Relevance of β and σ Convergence: 
An empirical study of the Indian Federation

Dukhabandhu Sahoo
Assistant Professor
School of HSS & M, IITBBS
Bhubaneswar, India-751013

Abstract

The main objective of this paper is to test the unconditional convergence (β and σ convergence) across 15 major Indian States from 1980-81 to 2003-04. The study reveals that some initially poor States (e.g. Rajasthan, West Bengal and Andhra Pradesh) have achieved growth rates in their real per capita GSDP which is commendable. However, this growth rate is not accompanied by reduced inequality across these States, therefore, cannot be egalitarian, something any federal government would cherish. As seen from the pages of economic history, the market forces cannot reduce inequality. This is more so in India, since the market here is far from perfect due to a host of factors lying outside the scope of economics. After five and half decades of planning, regional inequality still is a major issue. In fact, the reform regime has seen more of this evil. Given the structural differences across the states, some degree of inequality among the States is indispensable.

**Key words:** Convergence; Fiscal Policy; Panel Data

**JEL classification:** C22, J24, O23
1. Introduction

The classical doctrine lost its credibility with the Great Depression, and that thrust into the self-regulating forces of the market gave way to increasing skepticism. As a result, the role of market paved way to the role of government (and sometimes the combination of the two) to understand, explain and formulate the economic policies (Garvy, 1975). Given that modern government acts as an agent of welfare states, egalitarianism is never far from their agenda. Therefore, reducing inequality and poverty has become the major policy objective of many governments. Thus, an important issue the modern government has to address with the spirit of development economics is whether economies that initially were poor subsequently grow faster in per capita income terms and converge with those started out ahead. It is also observed that, income differentials are not only extremely large across countries, income differentials across regions of a given country can also be significant (Heshmati, 2006) and India being a union of different regions (28 States and seven Union Territories) can hardly be an exception. Inequality in any dimension gives rise to unequivocal negative effects on subsequent growth and development, and worsens economic, social, and political tension among regions leading to misallocation of resources (Chowdhury, 2003). Therefore, it is important to identify the sources of changes in productivity and growth in order to recommend appropriate policies for accelerating growth and achieving equity by raising the standards of living of people in different States (regions) in a federal set up like India.

India accounts for a meager 2.4 percent of the world’s surface area, yet it sustains a whopping 16.7 percent of the world’s population, amounting to a little over one billion people residing in 28 States and seven UTs. The variation in physical geography, culture, and economic conditions across these states and territories is enormous. Some states have achieved rapid economic growth in recent years, whereas others have languished. However, in spite of five and half decades of development planning in India aiming to reduce the income disparities among regions, inequality in income and growth across the regions has been rising over time. Further, in spite of considerable research undertaken on the subject, much more remains to be understood to explore the nature and causes of differences in growth rates in order to calibrate appropriate policies and institutions to achieve balanced regional growth by spreading the benefits of growth processes across different regions of India. Therefore, the objective of this paper is to explore the proximate policy variables of the States and center that could explain the growth differentials across the Indian States.

The paper focuses on the 15 most populous States of India, which excludes the Himalayan States, the northeastern States except Assam, and the seven UTs. Thus, the current paper includes the 15 major States of India namely; Andhra Pradesh (AP), Assam (AS), Bihar (BI), Madhya Pradesh (MP), Rajasthan (RJ), Orissa (OR), Uttar Pradesh (UP), Maharashtra (MA), West Bengal (WB), Punjab (PU), Gujarat (GU), Tamil Nadu (TN), Haryana (HY), Karnataka (KT) and Kerala (KR). The included States have a combined population of 997 million (approximately 94 percent of India’s population) and cover 2.9 million km$^2$ (87 percent of India’s total land area). Economic performance varies greatly among these 15 States. The Gross State Domestic Product (GSDP) per capita, among the 15 sample States, ranges from Rs. 3,775 per year in 2003-04 in the poorest State, Bihar (population 82 million), to Rs. 20,000 per year in the richest State, Gujurat (population 96 million).
This paper applies mainstream economic theory and draws on existing empirical studies in order to achieve its objectives. The paper is organized as follows. Section two gives the theoretical framework of convergence. It presents the theoretical background for testable hypotheses. It also reviews the results of previous studies of convergence across Indian States, then validates the functional form of the model. The results of empirical estimations and the discussion on the measures of convergence are given in section three while the fourth section summarizes the conclusions on inter-state convergence in the Indian federation.


2.1 Measures of Convergence

There are two standard ways of examining the presence or absence of unconditional convergence (Barro and Sala-i-Martin, 1995). The first measure is absolute or commonly known as, β-convergence and it implies that poor economies (in this case the poor Indian States) tend to grow faster than their richer counterpart (due to the diminishing marginal productivity of capital as explained by the Inada condition of Neoclassical growth models, Solow, 1956) contingent upon reasonably homogeneous preferences and technology and no barriers to the inter-regional movement of factors of production. The second measure is σ-convergence which states that the inequality across States tends to decline over time. However, the former does not necessarily warranty the later as explained below:

Let \( Y_{it} \) be the per capita income of the \( i^{th} \) State at time period, ‘t’. In this case, ‘i’ is 15 and ‘t’ ranges from 1980-81 to 2003-04 and \( Y_{it} \) is assumed to follow the following scheme, i.e.

\[
\ln Y_{it} = \alpha + (1 - \beta)\ln Y_{i,t-1} + \varepsilon_{it} \quad \ldots (2.1)
\]

where, ‘\( \ln \)’ is the natural logarithm of the series, \( \alpha \) and \( \beta \) are the parameters and \( \varepsilon_{it} \sim \text{IID}(0,\sigma^2) \). With some arrangements, equation 2.1 can be expressed as:

\[
\ln(Y_{it}/Y_{i,t-1}) = \alpha - \beta \ln Y_{i,t-1} + \varepsilon_{it} \quad \ldots (2.2)
\]

By taking the derivative of equation 2.2 with respect to \( \ln Y_{i,t-1} \), one would get:

\[
\frac{d\ln(Y_{it}/Y_{i,t-1})}{d\ln Y_{i,t-1}} = -\beta \quad \ldots (2.3)
\]

The left hand side of equation 2.3 is the definition of absolute or β-convergence. Under the assumption, \( \beta > 0 \) (\( \beta \), in fact lies between 0 to 1 as shown later), the equation establishes the fact that States with low per capita income tend to grow faster than States with high per capita income (the measure of β convergence). Now, in order to relate both β and σ convergence at steady-state equilibrium, let’s define the measure of inequality at time period ‘t’, ‘\( D_t \)’, which is:

\[
D_t = \text{var}(\ln Y_{it}) = (1/15)(\ln Y_{it} - \mu)^2,
\]

where, ‘\( \mu \)’ is the arithmetic mean of \( \ln Y_{it} \). Putting the value of \( \ln Y_{it} \) from equation 2.1, we get: \(
\text{var}(\ln Y_{it}) = (1 - \beta)^2 \text{var}(\ln Y_{i,t-1}) + \text{var}(\varepsilon_{it}) \ldots (2.4)
\), i.e.,

\[
D_t = (1 - \beta)^2 D_{t-1} + \sigma^2 \quad \ldots (2.5)
\]

If, β convergence would lead to σ convergence, then at steady state equilibrium, one must have, \( D_t = D_{t-1} \ldots = D^* \ldots \ldots (2.6) \), where \( D^* = \sigma^2 \), the steady state level of inequality.
From equations 2.5 and 2.6, we get,

\[ D^* = \sigma^2 \beta (1 - (1 - \beta)^2) \quad (2.7). \]

Some important observations could be made from equation 2.7. First, if \( \beta = 0 \), i.e. if poor states do not grow faster than the rich states, then at steady state, the inequality is not defined, an impossible case and if \( \beta > 1 \) or \( \beta < 0 \), then, \( D^* \) becomes negative, also theoretically impossible. On the other hand, if \( \beta = 1 \), then, \( D^* = \sigma^2 \), again quite unrealistic. Thus, the only possibility is, \( 0 < \beta < 1 \), which implies \( \beta \) convergence and falling inequality are not synonymous or \( \beta \) convergence is a necessary but not the sufficient condition for \( \sigma \) convergence. However, before analyzing the empirical issues relating to convergence in India, it is pertinent to highlight some of the issues studied on the theme in Indian context.

2.2 Studies of Convergence across Indian States: Some issues

Several studies covering different time periods examine whether per capita income levels have been converging or diverging in India. Most of the studies have shown that there is a tendency toward divergence rather than convergence. Nair (1971) finds no noticeable reduction in inter-state income differentials between 1950 and 1960, and Chaudhury (1974) concludes that the degree of state income inequality did not change between 1950 and 1970. Majumdar and Kapoor (1980) revealed that inter-state inequality of income in India steadily increased during 1962–76.

There are some recent literature on the issue of regional growth and convergence in per capita real income across the States in India. These studies also have tried to unearth the determining forces of the tendency of convergence or divergence. While some of these studies reveal that the growth pattern of per capita income has followed a divergent tendency in absolute term (Marjit and Mitra, 1996; Rao, et al., 1999; Dasgupta, et al., 2000); after controlling for internal migration, center-state grants, and different indices of physical, social and economic infrastructure, there is also evidence in favour of unconditional and conditional convergence in per capita real income across the States (Cashin and Sahay, 1996; Nagaraj, et al., 1997; Aiyer, 2001). Number of several other studies (for instance, Rao, 2007; Ahluwalia, 2000, and 2002; Shand and Bhide, 2000; Rao, et al. 1999) have observed that the regional inequality in India has widened, especially during the 1990s. However, these studies have used pre-revised State Domestic Product (SDP) data. Further, some analysis do not adequately cover the post-reform period, especially the new millennium when the growth rate has accelerated at the aggregate as well as at the State level.

To sum up: the studies addressing the issue of growth and convergence in India have used different samples of states over different time periods and at times arrived at conflicting conclusions. But, the most important policy issue that is grossly overlooked in these studies is how the fiscal policy of the governments both of the center and States has contributed towards the growth and (in)equality in the Indian Federation. This needs immediate and urgent attention so that the federal fabric of the country is not endangered. Another issue that needs due methodological attention is the estimation of State Domestic Product (SDP) used by the existing studies. SDP in India are based on the United Nations System of National Accounts (SNA) 1993. The new SDP series not only changed base year in terms of price, but also revised the production boundary in a number of sectors, notably, agriculture, real estate and finance (Bhattacharya and Sakthivel, 2003). It has also shifted the occupation force database from the Census to the National Sample Survey (NSS). Finally, it has incorporated some new dynamic economic activities, such as, software, which were not included in the
earlier series. The SDP growth rates from the earlier series therefore cannot be compared with the same from the revised series. A proper analysis of regional growth and inequity should therefore be done through a common database. This paper tries to overcome this methodological problem by extending the 1993-94 SDP series backward to compare growth and regional variation across states on a common database.

3. Growth and Inequality across Indian States: The issue of ‘β’ and ‘σ’ Convergence

As mentioned earlier the present study is an endeavour towards addressing the issue of growth and inequality across 15 major Indian States from 1980-81 to 2003-04, and the policy concerns it endangers. The relevant data for the present study are sourced from Central Statistical Organization (CSO) and Reserve Bank of India (RBI). However, before getting into the analysis, some conceptual issues regarding the data on the SDP need to be addressed. The SDP are estimated by the individual states, thus strictly are not comparable due to the qualitative differences in data collection and computation system. The CSO has revised the SDP series with base 1993-94 and the revised series of SDP is available only from 1993-94. The revised series based on new concepts of sectors and data; alter relative growth across States, sectors and periods. For a proper analysis of regional growth and inequality over time, the revised series of SDP should be extended backward. For this purpose, the Price Correction Factor (i.e. PCF, defined as the ratio of implicit deflator for 1993-94 series to the 1980-81 series for the year 1993-94) and the Quantum Correction Factor (QCF) are used to have the consistent series of SDP with the 1993-94 series data 1. Additionally, the SDP of the States like Bihar, Madhya Pradesh and Uttar Pradesh are combined with the SDP of the bifurcated States to make the measures of growth and inequality comparable over time.

Interstate Growth Comparison

Both the Gross State Domestic Product (GSDP) and Net State Domestic Product (NSDP) could be used as a measure of SDP. However, from an accounting perspective, GSDP would be more appropriate measure of SDP. Thus, the analysis in the present paper is centered around GSDP as a measure of SDP. The growth rates of GSDP and the per capita GSDP, across the sample 15 major states have shown a fair degree of variation. While some states have witnessed rapid and phenomenal growth, the rest lagged behind. The annual moving average growth rates of GSDP for 15 major States at 1993-94 prices for the two sub periods of 1980s (1980-81 to 1989-90) and 1990s through the new millennium (1990-91 to 2003-04), and for the whole sample period, i.e. (1980-81 to 2003-04) are given in Table 1. It may be seen that except few States –Rajasthan, Orissa and Kerala, all other States have progressed rapidly during the 1980s. Rajasthan recorded the highest GSDP growth rate (nine percent), while the GSDP growth rate of Orissa was hovering around 3.3 percent per annum. However, in general, there was a comparatively balanced regional growth during the 1980s. But, the post-reform era belonged to the relatively industrialized States and States those have resorted to service sector. The GSDP both in absolute and per capita term of relatively better industrialized States like, Gujarat and West Bengal, grew at over 7.4 and nearly seven percent per annum respectively. Among other major States, Karnataka and Maharashtra have performed very well with over six percent growth. It is surprising to note that West Bengal which is considered to be a more socialistic State has grown faster than some of the pro-reform States, such as, Andhra Pradesh (5.7 percent) and Punjab (4.5 percent), during the reform era. Such a startling scenario in West Bengal, contrary to the common perception

1 for the detailed discussion of the methodology see Bhattacharya and Sakthivel, 2003
needs an in-depth, careful and robust inquiry. The two slow growing States Andhra Pradesh and Punjab have comparatively better infrastructure and known to have pro-market attitude. While Punjab’s slow growth may be attributed to stagnation in agriculture and fiscal mismanagement that of Andhra Pradesh needs an in-depth but careful scrutiny. A detailed study on Andhra Pradesh (Rao and Mahendra Dev, 2003) also confirms the slow growth rate of GSDP in the post reform era. Among other States, Rajasthan, Kerala, Haryana, and Tamil Nadu have recorded above average growth rate during the reform era. The GSDP of Kerala accelerated in the post-reform period, due to the remittances from the golf by the people of Kerala working there. One striking finding of the paper is that, Orissa which had the lowest growth rate among the sample States during the pre-reform era (3.3 percent), has achieved a considerable jump in the growth rate in the reform era (5.1 percent). This staggering achievement of Orissa can be attributed to her greater adoptability to the reform, particularly, reforms in the loss making Public Sector Units (PSUs) like the State Electricity Board, Iron and Steel industries and reform to bring transparency and accountability in General Administration.

The other issue that needs to be addressed is whether initially poor States have grown faster than initially rich States between 1981 and 2004? Prima facie, the present study supports this proposition (Table 1). As explained by the neoclassical models, the relatively poorer States of India like Orissa, Rajasthan and Andhra Pradesh had below-average real per capita GSDP in 1981, and relatively high rates of growth in 24 years after. While Punjab clearly had the highest real per capita GSDP in 1981, its 1981-2004, growth rate (2.7 per cent) was close to that which would be predicted given its initial level of per capita income. But, Bihar, the poorest State in 1981, could not achieve the higher growth rate 24 years after, as postulated in the neoclassical growth models. This aboration can be attributed to a host of factors like the deterioration of the law and order in the State owing to gross negligence to improve the general administration by the successive State governments and due to the inefficiency of the State government to utilize the central transfer.

\[2\text{ in the neoclassical parable, on striking force to raise the growth rates of the poorer states is the transfer of resources from the richer states to the poorer states through central transfer (Cashin and Sahay, 1996)}\]
Table 1 Growth Rates (Gr.) of SDP (GSDP) and per capita GSDP of 15 major States at 1993-94 Prices (percent per annum)

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<tbody>
<tr>
<td>BI</td>
<td>2912.0</td>
<td>AS 3.8</td>
<td>BI 1.5</td>
<td>OR 3.3</td>
<td>OR 1.5</td>
<td>BI 3.0</td>
</tr>
<tr>
<td>RJ</td>
<td>4284.3</td>
<td>BI 3.9</td>
<td>AS 1.8</td>
<td>KR 3.7</td>
<td>AS 2.0</td>
<td>AS 3.4</td>
</tr>
<tr>
<td>OR</td>
<td>4538.5</td>
<td>UP 4.2</td>
<td>UP 1.9</td>
<td>AS 4.2</td>
<td>WB 2.1</td>
<td>UP 3.5</td>
</tr>
<tr>
<td>UP</td>
<td>4551.6</td>
<td>OR 4.3</td>
<td>MP 2.5</td>
<td>WB 4.4</td>
<td>KR 2.3</td>
<td>MP 4.5</td>
</tr>
<tr>
<td>AS</td>
<td>5057.7</td>
<td>MP 4.8</td>
<td>OR 2.6</td>
<td>BI 4.9</td>
<td>UP 2.7</td>
<td>PU 4.5</td>
</tr>
<tr>
<td>AP</td>
<td>5175.1</td>
<td>PU 4.8</td>
<td>PU 3.0</td>
<td>UP 5.1</td>
<td>BI 2.7</td>
<td>TN 5.1</td>
</tr>
<tr>
<td>WB</td>
<td>5335.5</td>
<td>KR 4.9</td>
<td>HY 3.4</td>
<td>KT 5.2</td>
<td>MP 2.7</td>
<td>OR 5.1</td>
</tr>
<tr>
<td>MP</td>
<td>5422.3</td>
<td>TN 5.4</td>
<td>KR 3.7</td>
<td>MP 5.2</td>
<td>KT 3.2</td>
<td>HY 5.3</td>
</tr>
<tr>
<td>KT</td>
<td>5575.1</td>
<td>WB 5.8</td>
<td>WB 3.9</td>
<td>PU 5.3</td>
<td>PU 3.3</td>
<td>AP 5.7</td>
</tr>
<tr>
<td>TN</td>
<td>6003.9</td>
<td>HY 5.9</td>
<td>MH 4.0</td>
<td>TN 5.7</td>
<td>MH 3.7</td>
<td>RJ 5.8</td>
</tr>
<tr>
<td>KR</td>
<td>6275.5</td>
<td>KT 6.0</td>
<td>TN 4.1</td>
<td>GU 5.9</td>
<td>GU 3.9</td>
<td>KR 5.8</td>
</tr>
<tr>
<td>GU</td>
<td>7404.7</td>
<td>AP 6.0</td>
<td>KT 4.2</td>
<td>MH 6.1</td>
<td>HY 4.1</td>
<td>MH 6.3</td>
</tr>
<tr>
<td>MH</td>
<td>7833.4</td>
<td>AP 6.2</td>
<td>AP 4.2</td>
<td>AP 6.4</td>
<td>AP 4.1</td>
<td>KT 6.0</td>
</tr>
<tr>
<td>HY</td>
<td>8591.9</td>
<td>GU 6.8</td>
<td>GU 4.7</td>
<td>HY 6.6</td>
<td>TN 4.2</td>
<td>WB 6.9</td>
</tr>
<tr>
<td>PU</td>
<td>9360.6</td>
<td>RJ 7.4</td>
<td>RJ 4.8</td>
<td>RJ 9.6</td>
<td>GU 6.8</td>
<td>GU 5.4</td>
</tr>
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</table>

Nonetheless, there has been some evidence of convergence across the 15 major Indian States over the study period. However, the movement of the rank of the State (according to the growth rate), is mainly among poorer States and richer States, only exception being West Bengal, Andhra Pradesh, Haryana, Madhya Pradesh, Tamil Nadu and Punjab. West Bengal and Andhra Pradesh, the two poor States in 1981, have moved to the richer group in terms of growth rate in 2004, where as Madhya Pradesh, Tamil Nadu and Punjab, the three richer States in 1981 have come into the group of poor States in terms of growth rate.
Since the result is quite mix, it is not conclusive to establish the fact that poor States have a better growth rate than their richer counterparts in 24 years. Therefore, this needs to be further tested with some robust technique. In order to test for β convergence\(^3\), the present study estimated equation 2.2 with three different models, namely, Fixed Effect (FE), Random Effect (RE) and simple Pooled Ordinary Least Square (OLS) model\(^4\). Additionally, the study also divides the States into two groups based on their initial (1981) GSDP per capita and examines convergence within these two sub-groups. Group one includes the initial high-income (rich) States like Maharashtra, Punjab, Haryana, Gujarat, Tamil Nadu, Karnataka, Kerala and Madhya Pradesh. Group two includes the initial poor States like West Bengal, Rajasthan, Andhra Pradesh, Uttar Pradesh, Orissa, Bihar and Assam. After a check on different test statistics for all the competing models for panel data estimation, the study settled for the Two Way Random Effect model for all the groups (all 15 States, eight initial rich States, seven initial poor States) and the results are reported in Table 2. The results confirm the presence of β convergence across the 15 major Indian States as well as across the sub groups of eight rich States and seven poor States. The results show that the values of β's for all the samples is negative which imply that States with low level of initial per capita income grow faster than the States having higher initial per capita income: the connotation of β convergence\(^5\). Furthermore, the higher absolute value of β for the group of rich States than for the group of poor States implies that the speed of convergence is higher for the former group than the later group. This finding corroborates with the findings of previous study by Cashin and Sahay (1996).

<table>
<thead>
<tr>
<th>Group</th>
<th>Model</th>
<th>Estimated A</th>
<th>Estimated β</th>
<th>R(^2)</th>
<th>F- Stat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 15 States</td>
<td>Two Way Random Effect</td>
<td>0.73*</td>
<td>-0.08*</td>
<td>0.36</td>
<td>4.11*</td>
</tr>
<tr>
<td></td>
<td>SE (^5) 0.21 SE</td>
<td>T value 3.38</td>
<td>T value -3.3</td>
<td>SL (^7) 0.00 SL</td>
<td>0.00</td>
</tr>
<tr>
<td>Initial eight rich States</td>
<td>Two Way Random Effect</td>
<td>1.14*</td>
<td>-0.12*</td>
<td>0.33</td>
<td>3.34*</td>
</tr>
<tr>
<td></td>
<td>SE 0.36 SE</td>
<td>T value 3.15</td>
<td>T value -3.1</td>
<td>SL 0.00 SL 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Initial seven poor States</td>
<td>Two Way Random Effect</td>
<td>0.74*</td>
<td>-0.08*</td>
<td>0.28</td>
<td>1.95*</td>
</tr>
<tr>
<td></td>
<td>SE 0.32 SE</td>
<td>T value 2.27</td>
<td>T value -2.2</td>
<td>SL 0.02 SL 0.2</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* implies the coefficients are significant at 0 per cent level
$ SE stands for standard error, # SL stands for significance level

Then again, as explained in section 2.1, β convergence does not necessarily lead to σ convergence, i.e., even if the initial poor Sates grow faster than their richer counterparts, the inequality may not decline across the sample Sates. Therefore, it is pertinent to have a look at

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\(^3\) defined earlier

\(^4\) for a detailed review on these Econometric models see Dielman (1989) and Hsiao (2003)

\(^5\) logic is explained in section 2.1
the trend of inequality across the States. However, some issues relating to the measurement of inequality needs to be addressed as there is hardly any concept other than inequality that draws more attention in economics. But the measurement of inequality of a distribution is simple as well as complex. It’s simple because a simple measure of Range\(^6\) can, to some extent, capture the inequality in a distribution, and it is complex because of the addition of new dimension (social, political and ethnic) to the concept. In order to incorporate the new dimensions to the concept of inequality, one needs to work a lot on the subjective (qualitative) aspect. Therefore, the measures of inequality fall into two classes\(^7\) viz. positive measures, those make no explicit use of any concept of social welfare, and normative measures which are based on an explicit formulation of social welfare and the loss incurred from unequal distribution (Sen, 2002). While the line between these two types of measures is not a firm one, it is clear that there is a distinction, and it may be useful to discuss the two types of measures in details (which is beyond the scope of this paper)\(^7\). Then again, a pure normative measure lacks motivation where as in a positive measure one may miss many a properties of inequality. But some delimitation, however tentative, is indispensable to have a quantitative measure of inequality. Though, there are extensive literature on the positive measures of inequality, the present study has used the most convincing measures of inequality like Coefficient of Variation (CoV), Standard Deviation of Logarithms (SDLn) and Sen’s index (S)\(^8\). The inequality (as measured by these quantitative measures of inequality) across the Indian States during the study period is presented in Graph 2.1 and Graph 2.2. Here, Sen’s index is preferred over the widely used Gini coefficient (Lorenz ratio) because the former is sensitive to any transfer from the rich State to the poor State in the distribution\(^9\).

Over the period 1980-81 through 2003-04, the inequality of real per capita GSDP (as measured by CoV, SDLn and S) across the Indian States has widened. The inequality has accentuated after the liberalization of 1990-91. This may be due to the fact that the liberalization era has enabled the already rich industrialized States to adopt a pro-market policy that has given a boost to their growth. The economy as a whole witnessed a more regional balanced growth in the pre reform period and there were robust growth rate in initially poor States like, Andhra Pradesh and slow growth rate in initially rich states like Kerala and Madhya Pradesh. Therefore, the dispersion of real per capita GSDP across the states was not that prominent during this period.

\[ S = (1/2n^2\mu) \sum_{i=1}^{n} \sum_{j=1}^{n} |y_i - y_j| = 1-(1/n^2\mu) \sum_{i=1}^{n} \sum_{j=1}^{n} \min(y_i, y_j) \]
\[ S = 1+(1/n)(2/n^2\mu)[y_1+2y_2+ \ldots \ldots +ny_n], \] for \( y_1 < y_2 < \ldots \ldots < y_n \), where, \( y_i \) is the income of the \( i \)th state and the average level of income is ‘\( \mu \)’

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\(^6\) the ratio of excess of maximum value over the minimum value of a distribution to the mean value of the distribution

\(^7\) interested readers can go through Sen, 2002, Chapter 2

\(^8\) for a detailed understanding of the advantages, disadvantages and derivations of these measures, see Sen, 2002, Chapter 2

\(^9\) in fact the Sen’s index can be formulated with a little manipulation of Gini coefficient as follows:
However, in the 1984–91 sub periods, the initially poor States (Bihar, Assam, and Orissa) and the initially rich States (Punjab, and Maharashtra in 1984) had similar rates of economic growth. This widened the dispersion of real per capita GSDP in India as rich States’ growth was on a higher GSDP base. Sen’s index (S) is used to evaluate the role of central transfers to the States to reduce inequality. This index states that any transfer of resources from the richer State to the poor one should reduce the inequality. Yet, this index is growing over a period of time, baring sub periods of 1983-84 and the initial year of 1990s’ (Graph 2.1).

By and large, inequality has gone up in India during the study period implying the absence of ‘σ’ convergence. Thus, over a period of time, the role of central transfer as an inequality reduction mechanism is questionable. The presence and/or absence of ‘σ’ convergence in India is also tested with the help of Autoregressive (AR)\(^{10}\) model. The AR model for the three measures of inequality namely, CoV, SDLn and S can have the following specifications in spirit of the derived equation 2.5:

\[
CoV_t = \alpha + \sum_{i=1}^{p} \beta_i CoV_{t-i} + \varepsilon_t \quad \ldots \ldots \ldots (3.1)
\]

\(^{10}\) see Johnston and DiNardo (1997)
\[ SDLn_t = \alpha_2 + \sum_{q=1}^q \beta_q SDLn_{t-q} + \varepsilon_{2t} \] (3.2)

\[ S_t = \alpha_3 + \sum_{r=1}^r \beta_r S_{t-r} + \varepsilon_{3t} \] (3.3)

where CoV, SDLn and S are as defined earlier (which are used as a measure of dispersion in LnY_t). A positive and significant value of the coefficients of the explanatory variables would imply that the inequality is growing over a period of time. Though the literature prescribes for an AR(1) scheme, for conformation, the correct lag-length selection (here, selection of the value of p, q and r) is critical for any AR scheme, since excessively short lags may fail to capture the causality, lead to omitted variables and likely to produce serially correlated errors. Meanwhile, too long a lag leads to a rapid loss of degrees of freedom and to overparametarization. Therefore, the Akaike Information Criterion (AIC) has been used to detect correct lag-length and it confirms AR (1). Additionally, India experienced a structural change in 1991 and thus, one can expect a structural break in the model. So, to capture the impact of reform of 1991, the models are reformulated as switching regression models as follows:

\[ CoV_t = \alpha_4 + \alpha_4 D + (\beta_1 + \beta_1 D)CoV_{t-1} + \varepsilon_{4t} \] (3.4)

\[ SDLn_t = \alpha_2 + \alpha_2 D + (\beta_2 + \beta_2 D)SDLn_{t-1} + \varepsilon_{5t} \] (3.5)

\[ S_t = \alpha_3 + \alpha_3 D + (\beta_3 + \beta_3 D)S_{t-1} + \varepsilon_{6t} \] (3.6)

Where D stands for the structural dummy i.e. 1 for 1992 and thereafter and 0 otherwise (all other variables remain as defined earlier). In order to take care of probable autocorrelation problem, all the estimation in the analysis followed the Cochrane–Orcutt (C-O) Procedure. After the specification of the models for the test of ‘σ’ convergence, the equations (i.e. 3.4, 3.6 and 3.6), are estimated and the results are reported in Table 3. The high value of the adjusted R-square and close to two value of DW statistics, implies a good statistical fit of all the three models. The positive and significant coefficients of the explanatory variables conforms the fact that the inequality is growing across 15 Major Indian States over the study period of 1981 to 2004 and the positive but significant dummy slope coefficient for the CoV, SDLn and Sen’s index implies that the inequality (as measured by these measure of dispersion) across 15 major Indian States is getting aggravated due to the liberalization i.e. after liberalization, poor States have become poorer and relatively rich States have benefited more.

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11 for switching regression technique, see Ramanathan (2002)

12 in the presence of autocorrelation, the original series Y_t is transformed using the following method:

\[ Y_t^* = Y_t - \rho Y_{t-1} \]

where, \( Y_t^* \) = Transformed data, \( Y_t \) = Original data at time period t, \( Y_{t-1} \) = Original data at time period t-1 and ‘\( \rho \)’ is the autocorrelation coefficient. \( \rho = \Sigma (U_t - U_{t-1})^2 / \Sigma U_t^2 \). After the data are transformed according to the above formula, a new equation is estimated by the OLS method.
### Table 3 Regression results of equations 2.11 through 2.13

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<td>0.58*</td>
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<tr>
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<td>2.13</td>
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* implies the coefficients are significant  
$ SE stands for standard error, # SL stands for significance level

### 4. Conclusion and Policy Suggestions

To conclude, it can be said that some initially poor States (e.g. Rajasthan, West Bengal and Andhra Pradesh) have achieved growth rates in their real per capita GSDP which is commendable. However, this growth rate is not accompanied by reduced inequality across these States, therefore, cannot be egalitarian, something any federal government would cherish. As seen from the pages of economic history, the market forces cannot reduce inequality. This is more so in India, since the market here is far from perfect due to a host of factors lying outside the scope of economics. Notwithstanding, some explanation needs to be unearthed from the system within i.e. from the economic structure and the policy decisions of the center and States so that policies can be calibrated to reduce an evil like inequality.
Reference:


