under the Green Revolution period. Between 1967 and 1978 important efforts were made to reduce the gap between population growth and food production, through the introduction of high-yielding seed varieties and through the implementation of tenancy and ceiling-redistributive reforms and of land consolidation. The process of modernization of agriculture has ensured that Indians have more food on average, and the impact of land reforms on poverty has been positive leading to a rise in agricultural wages (Besley and Burgess, 2000). However, it would

[1] Sachs, Bajpai and Ramiah (2002).

appear that the Green Revolution has not produced even results across all rural areas, and that greater efficiency in redistribution policy is still needed (Land Research Action Network, 2003). The highest increment in agricultural production was registered in Punjab, where it grew at an annual rate of 4.5% on average between 1970-1994. Successful reforms have also been implemented in Haryana, but other States, like Bihar, that were poorer and still largely dependent on rural sectors, recorded a rate of growth of just 1.5% (Table 2 in Mearns, 1998).

The 1980s.

The second wave of reforms is identified with the "pro-business" policies initiated by Indira and Rajiv Gandhi during the 1980s. These policies were mainly directed at increasing the productivity of firms through the simplification of the licence system and the relaxation of industrial controls, thereby allowing new investments and product diversification and letting private companies enter into those sectors that used to be monopolies of the Centre. This strategy was accompanied by high trade barriers in order to promote the creation and consolidation of firms and shield them from foreign competition. Chari (2007) estimates that relative Total Factor Productivity (TFP) improvement in the deregulated industries was about 32% over a period of ten years following the licence reform. The industrial sector experienced a sustained growth in states like Gujarat, Punjab and Maharashtra (Bhide *et al*., 2005). States specialising in manufacturing activities appear to have played a key positive role in driving and sustaining Indian growth in the 1980s, while in the previous decades their impact on growth had been opposite in sign (Rodrik and Subramanian, 2004). In addition, it has been noted that the manufacturing industry exerted a positive impact on the convergence process if the registered or large scale sector is considered, while unregistered or small scale manufacturing, which constitute the majority of the secondary sector, showed no clear sign towards convergence or divergence in the Indira and Rajiv Gandhi's period (Nair, 2004).

The 1990s.

This policy stance changed with the "pro-market" attitude of the new governments in the aftermath of the financial and political crisis in 1991 (Basu and Maertens, 2007, provide a useful account of the events that led to the crisis). The pro-liberalization reforms opened the Indian market to foreign competition. Even if trade barriers were only lowered very gradually, these new policies stimulated an increase in Indian trade and a jump in FDI inflows. In particular, some states like Karnataka, Andhra Pradesh and Tamil Nadu, thanks to the foreign investments[2], experienced a sustained

[2] One hundred percent foreign investment was permitted in information technology units set up exclusively for exports. These units can be set up under several schemes, including Export Oriented Units, Export Processing Zones, Special Economic Zones, Software Technology Parks, and Electronics Hardware Technology Parks (Panagariya, 2004).

growth of the IT activities, especially in towns like Bangalore, Hyderabad and Chennai where a highly mobile skilled and low-wage labour force was present. The activities in these areas have permitted India to become the major exporter of IT products in the world at the beginning of the new millennium (Chauvin and Lemoine, 2003). Even though this new wave of reforms also affected the deregulation of industry, most of the emphasis was placed on the liberalization of trade in services. This was achieved by opening up the insurance, banking, telecommunications and infrastructure sectors to the private sector, including foreign investors. The expansion of services during the 1990s seems to replace manufacturing as the engine of Indian growth, although an effective introduction of the new technologies into the rest of the economy must still be implemented (Dasgupta and Singh, 2005).

The Green Revolution, the "pro-business" and the "pro-market" policies have drastically changed the pattern of growth of India, transforming what still is a rural country into one of the fastest growing economies in the world. The impact of these changes on the performance and on the economic structure of the states is the topic of next section.

2.2. State-level growth performance and sector specialization

India's new accelerated pattern of growth can be traced back to the beginning of the 1980s under the Indira Gandhi's government. The economy started to grow at about 6% per year, leaving behind the "Hindu rate" of growth of the previous decades, which stagnated at around 3.5% between 1950 and 1980. As a consequence of the expansion of the economy, the average Net State Domestic Product (NSDP) per capita of the 24 states increased from 1,756 rupees in 1980 to 3,967 rupees in 2004 (Table 2). The most striking aspect of the table is that the six richest states at the beginning of the period – Delhi, Goa, Punjab, Maharashtra, Haryana and Gujarat – maintained the top positions in 2004. Similarly, the group of the six poorest states also remained very stable, with Bihar, Uttar Pradesh, Madhya Pradesh, Orissa and Assam locked in the bottom positions (even if these two last states left the bottom group in the first half of the 1980s and Madhya Pradesh entered in 1985). In the more recent periods, after a long period of slow growth because of the continued tensions between India and Pakistan for the control of the territory, Jammu and Kashmir joined the group of the six poorest states. Important considerations also emerge from the middle part of the table, where states like Tamil Nadu and Karnataka gained positions during the period. Furthermore, the north-eastern state of Arunachal Pradesh appears in the top group in the first half of 1990s replacing Gujarat, while between 1985 and 1990 Tripura, Meghalaya and Rajasthan leave the bottom group and maintain middle and middle-low positions in the next years.

A clearer picture of the economic performance of the states is obtained by looking at the evolution of the growth rates of the NSDP per-capita. Table 3 ranks the states from the fastest to the slowest and emphasises in bold and in italics the performance of the six richest states and of the six poorest states respectively at the beginning of the five-year period. For instance Maharashtra, which was the fourth richest state in 1980, grew at 2.2% per year between 1980 and 1985. Overall, the table reveals some mixed results. During the 1980s, all the six richest states in 1980 show a rate of growth above the rate of 3.1% per year, which was the average growth rate among the 24 states, whereas five of the six poorest states experienced a growth path under the average. This may have contributed to exacerbating the income inequalities across states. Rajasthan, that had the 23rd income level in 1980, is the only exception with 5,6% average growth per year, the second highest rate after Arunachal Pradesh. It is interesting to underline that the only rich state that grows at a higher rate in the first half of the 1980s relative to the second half is Punjab. This may be due to the lasting effects of the Green Revolution. All the other five richest states increase or maintain their rate of growth: for example, Goa jumps from a negative rate to 9.8% in the second half of the 1980s. Among the poorest states, Assam, Bihar and Orissa face a decline between 1985 and 1990, but Meghalaya, Madhya Pradesh, Uttar Pradesh and, in particular, Rajastan and Tripura show an increase in their rate of growth.

The following decade sees the poorest states continuing to grow below the national average, with the exception of Tripura which experienced a remarkable performance between 1995 and 2000. Some of the richest states however face a decline in their growth. By contrast, the middle-income and coastal states of Kerala, Karnataka, West Bengal and Tamil Nadu exhibited an increasing rate of growth, possibly due to the liberalization process of the Indian economy and to the amount of new FDI inflows. It is also important to underline the performance of Bihar in the second half of the 1990s, when its economy grew at 7.5% per year after negative growth in the first half. The last four years see Gujarat and Maharashtra growing at a fast rate together with the poor state of Orissa, while West Bengal, Kerala and Tripura managed to maintain the pattern of growth of the previous years. Goa and Tamil Nadu have displayed a fall in the rate, while Bihar interrupts the positive trend of the late 1990s.

These data yield some interesting conclusions that are summarized in Table 4. First of all, the six richest states have displayed, on average, a higher rate of growth than the six poorest ones in all the sub-periods analyzed. Furthermore, the second half of the 1980s is the best period in terms of growth for both groups, which displayed a very similar growth pattern. Finally, the ratio between the average per capita NSDP of the richest and of the poorest countries increased sharply during the

second decade, especially in early 1990s when poorest states probably suffered the most from the crisis in 1991.

Even if fast and sustained growth of the Indian economy in the last twenty-five years has produced different results in terms of state-level performance, the changes in its sectoral structure seem to have affected all the states, with a general shift form agriculture activities to the service sector (Table 5). Economic growth has been accompanied by a sharp reduction of the share of primary sectors on NSDP, from 43% of 1980 to 26% in 2004. This decrease has been absorbed by the growth of the manufacturing sector, especially in the second half of the 1980s – its share, stable at around 20% till 1985, jumps to 23% at the end of the decade and reaches 24% in 1995 – and by a rapid expansion of service activities. The tertiary sector, that experienced a stable growth pattern during the 1980s, has risen rapidly in the last ten years, and its share has reached 51% in 2004. These changes are confirmed by looking at the growth of the states with the highest share in the three sectors. The growth process has been principally driven by the states specialising in industry in the late 1980s, when also agricultural states registered a rate of growth of 4.4% per year, and in the early 1990s. During the second half of the 1990s states specialising in service have grown at a rate of 6% per year, and are still experiencing the fastest rate of growth in the more recent years.

Other interesting aspects emerge by looking at the evolution of the economy of some states. The share of agriculture is still high in the poor states of Orissa, Assam, Uttar Pradesh, and the production of primary items continues to have a strong impact on growth performance. This was the case for Bihar, which experienced a decrease in agricultural share from 47% to 41% and a negative growth between 1990 and 1995. However, agriculture seems to play a key role also in the rich state of Punjab, where its share is still about 40%. Among the most industrialized state, Gujarat is the only one that has experienced an increase of manufacturing share on NSDP. In Maharashtra and Tamil Nadu the manufacturing sector declined to the benefit of services in the last ten years. Furthermore, the share of manufacturing is also high in small states like Nagaland, Goa and Himachal Pradesh. It is interesting to underline that none of the poorest states appears in the top positions of the manufacturing shares rank, excluding Madhya Pradesh in 2000. However, this state experienced, as the previous case of Bihar, a fall in agricultural production, and consequently a slow rate of growth, between 1995 and 2000, and therefore a rise of non-agriculture share.

The poor states seem to suffer from an insufficient industrialization process, with 18% of the NSDP coming from secondary sector against 29% for the rich states. However, the expansion of the service sector appears to have affected both groups (Table 6): its share in the poor states jumped from 33% in 1980 to 47% in 2004, mirroring the increase in the rich states. Furthermore, while small states, like Goa and the western states Meghalaya, Manipur and Tripura, were

overrepresented among the most specialized in services during the 1980s, the service expansion of the 1990s is mostly concentrated in bigger states like Tamil Nadu and Maharashtra. In the latter one, the share of the tertiary sector reached 60% of NSDP in 2004.

These aspects need further investigation, especially concerning the type of service activities in which the states specialize. In poorer states, the incidence of public administration and expenditures in health, education and poverty alleviation programmes are high and have displayed an increase in states like Orissa and Assam. Similar situations can be found in the small and middle-low income states of Western India. In the case of Goa or Tripura, over 25% of service activities are represented by tourism activities. By contrast, the growth of services in middle-high and high income states, notably in Maharashtra or Gujarat, has mainly been driven by banking, insurance and other financial activities, or by business services, including IT, such as in Tamil Nadu or Karnataka.

The description of the states' economic structure suggests some tentative conclusions. First, the economy of the poorer states still appears to be heavily dependent on agricultural activities. The low share of the secondary sector seems to be a reasonable cause of their persisting backwardness. These states probably have not taken advantage of the reforms, in particular in agriculture, where they failed to follow the successful example of Punjab or Haryana. Second, service expansion has been uneven across the states in terms of sub-sectors: the richest and most industrialized states appear to benefit the most from the support of growth-driven activities. Finally, business services and IT industry are mainly concentred in the south of India, where coastal and middle income states are located.

To sum up, all the aspects emerged from this discussion underline how the growth process in India and the changes in the structure of its economy have been highly uneven among the states. There are strong signals of divergence during the period 1980-2004. Table 4 shows the ratio between rich and poor states in terms of per-capita NSDP. Even when we exclude Bihar and Delhi, respectively the poorest and the richest state in all sub-periods, this ratio increases from 1.96 in 1980 to 2.84 in 2004. This means that 410 million of people in the poorest states have, on average, only around one third of the income of the 221 million of inhabitants of the richest states. Furthermore, the divergence between economic regions has been steadily increasing since the early 1990s. Figure 1 shows the standard deviation of per-capita NSDP in a log-scale. Its value increases from 0.34 in 1980 to 0.39 in 1990, but then reaches 0.5 in 2002. It is important to note that the rise in the standard deviation during the 1980s mostly happened in the second half of the decade, suggesting that not only the "pro-market" but also the "pro-business" reforms have produced larger benefits for the rich states than for the poor ones.

These results are confirmed by transition matrices[3] (Table 7) that display the estimated probabilities that states can become relatively richer or poorer conditional on their initial level of per-capita NSDP. States are grouped into four quartiles, from the poorest ones to the richest ones, depending on their initial level of income. The states present a very high degree of persistence over the whole period. However, low and middle-low NSDP states display more dynamism in the 1980s, when, for instance, the probability for the poorest states to increment their position was around 15%. During the 1990s, middle-high and high income states face a small increase in the probabilities of changing quartile, while the first two quartiles show a greater degree of persistence relative to the previous decade.

The following sections will seek to explore the main determinants of the stylised facts presented in this section. Our main emphasis will be on the spatial pattern of growth across Indian states, and on the importance of neighbouring states in influencing the performance of individual states.

3. Convergence and divergence across Indian States

We make use of a number of empirical methodologies to analyse the pattern of growth of the Indian states and to explore the determinants of their different performance. The literature on convergence or divergence across states or regions evolved considerably since Baumol (1986) and Barro and Sala-i-Martin (1991). The two concepts of absolute and conditional β-convergence, directly derived from the dynamic implications of the Solow model (1956), seek to establish whether rates of growth in a cross-section of countries or regions are negatively related to initial levels of GDP per capita. It is well known that cross-sectional regressions could present problems of both omitted variables bias and endogeneity. The conditional convergence approach could itself be considered as one possible way to address the omitted variable bias, but the introduction of additional explanatory variables could raise a further problem of endogeneity, since the rate of growth could in turn influence some of the conditioning variables. In order to alleviate this potential difficulty, control variables are usually introduced in a predetermined form.

An effective strategy to deal with the issue of omitted variables bias in cross-sectional regressions is to reformulate the neoclassical convergence equation in a panel data format (Knight *et al.*, 1993, and Islam, 1995). The dynamic specification makes it possible to relax the identical technology assumption and to control for unobservable country- or state-specific effects. Persistent

[3] See Quah (1993, 1996, 1997).

disparities in technology development and in the quality of institutions have been found to play an important role in explaining cross-country economic performance.

This panel data approach is however not sufficient to deal with time-varying country-specific effects nor with endogeneity. Caselli *et al.* (1996) suggest using the Arellano-Bond (1991) GMM efficient estimator for dynamic panel data. However, this *First-Differenced GMM* approach has been found to suffer from serious bias when the time series are persistent and the number of time series observations is small. These issues could be potentially serious in the empirical analysis of growth and even more when it comes to studies of convergence, which is known to be a long run phenomenon. By exploiting an additional assumption that imposes a stationarity restriction on the initial conditions for GDP per capita, Blundell and Bond (1998) are able to obtain moment conditions that remain informative even for persistent series. This *System GMM* uses the lagged first-differences as instruments not only for the standard set of equations in first differences (as in the Arellano-Bond procedure), but also for a supplementary set of equations in levels (see also Bond *et al*., 2001).

We use data for a subset of 24 Indian states for the period 1980-2004, made available by the Indian Central Statistical Organization (CSO). The Data Appendix describes the data set. We first analyse β-convergence by estimating a log-linearised dynamic version of the Solow model:

$$(1) \qquad \ln(Y_{i,t}) - \ln(Y_{i,t-\tau}) = -(1-e^{-\beta\tau})\ln(Y_{i,t-\tau}) + (1-e^{-\beta\tau})\frac{\alpha}{1-\alpha}\left[\ln(s) - \ln(n+g+d)\right] + \eta_i + \varepsilon_{i,t}$$

where $Y_{i,t}$ denotes the level of GDP per capita of state *i* at time *t,* s the saving rate, *n* the population growth rate, *g* the rate of labour-augmenting technological progress, *d* the depreciation of physical capital, α the share of capital in total output and β the convergence rate measuring the speed at which a given economy converges to its steady state output level. In empirical applications of the Solow model the investment rate or the capital expenditure are used as alternative proxies of the saving rate *s*. The sum of the common exogenous rate of technical change and the common depreciation rate is assumed to be 0.05.

Table 8 reports estimates for the textbook Solow model in both its unrestricted and restricted versions. The latter is obtained by imposing that savings (using capital expenditure as a proxy) and population growth enter in a difference format, to test whether in steady state they exhibit the same rate of growth. The results on convergence appear to be different depending on the estimation method. Both the OLS and the System GMM findings are consistent with divergence among the states, whereas the within-group (Fixed-Effect) and the Differenced GMM estimators imply a

relatively high rate of convergence. The differences among the estimators are in line with the results of empirical analysis over cross-sections of countries. OLS have been shown to yield estimated convergence coefficients that are lower than those obtained after controlling for regional specific effects. Differenced GMM tends to provide even higher estimates of the convergence rate. However, Bond *et al.* (2001) use System GMM estimators and obtain results strikingly similar to the simple OLS regressions.

In our estimates, we obtain positive values for the β coefficients (implying convergence) when we use the Fixed-Effect and the Difference GMM estimators. According to the analysis in Bond *et al.* (2001), however, these estimates could be affected by a positive bias. When using a regional dataset, there could be an additional source of positive bias in the estimation of the convergence coefficient due to spatial interactions across the observations, which can be attributed to the presence of knowledge spillovers, trade, and migration among neighbouring regions. The issue of possible spatial interactions across the observations deserves particular attention and we will discuss it in detail in the next section. At this stage, it would appear that the most plausible estimates of the regional growth pattern are obtained with the System GMM specification. This yields a divergence rate of 1.1 percent for the unrestricted version of the Solow model and 2.3 percent for the restricted version. These results are consistent with other existing empirical findings, which also find evidence of increasing gaps between Indian regions (see Bandyopadhyay, 2006, for an accurate analysis of the issues).

However, the estimates obtained through System GMM for the unrestricted version of the Solow model are at variance with the neoclassical theory in terms of the sign associated to the proxy for investment rate represented by the capital expenditure, which appears to be negatively associated with growth (although not in a significant way). The opposite applies to the variable summarizing the rate of population growth augmented by the rate of technological improvement and the rate of depreciation of capital, which attracts a significant negative sign. Hence, the standard Solow model does not appear to be particularly suited to capture long-run sources of growth and divergence across Indian states. This is also true when we consider its restricted form, allowing us to compute the share of capital in production represented by the parameter α. Its estimated magnitude of about 7 percent is far too low compared to the broadly accepted 30 percent value of the economic literature.

4. The spatial pattern of growth

The possible presence of spatial interactions in the cross section of states may be responsible for the odd results of the previous section. In a regional dataset the spatial interactions across observations can seriously affect the estimates of convergence patterns, whose magnitude could be overestimated. We therefore relax the assumption that observations are represented by states with arbitrarily drawn boundaries and implement a model which allows for a degree of dependence across locations sharing a common border. Specifically, we make use of the so called Spatial Lag System GMM Model, which introduces a spatial lag of the dependent variable among the explanatory variables and controls jointly for both time and spatial interaction across observations (Anselin, 1988; Arbia, 2006). In order to explore the robustness of these effects, rather than considering interaction only across contiguous states sharing common borders, we also take into account a more general specification in which the strength of the spatial interactions is inversely related to the distance among regions. In our application, we consider the distances in highway kilometres separating the main urban centres of each state.

The spatial dimension has been only marginally considered in recent studies concerning convergence across Indian States. However, a simple visual analysis of the patterns of growth relating to the Indian Federation map would suggest that the group of best performers countries concentrates in the South, while the poorer countries concentrate in the north-eastern landlocked part of the federation. For panel dataset with a time series dimension the most common way to address this issue is the use of the so called *Spatial Lag Model*, which takes the following form:

$$(2) \quad \ln(Y_{i,t}) - \ln(Y_{i,t-\tau}) = \alpha + \rho W[\ln(Y_{i,t}) - \ln(Y_{i,t-\tau})] + \beta \ln(Y_{i,t-\tau}) + \gamma X'_{i,t} + \varepsilon_{i,t} \qquad \varepsilon_{i,t} \sim \text{i.i.d.}(0, \sigma^2 I_n)$$

where W is a binary contiguity matrix expressing neighbouring regions by 0-1 values. The value 1 is assigned when two regions have a common border of non-zero length, *i.e.* they are considered first-order contiguous. We also consider a second spatial specification in which the elements of the matrix W are the inverse of the distances among capital cities of each of the 24 states measured in highways kilometres. In equation (2), ρ denotes the coefficient associated to the spatial lag of the dependent variable and ε is a vector of independently and identically distributed error terms. The matrix X contains additional explanatory steady-state variables and γ is its respective vector of coefficients.

In order to estimate equation (2) one has to take into due account the source of endogeneity induced by the spatial lag of the dependent variable. To overcome the problem, we only present

estimates of model (2) obtained through the System GMM estimator[4], which allows us to treat the spatial lag as endogenous and, hence, estimate consistent coefficients (For a comprehensive survey on the panel data techniques that can implemented allowing for the presence of spatial autocorrelation see Mutl 2006).

Table 9 reports estimates obtained through System GMM, considering both the whole sample period 1980-2002 and the two sub-periods 1980-1990 and 1991-2002. In the left half of the table we display results obtained considering distances in highway kilometres across capitals of the 24 states for both the unrestricted and the restricted versions of the Solow model. The spatial coefficient appears to be significant for the series considered as a whole and over the period 1980-1990, for both the versions of the Solow model. Our results are reinforced when considering a spatial model with borders effect. The spatial lag turns out to be always significant in the unrestricted version of the Solow model, and significant for the whole series and for the second sub-period 1991-2002 when estimating the restricted version of the model.

Hence, taking into account spatial interactions across observation does not contradict our previous finding of a significant rate of divergence across Indian States in terms of NSDP per capita. However, such a result could reflect large geographical disparities in the sector distribution of economic activity. As argued by Purfield (2006), approximately half of the total agricultural value added in India is produced in the northern and central states, whereas 40 percent of industrial and service sector output is produced in the coastal states of Maharashtra, Gujarat and Tamil Nadu. In order to check the robustness of our results to the possible interference of sector effects we also test three conditional convergence specifications using the share of production sectors to NSDP as added explanatory variables. These results are reported in the three remaining columns in Table 10 and Table 11 for the two different spatial specifications considering respectively distance and border effects. The spatial effects are still present but are highly reduced in significance when considering the distances, whereas they are still present and highly significant when measured in terms of the border effect. These results tend to suggest that spatial interactions are stronger across very close states, and tend to disappear rapidly for longer distances.

When considering spatial effects for the Indian federation one has to take into account the possibility of a bias due to the presence of coastal states. Many of the largest urban centres tend to

[4] However, in addition to the System GMM, we implemented also the maximum likelihood estimator for the cross section counterparts of both the spatial lag and spatial error model. In particular, we tested the two specifications for the whole period 1980-2003, for the decade 1980-1990 and for the post-crisis period 1993-2003. For all the cross sectional specifications of absolute convergence, the spatial coefficients are found to be not significant. These results are also confirmed through the implementation of Moran I and Geary's tests for the detection of spatial correlation. The results can be shown if requested.

be located on the coast. In general, landlocked states have usually experienced slower paces of growth because of the difficulties in accessing the advantages of international trade (Sachs and Warner, 1997). For instance, given the high cost of domestic transport, it is often relatively easier and cheaper for coastal states to satisfy their food demand through imports rather than from purchases from the hinterland (Pingali and Khwaja, 2004). After the process of liberalization and openness to international markets started with the 1990s reforms, the gap between coastal and landlocked states could have further widened. Our spatial estimates would then capture this effect. This hypothesis is confirmed in Figure 2, which suggest an association between coastline length and economic growth during the post-reform period.

5. Economic reforms and regional disparities

The last two decades have witnessed a constant increase in the level of divergence of income per capita among the states of the Indian Federation. However, the dimension of the gap separating poorer and richer areas has increased especially during the 1990s. This acceleration in the divergence rate has been mainly attributed to the heterogeneous impact of the liberalization reforms implemented since the early 1990s. The reform process was initially prompted by the heavy economic crisis experienced in 1991. The first step of the adjustment programme consisted of a strong devaluation of the Rupee to discourage imports and attract foreign direct investments. In general, the reforms that followed have been aimed at achieving a broad liberalization of the economy and an increasing degree of openness to international markets through a steady cut in tariffs.

The results displayed in Tables 10 and 11 illustrate how the process of divergence across Indian States evolved over time. We consider both the whole period 1980-2004 and the two sub-samples 1980-1990 and 1991-2004. The results are quite mixed when considering the Spatial Lag obtained from the distance in highway kilometres across states (Table 10). However, when moving to the results obtained considering the contiguity across states (Table 11), the convergence coefficient displays a structural break changing from insignificant during the 1980s to a negative value during the 1990s, implying a divergence rate in the range 1%-2% (see also Figure 3). With regard to the analysis of the impact of sector shares over the three periods we obtain the following results. Manufacturing and services appear to be generally positively related to growth, both for the whole period and for the 1980s. However, the share of services is much more significant than the manufacturing share during the whole period and in both the spatial specifications displayed in

Tables 10 and 11. During the 1990s the impact of both sector shares becomes not significant and this could appear quite striking especially for what concerns the service share. However, the level of aggregation is really high not allowing to precisely disentangle the impact of some branches of services which could have strongly influenced disparities in patterns of growth during the 1990s.

Particular attention deserves to be paid to the agricultural sector, which is found to play a significantly negative role over all the time spans considered. Rural areas have constantly lagged behind in terms of performance with respect to the rest of the Indian states during both decades considered in the analysis. However, within the group of rural states – defined as those whose share of agriculture multiplied by the percentage of arable land and the percentage of irrigated land is over 42 – remarkable differences in terms of economic performance are present. In particular, those states with a large share of agriculture, together with a high percentage of arable land and an efficient system of irrigation, have generally outperformed other rural areas.

Figure 4 illustrates empirically how the relationship between agricultural share and growth changes when the whole sample or, alternatively, the sub-sample including only states with a share of agriculture sector over the average is considered. States like Haryana and Punjab performed relatively well, despite their prevalent rural component in NSDP. This stylized fact is in line with the general finding that rural areas tend to be a reservoir of inefficient labour with low marginal productivity. Such a context tends to be alleviated when labour can be reallocated in a newly established industrial sector or, as in the case of Haryana and Punjab, when productivity is enhanced through innovation and increased arable land. These two states have been among the most successful ones to implement innovative rural reforms through a continued expansion of farming and irrigated areas, double cropping existing farmland and use of seeds with improved genetics.

The case of Uttar Pradesh is striking in this sense. This state, together with Haryana and Punjab, leads in terms of arable and irrigated land. Nonetheless, it has experienced poor performance in terms of economic growth. This could be partially explained through the fact that Uttar Pradesh, one of the states with the highest rate of poverty, also has the highest population density. The relative improvement in rural techniques may have been insufficient to offset a Malthusian dynamics, with population growing faster than food resources.

6. Conclusions

During the last two decades the states of the Indian federation experienced a continuous divergence in terms of their NSDP per capita. The main novel aspect of the analysis in this paper is the attention to the spatial aspects of the performance of Indian states, and the attempt to capture the role played by the economic performance of the neighbouring states.

Our main results are summarized in Table 12, which displays all the coefficients obtained from the different specifications included in the paper. System GMM and the Random Effect Model are the only estimation methods whose results are consistent with the stylized facts of divergence, also in accordance with our preliminary descriptive analysis about the process of growth across the Indian States. Table 12 also summarises our estimates of the convergence coefficients resulting from the spatial analysis and controlling for the sector shares. The rate of divergence ranges between 0.6% and 2.3%, depending on the specification of the dynamic model. Table 12 makes also clear that we reject the Solow Model because implied estimates for the share of capital α are always too far from the widely accepted 30%. However, this result could also be generated by the use of the capital expenditure as a proxy for savings.

We argue that such a divergence has mainly been driven by the economic backwardness of rural areas. However, some prevalently rural states such as Punjab and Hariana have performed relatively better due to more in-depth innovation during the Green Revolution and to the wider availability of arable land. When controlling both for spatial effects and sector shares (see again the lower part of Table 12), we show how the pace of divergence has experienced a substantial acceleration during the 1990s, after the process of reform started with the 1991 economic recession. The process of liberalization and increased openness to international markets has imparted a clear spatial connotation to the gap dividing low and fast growing states. Evident disparities emerged between landlocked states and states having access to the sea, possibly due to a comparative advantage of the latter in increasing their volume of trade in the post-reform period.

Hence, the last two decades have seen winners and losers among the states of the Federation. Winners were those states that benefited the most from the recent process of reform and liberalization, thanks also to their geographical advantage and to the presence of a developed service sector. Losers were instead the landlocked and highly populated states with a predominant agricultural sector and a low level of innovation. In some of these rural states where these problems assume a heavier dimension (like Uttar Pradesh), the pressure on resources culminates in high rates of poverty.

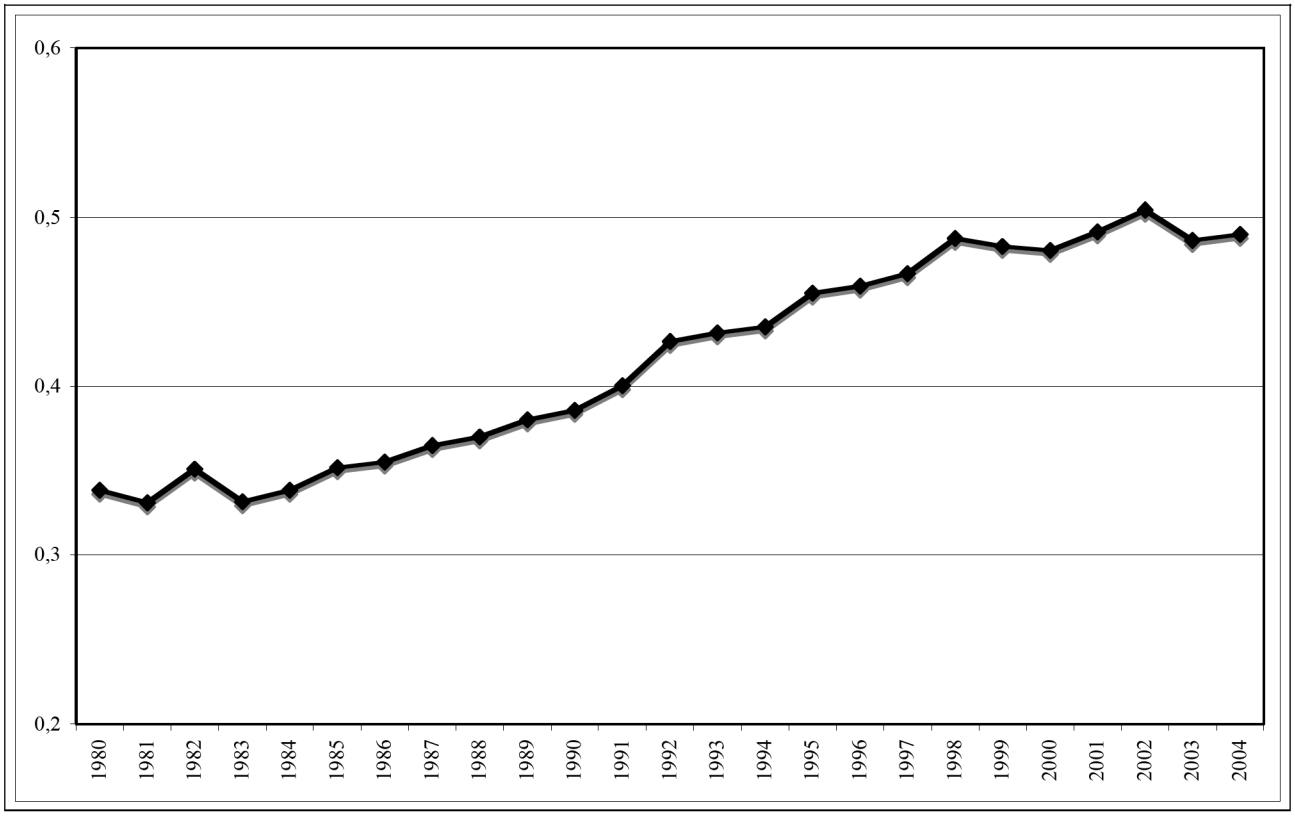
Historically, the growth pattern in India has been very uneven. In the more recent period, the imbalances in the growth process have become more severe. It would appear that there has been no trickle-down of economic growth from the fastest growing states to the poorer states. At a time when India is poised to become a leading economic superpower, it is crucial that these imbalances are corrected, so that there are no losers from India's success story.

Data Appendix

This paper considers 24 States of the Indian Federation: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tritura, Uttar Pradesh, West Bengal and the Union Territory of Delhi. The inclusion in the analysis of small and north-eastern States like Goa or Manipur and the Union Territory of Delhi, generally not considered in convergence studies, is mainly justified by the use of the Spatial Error Model. Mizoram and Sikkim are excluded from the sample due the lack of data, while Jharkhand, Chhattisgarh and Uttaranchal, created out respectively of Bihar, Madhya Pradesh and Uttar Pradesh, are considered parts of the original states for the years after the separation in 2000.

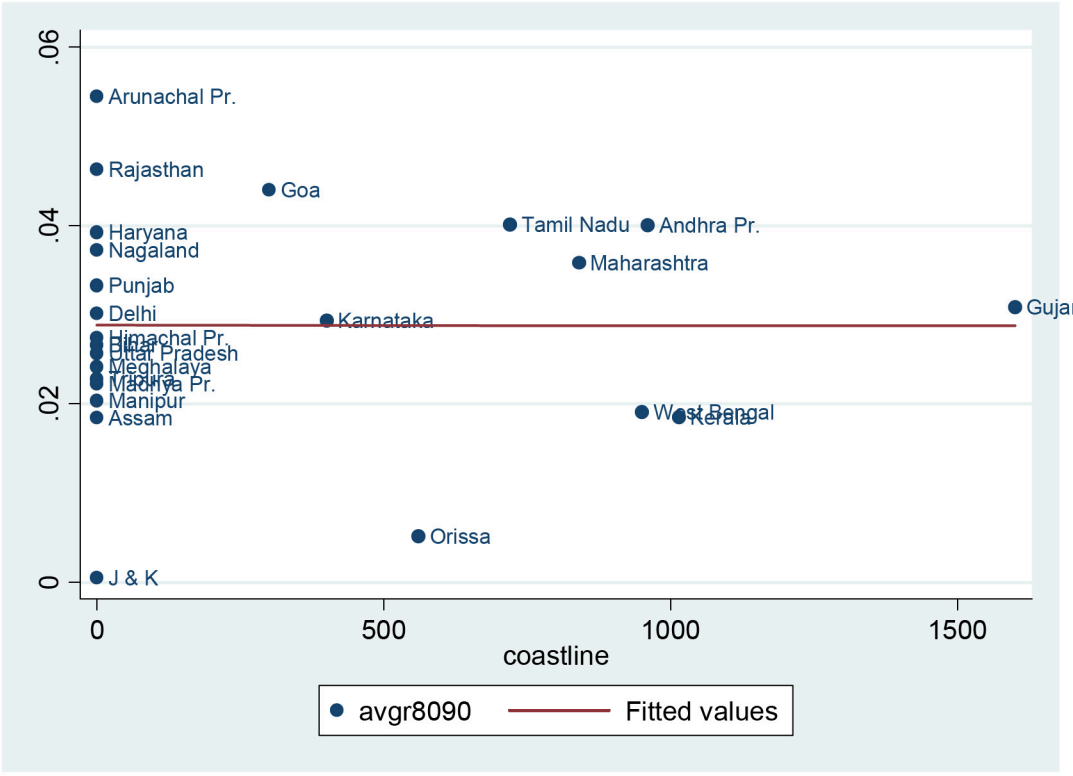
The main source of the data is the Central Statistical Organisation (CSO) for the years 1980-2004. Net State Domestic Product (NSDP) series is at factor cost and is based on 1980 constant prices. According to CSO, NSDP is divided into: Agriculture, which includes Forestry and logging, Fishing and Mining and quarrying; Manufacturing, subdivided into Registered, Unregistered, Construction and Electricity, gas and water supply; Services, ramified into Transport, storage and communication, Trade, hotels and restaurants, Banking and insurance, Real estate, ownership of dwelling and business services, Public administration and Other services

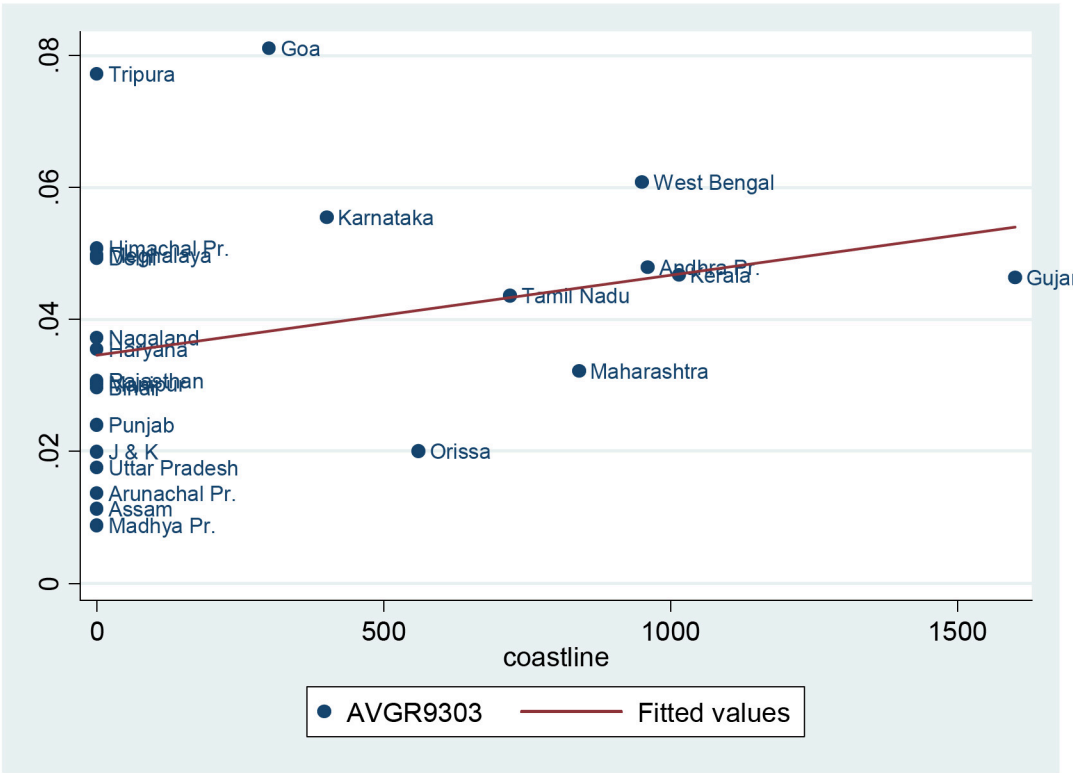
Figure 1. Per-capita NSDP standard deviation (log-scale).



Source: CSO

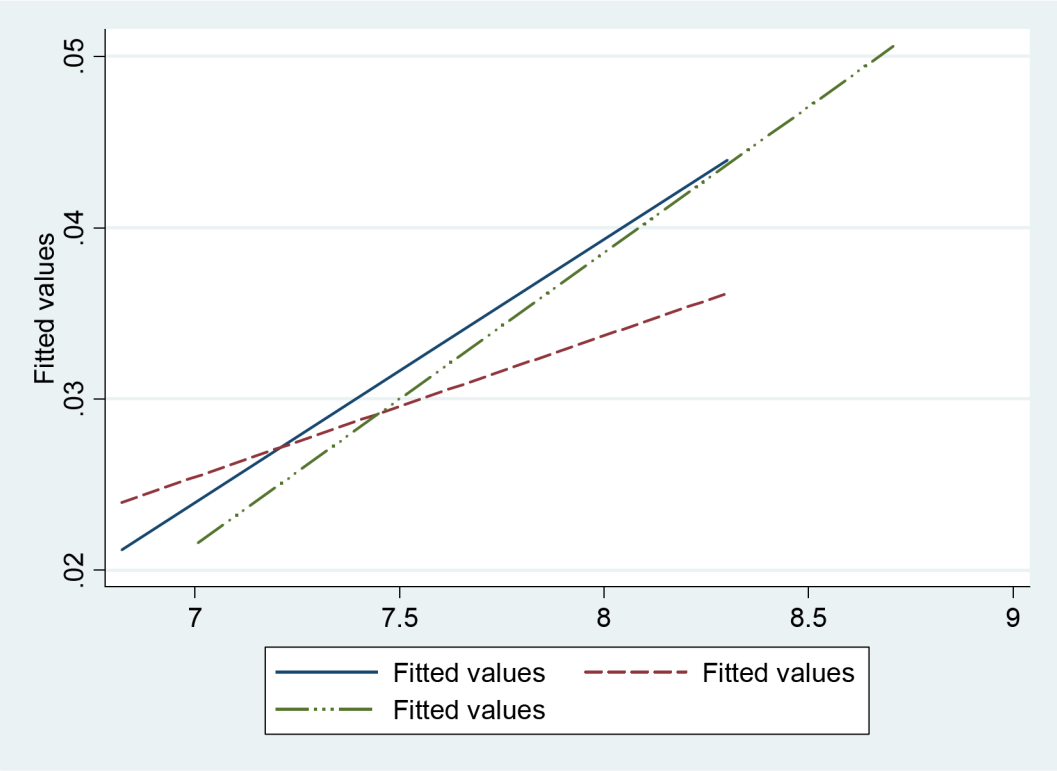
Figure 2. Length of the coastline and growth in the pre- and post-reform period.





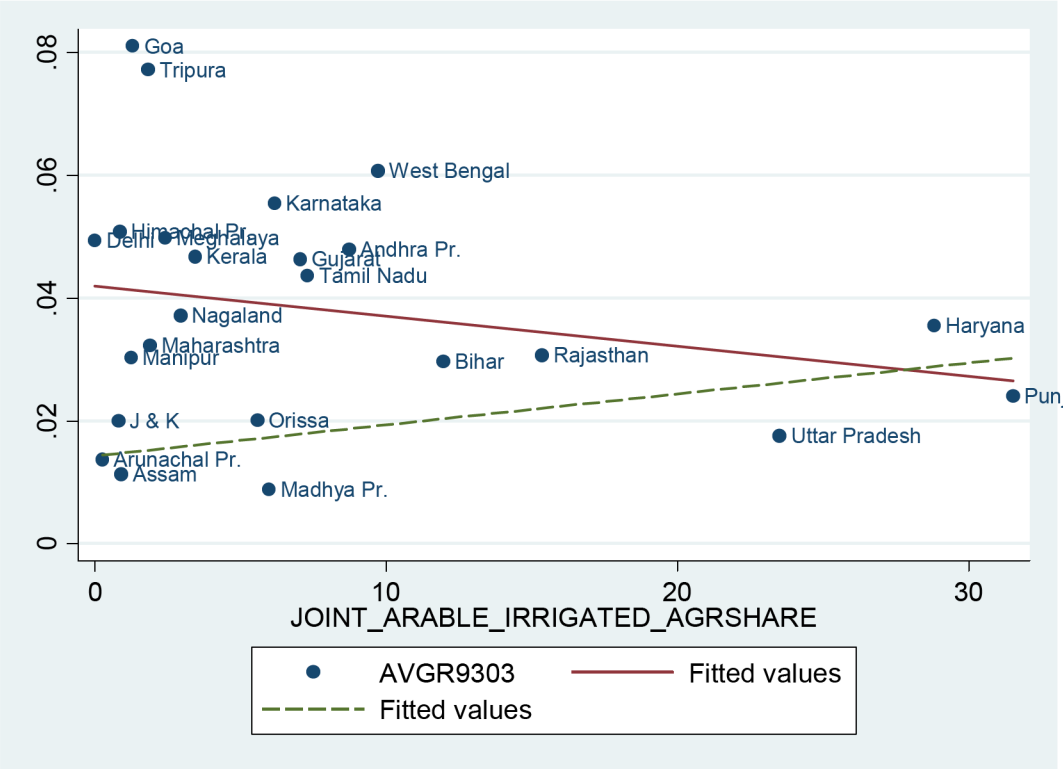
Source: CSO and indiastat.com

Figure 3. Pattern of divergence in level of GDP per capita across 24 Indian States over the period 1980-2004 (solid line), 1980-1990 (dashed line) and 1991-2004 (dashed-dotted line).



Source: CSO (Note: PDGP is equivalent to the per capita state product, also denoted as NSDP).

Figure 4. Agriculture and growth across 24 Indian States in the 1990s. The role of irrigation and arable land.



Legenda: the solid line represents the fit computed over the whole sample of 24 Indian states. The dashed line represents the subsample of states having a share of the agriculture sector (multiplied by the share of arable land and the share of irrigated land) over 42%.

Source : CSO and indiastat.com

Table 1. States population (thousands) and density (inhabitans/km^2), 2004.

State	Population	Density	State	Population	Density
Uttar Pradesh	178829	750	Assam	28332	361
Maharashtra	102099	332	Punjab	25735	511
Bihar	88687	942	Haryana	22513	509
West Bengal	84228	949	Delhi	15393	10379
Andhra Pradesh	79094	288	Jammu and Kashmir	11124	50
Madhya Pradesh	64988	211	Himachal Pradesh	6507	117
Tamil Nadu	64388	495	Tritura*	3305	304
Rajasthan	60802	178	Manipur	2469	111
Karnataka	55209	288	Meghalaya	2429	108
Gujarat	53788	274	Nagaland**	2149	117
Orissa	38409	247	Goa	1475	398
Kerala	33072	851	Arunachal Pradesh	1149	14

Source: CSO
Notes:
* 2003
** 2002

Table 2. Per Capita Net State Domestic Product (NSDP) at constant (1980) prices.

	1980		1985		1990		1995		2000		2004
Delhi	4030	**Delhi**	4665	**Delhi**	5447	**Delhi**	6580	**Delhi**	9108	**Delhi**	10764
Goa	3145	**Punjab**	3249	**Goa**	4883	**Goa**	5952	**Goa**	8535	**Goa**	8232
Punjab	2674	**Goa**	3091	**Punjab**	3730	**Maharashtra**	4533	**Maharashtra**	4880	**Maharashtra**	6125
Maharashtra	2435	**Haryana**	2893	**Haryana**	3509	**Punjab**	4120	**Punjab**	4774	**Haryana**	5327
Haryana	2370	**Maharashtra**	2705	**Maharashtra**	3483	**Haryana**	3645	**Haryana**	4372	**Punjab**	5308
Gujarat	1940	**Gujarat**	2186	**Arunachal Pradesh**	2709	**Arunachal Pradesh**	3607	**Gujarat**	3753	**Gujarat**	5072
Jammu and Kashmir	1776	Arunachal Pradesh	2119	Gujarat	2641	Gujarat	3501	Tamil Nadu	3691	West Bengal	4394
West Bengal	1773	West Bengal	1929	Himachal Pradesh	2241	Tamil Nadu	2883	Karnataka	3645	Karnataka	4249
Himachal Pradesh	1704	Jammu and Kashmir	1832	Tamil Nadu	2237	West Bengal	2683	Arunachal Pradesh	3530	Arunachal Pradesh	3991
Arunachal Pradesh	1571	Tamil Nadu	1798	West Bengal	2145	Himachal Pradesh	2589	West Bengal	3507	Tamil Nadu	3977
Karnataka	1520	Himachal Pradesh	1781	Andhra Pradesh	2060	Karnataka	2573	Himachal Pradesh	3261	Himachal Pradesh	3963
Kerala	1508	Nagaland	1653	Karnataka	2039	Andhra Pradesh	2429	Tripura	3070	Andhra Pradesh	3718
Tamil Nadu	1498	Karnataka	1644	Nagaland	1976	Kerala	2336	Andhra Pradesh	3068	Tripura*	3638
Manipur	1419	Manipur	1598	Rajasthan	1942	Nagaland	2293	Kerala	2822	Kerala	3509
Andhra Pradesh	1380	Andhra Pradesh	1573	Kerala	1815	Rajasthan	2073	Nagaland	2727	Nagaland**	2922
Meghalaya	1361	Assam	1510	Jammu and Kashmir	1784	Jammu and Kashmir	1915	Rajasthan	2349	Rajasthan	2831
Nagaland	1361	Kerala	1507	Manipur	1739	Tritura	1865	Meghalaya	2311	Meghalaya	2750
Madhya Pradesh	1358	Orissa	1442	Meghalaya	1733	Meghalaya	1838	Manipur	2204	Manipur	2579
Orissa	1314	*Meghalaya*	1412	*Madhya Pradesh*	1696	*Madhya Pradesh*	1809	*Jammu and Kashmir*	2100	*Jammu and Kashmir*	2297
Tritura	1307	*Madhya Pradesh*	1409	*Uttar Pradesh*	1652	*Manipur*	1807	*Madhya Pradesh*	1917	*Orissa*	2262
Assam	1284	*Uttar Pradesh*	1375	*Tripura*	1642	*Uttar Pradesh*	1687	*Uttar Pradesh*	1789	*Madhya Pr.*	2195
Uttar Pradesh	1278	*Rajasthan*	1338	*Assam*	1544	*Orissa*	1640	*Orissa*	1749	*Uttar Pradesh*	1970
Rajasthan	1222	*Tripura*	1240	*Orissa*	1383	*Assam*	1595	*Assam*	1646	*Assam*	1862
Bihar	917	*Bihar*	1074	*Bihar*	1197	*Bihar*	915	*Bihar*	1285	*Bihar*	1266
Average 24 states	1756		1959		2384		2786		3421		3697

Source: CSO

Notes:

- * see table 1.
- ** see table 1.
- Per-capita NSDP is expressed in Indian Rupees.

Table 3. Per Capita NSDP average annual growth (in percentage).

	80-85		85-90		90-95		95-00		00-04		80-90		90-00
Arunachal Pr.	6.2	**Goa**	9.8	Gujarat	6.8	Tripura	10.5	**Gujarat**	7.9	Arunachal Pr.	5,7	*Tripura*	6,6
Haryana	4.2	*Rajasthan*	8.9	**Arunachal Pr.**	6.1	**Goa**	7.9	*Orissa*	6.8	*Rajasthan*	5,6	Karnataka	6,0
Nagaland	4.2	*Tripura*	5.8	**Maharashtra**	5.6	*Bihar*	7.5	**Maharashtra**	5.9	**Goa**	4,8	**Goa**	6,0
Punjab	4.0	Andhra Pr.	5.8	Tamil Nadu	5.3	Karnataka	7.3	West Bengal	5.8	Andhra Pr.	4,3	Tamil Nadu	5,2
Tamil Nadu	3.9	**Maharashtra**	5.3	Kerala	5.2	**Delhi**	6.8	Tritura*	5.8	**Haryana**	4,3	West Bengal	5,0
Assam	3.4	Arunachal Pr.	5.2	Karnataka	4.8	West Bengal	5.5	Kerala	5.6	Tamil Nadu	4,2	Kerala	4,5
Bihar	3.3	**Gujarat**	5.1	West Bengal	4.6	Tamil Nadu	5.1	Rajasthan	5.6	Nagaland	3,9	Gujarat	4,2
Delhi	3.2	Himachal Pr.	4.8	**Goa**	4.1	Andhra Pr.	4.9	**Haryana**	5.1	**Gujarat**	3,9	Andhra Pr.	4,2
Andhra Pr.	2.8	Tamil Nadu	4.5	**Delhi**	4.0	Himachal Pr.	4.8	Himachal Pr.	5.0	**Maharashtra**	3,7	Himachal Pr.	3,9
Gujarat	2.7	Karnataka	4.4	*Orissa*	3.6	Meghalaya	4.7	Andhra Pr.	4.9	**Punjab**	3,4	Nagaland	3,8
Manipur	2.4	**Haryana**	4.3	Andhra Pr.	3.5	Nagaland	4.5	Meghalaya	4.4	**Delhi**	3,2	**Maharashtra**	3,6
Orissa	2.3	*Meghalaya*	4.3	Nagaland	3.1	*Manipur*	4.2	**Delhi**	4.3	Karnataka	3,1	Meghalaya	3,0
Rajasthan	2.3	*Madhya Pr.*	4.0	Himachal Pr.	3.0	Kerala	3.9	Manipur	4.1	Himachal Pr.	3,0	**Arunachal Pr.**	2,9
Maharashtra	2.2	Kerala	3.9	*Tripura*	2.7	**Haryana**	3.8	Karnataka	4.0	*Bihar*	2,8	**Delhi**	2,6
West Bengal	1.8	*Uttar Pradesh*	3.8	**Punjab**	2.0	**Punjab**	3.0	Nagaland**	3.8	*Uttar Pradesh*	2,6	*Orissa*	2,6
Karnataka	1.7	Nagaland	3.7	Rajasthan	1.9	Rajasthan	2.7	*Madhya Pr.*	3.8	Meghalaya	2,5	Manipur	2,5
Uttar Pradesh	1.5	**Delhi**	3.2	*Madhya Pr.*	1.5	J & K	1.9	Arunachal Pr.	3.1	*Tripura*	2,4	**Punjab**	2,5
Himachal Pr.	1.1	**Punjab**	2.8	J & K	1.4	Gujarat	1.6	*Assam*	3.1	Madhya Pr.	2,4	Rajasthan	2,3
Madhya Pr.	0.8	*Bihar*	2.4	Meghalaya	1.3	**Maharashtra**	1.6	**Punjab**	2.7	Manipur	2,1	**Haryana**	2,3
Meghalaya	0.7	West Bengal	2.1	Manipur	0.8	*Orissa*	1.5	*Uttar Pradesh*	2.4	West Bengal	2,0	J & K	1,7
J & K	0.6	Manipur	1.7	**Haryana**	0.8	*Madhya Pr.*	1.4	*J & K*	2.3	Kerala	2,0	*Madhya Pr.*	1,5
Kerala	0.1	Assam	0.5	*Assam*	0.7	*Uttar Pradesh*	1.3	Tamil Nadu	2.0	*Assam*	1,9	*Bihar*	1,4
Goa	-0.1	Orissa	-0.1	*Uttar Pradesh*	0.4	*Assam*	0.6	*Bihar*	0.4	*Orissa*	1,1	*Uttar Pradesh*	0,9
Tripura	-0.9	J & K	-0.2	*Bihar*	-4.8	**Arunachal Pr.**	-0.3	**Goa**	0.4	J & K	0,2	*Assam*	0,7
Average 24 states	2.3		4.0		2.8		4.0		4.1		3,1		3,3

Source: CSO.
Notes:
- * 2000-2003
- ** 2000-2002
- Based on table 1, richest states at the beginning of the period are in bold, while the poorest ones in italics.

Table 4. Per-capita NSDP comparison between richest and poorest states.

Average per-capita NSDP	**1980**	**1985**	**1990**	**1995**	**2000**	**2004**
6 richest states	2766	3132	3960	4740	5904	6805
6 poorest states	1220	1308	1519	1576	1748	1975
ratio	2.27	2.39	2.61	3.01	3.38	3.45
richest states exc. Delhi	2513	2825	3663	4371	5263	6013
poorest states exc. Bihar	1281	1355	1583	1708	1840	2117
ratio	1.96	2.09	2.31	2.56	2.86	2.84
5-years average growth						
6 richest states		2.7%	5.1%	3.8%	3.8%	4.4%
6 poorest states		2.0%	4.9%	0.7%	2.8%	3.1%
Population ('000)	**1980**	**1985**	**1990**	**1995**	**2000**	**2004**
6 richest states	132541	148082	125856	141157	206245	221003
6 poorest states	258816	301276	345355	332966	379155	410369
richest states exc. Delhi	126450	140536	116592	129874	192661	205610
poorest states exc. Bihar	189575	224050	259698	261174	297282	321682

Source: CSO.

Table 5. States specialization: shares of the 6 most specialized states in agriculture, manufacturing and services.

	1980		1985		1990		1995		2000		2004
				Agriculture							
Tripura	0.559	Orissa	0.545	Rajasthan	0.486	Punjab	0.460	Punjab	0.421	Punjab	0.389
Madhya Pradesh	0.556	Madhya Pradesh	0.545	Madhya Pradesh	0.485	Madhya Pradesh	0.459	Uttar Pradesh	0.410	Madhya Pradesh	0.378
Orissa	0.553	Arunachal Pradesh	0.529	Punjab	0.483	Orissa	0.424	Bihar	0.374	Uttar Pradesh	0.374
Bihar	0.552	Punjab	0.511	Bihar	0.466	Uttar Pradesh	0.420	Assam	0.371	Orissa	0.354
Haryana	0.546	Tripura	0.509	Arunachal Pradesh	0.462	Haryana	0.418	Orissa	0.358	Jammu and Kashmir	0.352
Uttar Pradesh	0.523	Rajasthan	0.503	Haryana	0.457	Rajasthan	0.417	Arunachal Pradesh	0.357	Rajasthan	0.338
Aver. 24 states	0.433		0.407		0.362		0.323		0.283		0.259
NSDP per-capita average growth***	1.9%		4.4%		1.5%		2.3%		3.1%		
				Manufacturing							
Maharashtra	0.351	Maharashtra	0.351	Goa	0.354	Nagaland	0.471	Goa	0.430	Gujarat	0.391
Tamil Nadu	0.335	Gujarat	0.331	Maharashtra	0.349	Gujarat	0.397	Nagaland	0.386	Goa	0.389
Goa	0.297	Tamil Nadu	0.314	Gujarat	0.346	Maharashtra	0.334	Gujarat	0.380	Himachal Pradesh	0.357
West Bengal	0.293	Goa	0.289	Tamil Nadu	0.331	Tamil Nadu	0.325	Himachal Pradesh	0.343	Nagaland**	0.311
Gujarat	0.272	West Bengal	0.265	Nagaland	0.299	Himachal Pradesh	0.322	Madhya Pradesh	0.291	Maharashtra	0.271
Delhi	0.249	Delhi	0.262	Delhi	0.290	Goa	0.321	Tamil Nadu	0.285	Arunachal Pradesh	0.270
Aver.24 states	0.197		0.203		0.225		0.241		0.236		0.234
NSDP per-capita average growth***	2.3%		5.0%		4.8%		4.2%		3.8%		
				Services							
Delhi	0.708	Delhi	0.694	Delhi	0.677	Delhi	0.752	Delhi	0.746	Delhi	0.786
Nagaland	0.534	Meghalaya	0.489	Meghalaya	0.542	Tripura	0.596	Manipur	0.596	Tripura*	0.643
Meghalaya	0.436	Goa	0.487	Manipur	0.518	Meghalaya	0.578	Tripura	0.590	Maharashtra	0.603
Manipur	0.432	Nagaland	0.475	Tripura	0.507	Manipur	0.571	Maharashtra	0.555	Manipur	0.594
Goa	0.418	Manipur	0.472	Goa	0.488	Goa	0.544	Meghalaya	0.548	Tamil Nadu	0.593
Tamil Nadu	0.406	Tripura	0.446	Assam	0.457	Maharashtra	0.476	Tamil Nadu	0.539	Kerala	0.586
Avera. 24 states	0.370		0.391		0.413		0.436		0.481		0.506
NSDP per-capita average growth***	2.4%		4.7%		2.3%		6.0%		4.4%		

Source: CSO

Notes:

- * see table 1.
- ** see table 1.
- *** The average annual growth is referred to the next years

Table 6. Average shares in agriculture, manufacturing and services of the richest and poorest states.

Agriculture	**1980**	**1985**	**1990**	**1995**	**2000**	**2004**
richest	0.34	0.30	0.30	0.27	0.20	0.18
richest without Delhi	0.40	0.35	0.36	0.32	0.23	0.22
Poorest	0.53	0.49	0.45	0.41	0.37	0.35
Manufacturing						
Richest	0.26	0.28	0.28	0.28	0.30	0.29
Poorest	0.14	0.15	0.16	0.17	0.18	0.18
Services						
richest	0.40	0.42	0.42	0.45	0.50	0.53
richest without Delhi	0.34	0.37	0.37	0.39	0.45	0.47
poorest	0.33	0.36	0.39	0.42	0.45	0.47

Source: CSO

Table 7. Transition matrix estimates

1981-2004

	I Quartile	II Quartile	III Quartile	IV Quartile	Total
I Quartile	88.19	11.81	0.00	0.00	100.00
II Quartile	11.97	78.17	9.86	0.00	100.00
III Quartile	0.00	10.42	84.03	5.56	100.00
IV Quartile	0.00	0.00	6.29	93.71	100.00

1981-1990

	I Quartile	II Quartile	III Quartile	IV Quartile	Total
I Quartile	84.85	15.15	0.00	0.00	100.00
II Quartile	15.15	74.24	10.61	0.00	100.00
III Quartile	0.00	10.61	84.85	4.55	100.00
IV Quartile	0.00	0.00	4.55	95.45	100.00

1991-2004

	I Quartile	II Quartile	III Quartile	IV Quartile	Total
I Quartile	91.03	8.97	0.00	0.00	100.00
II Quartile	9.21	81.58	9.21	0.00	100.00
III Quartile	0.00	10.26	83.33	6.41	100.00
IV Quartile	0.00	0.00	7.79	92.21	100.00

Source: CSO

Table 8. Unrestricted and restricted Solow model for 24 Indian states (1980-2004).

	Unrestricted Solow Model				Restricted Solow Model			
	Random Effect	Fixed Effect	Differenced-GMM	System-GMM	Random Effect	Fixed Effect	Differenced-GMM	System-GMM
Lag Annual Growth	-	-	-0.345	-0.399	-	-	-0.325	-0.405
			(0.067)***	(0.062)***			(0.077)***	(0.068)***
lag_log_NSDP	0.008	-0.162	-0.33	0.016	0.008	-0.165	-0.388	0.033
	(0.008)	(0.023)***	(0.070)***	(0.008)**	(0.008)	(0.023)***	(0.070)***	(0.016)**
Lag log Capital Expenditure	-0.0004	0.047	0.001	-0.003	-	-	-	
	(0.002)	(0.007)***	(0.019)	(0.002)				
Annual Growth of the Population + 0.05	-0.052	-0.111	-0.026	-0.062	-	-	-	
	(0.025)**	(0.034)***	-0.048	(0.030)**				
Lag log Capital Expenditure—(Annual Growth of the Population + 0.05)	-	-	-	-	0.001	0.051	0.0017	-0.0024
					(0.002)	(0.007)***	(0.018)	(0.003)
Constant	-0.171	0.677	-	-0.206	-0.049	0.835	-	-0.173
	(0.081)**	(0.153)***		(0.091)**	(0.054)***	(0.126)***		(0.106)
Implied β	**-0.008**	**0.177**	**0.281**	**-0.011**	**-0.008**	**0.180**[5]	**0.346**	**-0.023**
Prob > chi2	(0.007)***	(0.000)***	(0.000)***	(0.000)***	(0.007)***	(0.000)***	(0.000)***	(0.000)***
Implied α	-	-	-	-	**0.176**	**0.236**[6]	**0.442**	**0.068**
Prob > chi2					(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
Number of ID	24	24	24	24	24	24	24	24
Observations	546	546	499	525	546	546	499	525
R-squared	0.0145	0.11	-	-	0.0062	0.102	-	-
Number of instruments		-	252	328		-	189	193
	-	62.92	-	-		63.6	-	
Hausman Test		(0.000)				(0.000)		
	-	-	-3.68	-3.78		-	-3.60	-3.63
Arellano-Bond test for AR(1) in first differences:			(0.000)	(0.000)			(0.000)	0.000
	-	-	-0.23	1.26		-	-0.25	1.05
Arellano-Bond test for AR(2) in first differences:			(0.819)	(0.208)			(0.805)	(0.295)
	-	-	0.000	0.000		-	0.000	0.000
Hansen test of overid. restrictions			(1.000)	(1.000)			(1.000)	(1.000)

Robust standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

[5] Computation method: (-(1-exp(-b))+0.165)
[6] Computation method: ((1-exp(-.180))*(a/(1-a))-0.051)

Table 9. Convergence across 24 Indian states (1980-2002): Spatial System GMM estimates with robust standard errors.

	Spatial analysis considering km distance (Highways)						Spatial analysis considering common borders					
	Unrestricted Solow Model			Restricted Solow Model			Unrestricted Solow Model			Restricted Solow Model		
	1980-2004	**1980-1990**	**1991-2002**	**1980-2004**	**1980-1990**	**1991-2002**	**1980-2004**	**1980-1990**	**1991-2002**	**1980-2004**	**1980-1990**	**1991-200**
Lag Annual Growth	-0.412	-0.416	-0.417	-0.415	-0.408	-0.426	-0.404	-0.392	-0.422	-0.406	-0.386	-0.428
	(0.060)***	(0.072)***	(0.068)***	(0.061)***	(0.068)***	(0.069)***	(0.060)***	(0.065)***	(0.071)***	(0.060)***	(0.066)***	(0.072)**
Spatial Lag Annual Growth	0.371	0.58	0.08	0.517	0.763	0.26	0.29	0.312	0.245	0.286	0.248	0.308
	(0.195)*	(0.265)**	(0.266)	(0.219)**	(0.309)**	(0.277)	(0.115)**	(0.141)**	(0.133)*	(0.124)**	(0.156)	(0.139)**
lag_log_NSDP	0.024	0.033	0.025	0.03	0.031	0.033	0.018	0.017	0.023	0.024	0.017	0.028
	(0.006)***	(0.015)**	(0.006)***	(0.007)***	(0.021)	(0.007)***	(0.007)***	-0.015	(0.007)***	(0.007)***	(0.024)	(0.006)**
Lag log Capital Expenditure	-0.006	-0.004	-0.008				-0.006	-0.005	-0.008			
	(0.002)***	(0.004)	(0.003)***				(0.003)**	-0.004	(0.003)**			
Annual Growth of the Population + 0.05	-0.054	-0.054	-0.054				-0.058	-0.085	-0.048			
	(0.018)***	-0.034	(0.022)**				(0.018)***	(0.039)**	(0.021)**			
Lag log Capital Expenditure—(Annual Growth of the Population + 0.05)				-0.005	-0.003	-0.008				-0.005	-0.002	-0.008
				(0.002)**	(0.003)	(0.004)**				(0.002)**	(0.003)	(0.004)**
Constant	-0.263	-0.341	-0.246	-0.167	-0.195	-0.143	-0.221	-0.281	-0.218	-0.111	-0.07	-0.11
	(0.064)***	(0.146)**	(0.067)***	(0.051)***	(0.15)	(0.057)**	(0.064)***	(0.168)*	(0.067)***	(0.048)**	(0.16)	(0.054)**
Implied β	**-0.017**	**-0.023**	**-0.017**	**-0.020**	**-0.022**	**-0.023**	**-0.013**	**-0.012**	**-0.016**	**-0.017**	**-0.012**	**-0.019**
Prob > chi2	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.012)**	(0.000)***	(0.000)***	(0.058)*	(0.000)***	(0.000)***	(0.235)	(0.000)**
Implied α				**0.147**	**0.087**	**0.195**				**0.174**	**0.104**	**0.222**
Prob > chi2				(0.000)***	(0.000)***	(0.000)***				(0.000)***	(0.000)***	(0.000)**
Observations	480	197	283	480	197	283	480	197	283	480	197	283
Number of ID	24	23	24	24	23	24	24	23	24	24	23	24
Number of instruments	373	141	235	296	112	187	373	141	235	296	112	187
Arellano-Bond test for AR(1) in first differences:												
z =	-4.03	-3.59	-3.68	-4.05	-3.59	-3.67	-4.07	-3.72	-3.70	-4.09	-3.74	-3.69
Pr > z =	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Arellano-Bond test for AR(2) in first differences:												
z =	0.18	-0.23	0.45	0.14	-0.08	0.31	0.33	-0.12	0.57	0.24	-0.12	0.53
Pr > z =	(0.858)	(0.821)	(0.651)	(0.892)	(0.933)	(0.754)	(0.741)	(0.903)	(0.571)	(0.810)	(0.901)	(0.598)
Hansen test of overid. restrictions:												
	0.00	11.78	3.78	0.00	8.51	10.56	0.00	9.26	6.69	0.00	10.15	10.21
	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)

Robust standard errors in parentheses significant at 10%; ** significant at 5%; *** significant at 1%

Table 10. Convergence across 24 Indian states over the period 1980-2002 1980-1990, 1991-2002. Spatial System GMM estimates controlling for sector shares in total production. Spatial analysis considering km distance (Highways).

	1980-2002			1980-1990			1991-2002		
Lag Annual Growth	-0.401	-0.409	-0.405	-0.395	-0.401	-0.403	-0.413	-0.412	-0.416
	(0.057)***	(0.059)***	(0.060)***	(0.065)***	(0.065)***	(0.069)***	(0.068)***	(0.069)***	(0.069)***
Spatial Lag Annual Growth	0.325	0.248	0.354	0.53	0.439	0.531	0.097	0.047	0.094
	(0.218)	(0.205)	(0.212)*	(0.306)*	(0.300)	(0.281)*	(0.275)	(0.249)	(0.266)
lag_log_NSDP	0.009	0.017	0.019	0.017	0.012	0.027	0.012	0.019	0.021
	(0.006)	(0.007)**	(0.007)***	(0.015)	(0.013)	(0.016)*	(0.007)*	(0.007)***	(0.006)***
Lag log Capital Expenditure	-0.005	-0.008	-0.003	-0.001	-0.008	-0.002	-0.008	-0.009	-0.006
	(0.002)**	(0.002)***	(0.002)	(0.004)	(0.005)	(0.004)	(0.002)***	(0.003)***	(0.003)**
Annual Growth of the Population + 0.05	-0.05	-0.068	-0.058	-0.015	-0.044	-0.071	-0.06	-0.069	-0.045
	(0.019)***	(0.018)***	(0.024)**	(0.047)	(0.043)	(0.041)*	(0.024)**	(0.025)***	(0.027)*
lag_AGR	-0.11			-0.111			-0.083		
	(0.023)***			(0.036)***			(0.033)**		
lag_MAN		0.061			0.144			0.019	
		(0.040)			(0.065)**			(0.040)	
lag_SERV			0.087			0.134			0.079
			(0.032)***			(0.067)**			(0.034)**
Constant	-0.108	-0.236	-0.299	-0.093	-0.155	-0.43	-0.137	-0.239	-0.247
	(0.045)**	(0.051)***	(0.095)***	-0.146	-0.142	(0.182)**	(0.064)**	(0.073)***	(0.087)***
Implied β	**-0.006**	**-0.012**	**-0.013**	**-0.012**	**-0.009**	**-0.019**	**-0.008**	**-0.013**	**-0.015**
Prob > chi2	(0.013)**	(0.000)***	(0.000)***	(0.058)*	(0.106)	(0.005)***	(0.002)***	(0.000)***	(0.000)***
Observations	480	480	480	197	197	197	283	283	283
Number of ID	24	24	24	23	23	23	24	24	24
Number of instruments	361	361	361	141	141	141	223	223	223
Arellano-Bond test for AR(1) in first differences:									
z =	-4.01	-4.03	-4.00	-3.54	-3.57	-3.46	-3.58	-3.69	-3.61
Pr > z =	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Arellano-Bond test for AR(2) in first differences:									
z =	0.02	0.09	0.20	-0.25	-0.29	-0.24	0.36	0.52	0.40
Pr > z =	(0.988)	(0.925)	(0.842)	(0.802)	(0.771)	(0.807)	(0.716)	(0.604)	(0.686)
Hansen test of overid. restrictions:									
chi2=	0.000	0.000	0.000	10.09	9.62	7.12	4.71	6.3	2.3
Prob > chi2	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)

Robust standard errors in parentheses *significant at 10%; ** significant at 5%; *** significant at 1%

Table 11. Convergence across 24 Indian states over the period 1980-2002 1980-1990, 1991-2002. Spatial System GMM estimates controlling for sector shares in total production. Spatial analysis considering border effects.

		1980-2002			**1980-1990**			**1991-2002**	
Lag Annual Growth	-0.397	-0.408	-0.407	-0.373	-0.383	-0.387	-0.42	-0.422	-0.432
	(0.058)***	(0.059)***	(0.061)***	(0.061)***	(0.063)***	(0.067)***	(0.071)***	(0.071)***	(0.073)***
Spatial Lag Annual Growth	0.301	0.286	0.301	0.312	0.283	0.271	0.265	0.254	0.287
	(0.128)**	(0.131)**	(0.132)**	(0.146)**	(0.142)**	(0.140)*	(0.149)*	(0.149)*	(0.155)*
lag_log_NSDP	0.007	0.018	0.021	0.003	0.001	0.02	0.013	0.024	0.027
	-0.006	(0.007)**	(0.007)***	(0.014)	(0.015)	(0.018)	(0.007)*	(0.007)***	(0.008)***
Lag log Capital Expenditure	-0.004	-0.007	-0.003	-0.002	-0.009	0.002	-0.006	-0.008	-0.006
	(0.002)*	(0.002)***	(0.002)	(0.003)	(0.005)*	(0.004)	(0.003)**	(0.003)***	(0.003)**
Annual Growth of the Population + 0.05	-0.041	-0.056	-0.05	-0.05	-0.069	-0.076	-0.04	-0.042	-0.029
	(0.019)**	(0.017)***	(0.022)**	(0.047)	(0.045)	(0.044)*	(0.023)*	(0.021)**	-0.023
lag_AGR	-0.103			-0.121			-0.082		
	(0.022)***			(0.039)***			(0.033)**		
lag_MAN		0.048			0.147			-0.013	
		(0.042)			(0.064)**			(0.042)	
lag_SERV			0.082			0.135			0.067
			(0.031)***			(0.063)**			-0.041
Constant	-0.076	-0.214	-0.288	-0.057	-0.131	-0.373	-0.107	-0.212	-0.246
	(0.044)*	(0.051)***	(0.092)***	-0.152	-0.163	(0.208)*	-0.066	(0.064)***	(0.078)***
Implied β	**-0.005**	**-0.013**	**-0.015**	**-0.002**	**-0.001**	**-0.014**	**-0.009**	**-0.017**	**-0.019**
Prob > chi2	(0.047)	(0.000)***	(0.000)***	(0.15)	(0.878)	(0.061)	(0.002)***	(0.000)***	(0.000)***
Observations	480	480	480	197	197	197	283	283	283
Number of ID	24	24	24	23	23	23	24	24	24
Number of instruments	361	361	361	141	141	141	223	223	223
Arellano-Bond test for AR(1) in first differences:									
z =	-4.07	-4.07	-4.04	-3.69	-3.7	-3.63	-3.61	-3.71	-3.61
Pr > z =	(0.000)	(0.000)	(0.000)	(0.0009	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Arellano-Bond test for AR(2) in first differences:	0.15								
z =	0.15	0.160	0.170	-0.150	-0.180	-0.210	0.450	0.600	0.420
Pr > z =	(0.880)	(0.876)	(0.864)	(0.882)	(0.857)	(0.834)	(0.655)	(0.55)	(0.671)
Hansen test of overid. restrictions:									
chi2=	0.000	0.000	0.000	10.090	10.550	6.800	8.290	7.680	4.520
Prob > chi2	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)

Table 12: Summarizing results concerning the coefficients implied by the Solow Model.

Coefficients computed through the restricted and unrestricted Solow Model making use of different econometric methodologies (1980-2002) - Results extracted from Table 8.

Unrestricted

	Random Effect	Fixed Effect	Differenced GMM	System GMM
Implied β	-0.008***	0.177***	0.281***	-0.011***

Restricted

	Random Effect	Fixed Effect	Differenced GMM	System GMM
Implied β	-0.008***	0.180***	0.346***	-0.023***
Implied α	0.176***	0.236***	0.442***	0.068***

Coefficients computed through the restricted and unrestricted Solow Model making use of a Spatial System GMM over different periods - Results extracted from Table 9.

Spatial analysis considering km distance (Highways)

	Unrestricted			Restricted		
,	1980-2002	1980-1990	1991-2002	1980-2002	1980-1990	1991-2002
Implied β	-0.017***	-0.023***	-0.017***	-0.02***	-0.022**	-0.023***
Implied α				0.147***	0.087***	0.195***

Spatial analysis considering common borders

	Unrestricted			Restricted		
,	1980-2002	1980-1990	1991-2002	1980-2002	1980-1990	1991-2002
Implied β	-0.013***	-0.012*	-0.016***	-0.017***	-0.012	-0.019***
Implied α				0.174***	0.104***	0.222***

Coefficients computed through the unrestricted Solow Model making use of a Spatial System GMM over different periods and controlling for sectors - Results extracted from Table10 and 11.

Spatial analysis considering km distance (Highways) - Table 10

	1980-2002			1980-1990			1991-2002		
Controlling for:	Agricolture	Manufacture	Services	Agricolture	Manufacture	Services	Agricolture	Manufacture	Services
Implied β	-0.006**	-0.012***	-0.013***	-0.012*	-0.009	-0.019***	-0.008***	-0.013***	-0.015***

Spatial Effects considering Borders – Table 11

	1980-2002			1980-1990			1991-2002		
Controlling for:	Agricolture	Manufacture	Services	Agricolture	Manufacture	Services	Agricolture	Manufacture	Services
Implied β	-0.005	-0.013***	-0.015***	-0.002	-0.001	-0.014	-0.009***	-0.017***	-0.019***

*significant at 10%; ** significant at 5%; *** significant at 1%

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