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Convergence Hypothesis: Some Dynamics and Explanations of Agricultural Growth across Indian States§

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Abstract

In the recent years there has been considerable emphasis on understanding the regional dimensions of economic growth in India within the convergence implications of neoclassical growth paradigm. The study has tested the convergence hypothesis in per capita agricultural output and foodgrains productivity across the major 15 states of India. During 1971-2007, Indian states have exhibited sigma divergence in per capita agricultural output. The study on relationship between initial foodgrain output and growth rates has shown a divergence pattern rather than convergence during 1971-1988, and we could observe a weak convergence during 1988-2007.

Key words: Beta convergence, Sigma convergence, Agricultural development

JEL Classification: Q1, Q10, Q18

Introduction

India accounts for a meagre 2.4 per cent of the world surface area, yet it sustains a whooping 17.5 per cent of the world population, a little over one billion people residing in 28 states and 7 union territories. The variation across these states and union territories with regard to physical geography, culture, and economic conditions is enormous. Some states have achieved rapid economic growth in recent years, while others have languished. Indian agriculture is characterized by both inter-personal and inter-regional disparities. Inter-personal disparities have primarily arisen because of skewed distribution of land ownership due to the failure of land reforms in general, and legislation pertaining to ceiling on landholdings in particular. Wide inter-regional disparities exist because of differences in agro-climatic conditions and in resource endowments, mainly in terms of availability of irrigation and other rural infrastructure. A moot question therefore is, to find out whether the introduction of new technology would further accentuate the existing inter-personal and inter-regional inequalities. There is a wide spread feeling that the new technology is also expected to bypass the rainfed regions, thereby further accentuating regional disparities.

Several studies on high-income market economies, undertaken during the 1990s for the U.S., Japan, and regions within Western Europe have found evidences for strong convergence among the regions. But, we find little evidence of comparable convergence among Indian states. This raises an important question as to why some countries or regions demonstrate inter-regional convergence while others, like India, do not. In India, it appears that geographical variations across regions may block the convergence of incomes. There are two standard methods of examining the presence

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or absence of unconditional convergence (Barro and Sala-I-Martin, 1995). The first mode is the so-called 'σ-convergence' (sigma convergence), where we measure standard deviation of the Net State Domestic Product (NSDP) per capita across regions. There is σ-convergence if the standard deviation across states tends to decline over time. The second measure is β-convergence (beta convergence), where proportionate growth in per capita NSDP is regressed on the initial income. There is β-convergence if the coefficient on initial income, denoted by β, is negative and statistically significant.

Studies on Regional Pattern of Agricultural Development in India

Parikh (1980) has analyzed the state-specific as well as crop-specific growths in agricultural output. The study has explained the regional variations in growth performance in terms of growth rates achieved in various states, but is silent on the factors affecting productivity variation. Bhalla and Tyagi (1989) have analyzed the patterns in the development of Indian agriculture covering 17 major states and 19 crops. They have concluded that the new seed-fertilizer technology has played a major role in raising yield levels of various crops and thereby augmenting the agricultural development in India since mid-1960s. Ahluwalia (1991) has analyzed the sources of growth in production and found that during the period 1969-89 the main source of growth in production was the yield growth.

Sen (1992) has examined the impact of economic liberalization on Indian agriculture. He pointed out that liberalization would lead to increased concentration of growth in output and marketed surplus, in a context in which there were already several regional inequalities at the beginning of the 1980s. He has indicated a downward trend in agricultural investment which together with a decline in public and private investments, will have disturbing implications for the future growth of agricultural sector. Dholakia and Dholakia (1993) have undertaken a study on the growth pattern in the agricultural sector with special reference to Total Factor Productivity Growth (TFPG). They have concluded that the TFPG in agriculture has been the driving force behind the acceleration of overall growth in the Indian economy achieved during 1980s. Bhalla and Singh (2001) have examined 43 major crops for 17 states from 1962 to 1995 for analyzing the changes in the cropping patterns, growth rates of crop output and productivity changes. The study found that level of irrigation, fertilizer consumption and use of tractors were relatively high in the regions, which experienced high rate of growth of productivity. They found that disparities in productivity growth across states continue to remain very high and are a product of rigid structural factors like variations in the level of infrastructure and technological development in various regions.

Studies on Convergence Hypothesis in Indian Scenario

Nair (1971) has analyzed the inter-state differences during 1950-60 and found that there was no noticeable reduction in the income differentials. In other words, the first decade of Indian planning does not seem to have witnessed any tendency towards convergence of income levels. Majumdar and Kapoor (1980) have suggested that over the period 1962-76, there has been a steady increase in the inter-state inequalities of income in India. Dholakia (1994) has concluded on the basis of his study of 20 Indian states over the period 1960-61 to 1989-90, that there are marked tendencies of convergence of long-term economic growth rates across the states. He has identified the year 1980-81 as the 'year of break' in the trend of real incomes of Indian states and found that many of the lagging states started growing after this year, while the leaders began to stagnate.

Cashin and Sahey (1996*)* have claimed absolute convergence on the basis of data relating to 20 Indian states over the period 1961-91. At the same time, they have observed the dispersion of real per capita income increased during the period. Nagaraj *et al.* (1997) have studied the growth performance of Indian states during 1960-94 and found the evidence of conditional convergence. Rao *et al*. (1999) have focused their attention not only on the question of convergence but have also tried to examine the reasons for the observed pattern.

Dasgupta *et al.* (2000) have offered analytical description of the economic performance of the Indian states as reflected in their per capita Net State Domestic Product (NSDP). They found a clear tendency for the Indian states to have diverged during the period 1960 to 1996 as far as per capita NSDP was concerned. In terms of the shares of different sectors in the NSDP, however, there seems to be a tendency for the overall convergence towards the national average. Ahluwalia (2001) while analyzing the economic performance of the Indian states during the post-reform period, has suggested that not all rich states got richer relative to

the poor states. He cited Punjab and Haryana as the two key examples. While these were the two richest states in 1990-91, their growth rates of per capita SDP in the 1990s were not only lower than that in the 1980s, but also in both cases actually fell below the national average. He has also pointed out that not all the poorer states lagged behind. While suggesting that two poor states, Rajasthan and Madhya Pradesh, had performed well, Alhuwalia did not offer an explanation for their better performance.

Thus, a consensus is yet to emerge on the convergence issue relating to the Indian states. Most of the studies have tried to look into the economic performance in terms of per capita income. In order to have a deeper insight into the nature of divergence, it is meaningful to carry out the analysis for broad categories of per capita income, viz. the agricultural, manufacturing and tertiary sectors. It is also essential to look into the pattern of regional agricultural development in India. Keeping in view all these facts, we have framed the objective to test the convergence hypothesis in per capita agricultural output and foodgrains productivity across the major states of India.

Data and Methodology

The data on per capita agricultural output across the states for the period 1971 to 2007 was provided by the Economic and Political Weekly Research Foundation (EPWRF) database. The data on foodgrains productivity and crop-wise details were collected from 'Indian Harvest database' prepared by the Centre for Monitoring Indian Economy (CMIE).

Convergence Hypothesis

The convergence models demonstrate that in closed economies with no differences in technology and preferences, the growth rates in per capita incomes tend to be inversely related to the initial levels of per capita incomes. The principal force driving convergence in the neoclassical growth model is the diminishing returns to reproducible capital. Therefore, economies with lower initial values of capital-labour ratios will have higher marginal products of capital and therefore, tend to grow at higher rates (Evans and Karras, 1996). In the present study, we have attempted to test the convergence hypothesis in

(i) the per capita initial agricultural output and growth rates in per capita output, and

(ii) the gross value of initial foodgrains productivity and growth rates in productivity.

Sigma Convergence and Beta Convergence

Economies are said to satisfy the conditions of sigma convergence if the dispersion of per capita outputs over a cross-section of economies decreases over time. We began by calculating the coefficient of variation (CV) of per capita agricultural output across 15 states of India for each year starting from 1971 to 2007. Thereupon, we fitted a linear time trend over the series so generated.

The neoclassical theories suggest that at low levels of per capita output, an economy grows at high rate and vice versa. This leads to the hypothesis of absolute beta convergence, which predicts a negative relationship between the rates of growth in per capita agricultural output enjoyed by the states and the level of the initial per capita output at a given initial point of time. Thus, the beta convergence measures the speed at which poorer regions catch up with the richer ones. We looked at the line of best fit through a scatter of estimated compound growth rates of different states and their initial per capita income (average of initial 3 years). Our base period was 1970-71. The compound growth rates calculated were regressed on average per capita output for the initial 3 years to examine the convergence. The phenomenon of beta convergence occurs if the regression line yields a negative coefficient for the initial per capita income variable.

Convergence Hypothesis Testing in Foodgrains Productivity

In order to bring about a more comprehensive study, it is imperative to test the convergence in the foodgrains productivity across Indian states. The gross value of foodgrains output at constant prices per hectare of gross cropped area was worked out. To convert the output series into value terms, we have used the average of wholesale prices of each crop in 15 states and to express the series in constant prices, we have used the average of prices from 1992-93 to 1994-95 as the base. Thus, the total value of foodgrains output was worked out as follows:

$$\Sigma P_{I0} X_{IJ}$$

where, P_{I0} is the all India price of I^{th} crop for the base year and X_{IJ} is the physical quantity output of I^{th} crop in J^{th} year.

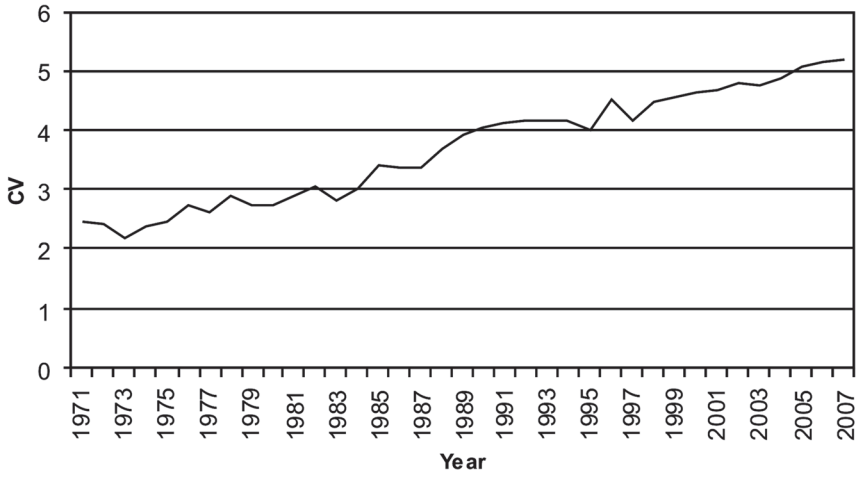

Figure 1. Coefficients of variation of per capita agricultural output across 14 major states of India

Source: EPWRF (2009) and CMIE (2009)

Results and Discussion

Convergence Hypothesis Test in Per Capita Agricultural Output

The movement pattern of coefficients of variation (CVs) of per capita agricultural output among 14 major states of India over a period of 37 years (1971-2007) is illustrated in Figure 1. An upward trend in CVs can be observed at an increasing rate till 1988 and thereafter, the trend remained increasing but at a decreasing rate. By and large, we can say the CVs have increased and the result of the linear time trend fitted over the series of CVs has shown a significant positive coefficient (Table 1). Therefore, it is clearly evident that for the period under review the Indian states did not exhibit sigma convergence in per capita agricultural output; on the contrary, a clear divergence was observed. As the sigma convergence measures the inter-regional inequality, we may very well infer that the inter-regional inequality among the Indian states had increased during 1971-2007.

Table 1. Estimated linear trend of coefficients of variation of per capita agricultural output

Year	Constant	CVs trend	F	R^2
1971-2007	33.8 (30.5)	72 (10.7)	114	0.81

Note: Figures within the parentheses are t-values

Further, to test the beta convergence hypothesis, we divided the entire time frame into two sub-periods: 1971-88 was taken as period-I and 1988-07 as period-II. The list of the selected states for the analysis and the abbreviations used for these states are given in Table 2. A glance at the scatter plot (Figure 2) shows the relationship between initial per capita agricultural output and compound growth rate (CGR) during the period 1971-88. West Bengal and Maharashtra had experienced higher growth rates despite their low initial per capita output. On the contrary, Bihar and Tamil Nadu, with almost similar initial per capita output, had experienced negative growth rates. Punjab had registered highest growth rate in the period-I with highest initial per capita output. Hence, during the first period, there is no evidence of beta convergence. In a scenario where we excluded West Bengal from the analysis, we could certainly observe a weak divergence; where states with higher initial per capita output enjoyed higher growth rates.

During period-II, Gujarat, Bihar and Orissa had experienced negative growth rates (Figure 3). Excluding these states, we could observe a clear convergence where growth rates of Punjab and Haryana had come down and states like West Bengal, Tamil Nadu, Karnataka, Madhya Pradesh and Rajasthan had experienced better growth rates than in the previous period. Here, we could observe the relationship between sigma and beta convergence. During period-I, the CVs had shown an upward trend at an increasing rate reflecting inequality among states and there was a weak beta divergence consequently. On the contrary, in period-II, the CVs were increasing at a decreasing rate and there was a beta convergence.

Table 2. States selected for analysis

States	Abbreviations used
Andhra Pradesh	ap
Bihar	bih
Gujarat	guj
Haryana	har
Karnataka	kar
Kerala	ker
Madhya Pradesh	mp
Maharashtra	mah
Orissa	or
Punjab	pjb
Rajasthan	raj
Tamil Nadu	tn
Uttar Pradesh	up
West Bengal	wb

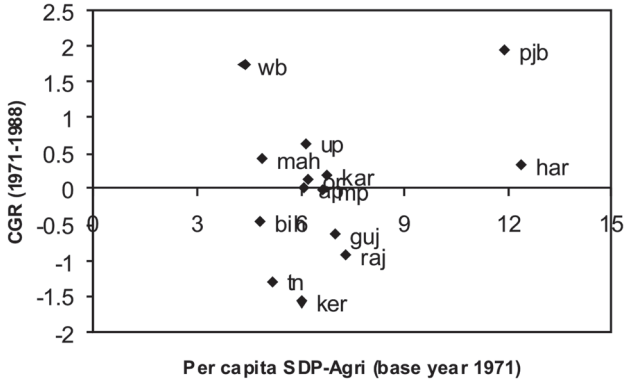

Figure 2. Scatter of states' estimated CGR and initial average per capita agricultural output (1971-88)

Source: EPWRF (2009) and CMIE (2009)

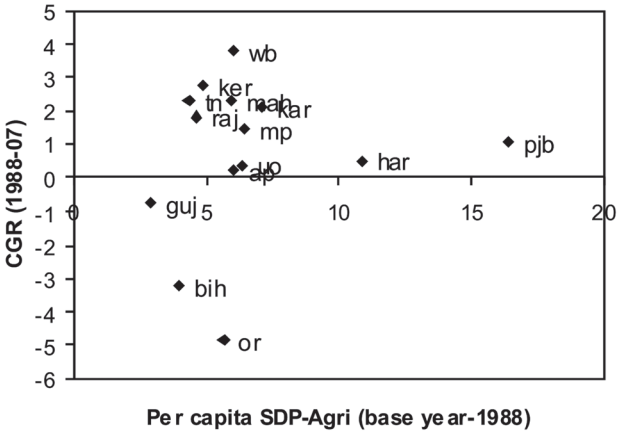

Figure 3. Scatter of states' estimated CGR and initial average per capita agricultural output (1988-07)

Source: EPWRF (2009) and CMIE (2009)

Convergence Hypothesis Test in Gross Value of Foodgrain Productivity Per Hectare

We also applied the convergence theory with another set of variables. Here, we analyzed the relationship between initial gross value of foodgrains output/ha in the base year and the compound growth over the two sub-periods, viz. 1971-88 and 1988-07. The division of entire time frame into two sub-periods also helped in comparing the convergence/divergence behaviour with the earlier method.

The analysis brought out some interesting features about the relation between initial foodgrain output and growth rates. During period-I, Haryana, Punjab, Andhra Pradesh, Tamil Nadu and West Bengal enjoyed a higher initial foodgrains productivity as well as higher growth rates than other states. Kerala could be considered as an outlier which enjoyed higher initial productivity and low growth rate. Accordingly, in period-I we could observe a divergence pattern (Figure 4).

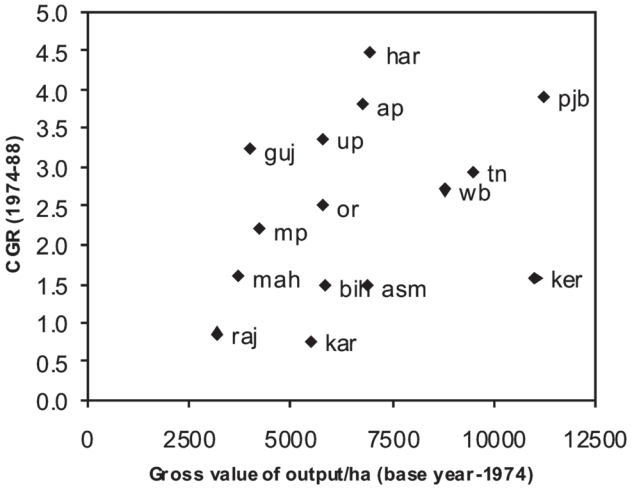

Figure 4. Scatter of states' estimated CGR and initial average value of foodgrains output/ha (1974-88)

Source: EPWRF (2009) and CMIE (2009)

During period-II (1988-07), it was observed that states like Karnataka, Orissa, Assam and Bihar, which had experienced very low growth rates during the previous period, had recovered drastically and marked better growth rates almost catching up with Punjab, Haryana and Andhra Pradesh (Figure 5). Punjab had registered a low growth rate in the period-II in comparison with growth rate of period-I. There is no evidence of a strong convergence during period-II. But, the situation has certainly improved as compared with period-I.

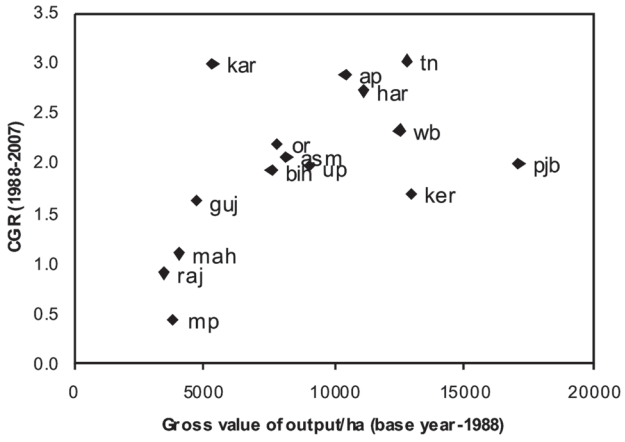

Figure 5. Scatter of states' estimated CGR and initial average value of foodgrains output/ha (1988-07)
Source: EPWRF (2009) and CMIE (2009)

Summary and Conclusions

During the period 1971-07, Indian states have not exhibited sigma convergence in per capita agricultural output; in fact, they have shown a clear divergence on this aspect. As the sigma convergence measures the inter-regional inequality, we can infer that the inter-regional inequality among the Indian states had increased over this period (1971-98). During 1971-88, there is no evidence of beta convergence. On excluding West Bengal from the analysis, we have observed a weak divergence, where states with higher initial per capita output enjoyed higher growth rates. During 1988-98, Gujarat, Bihar and Orissa have experienced negative growth rates. After excluding these states, we have observed a clear convergence. Thus, the relationship between sigma and beta convergence could be observed. During period-I, the CVs have shown an upward trend at an increasing rate reflecting inequality among states and a weak beta divergence was followed. On the other hand, during period-II, the CVs have increased at a decreasing rate and there was a beta convergence during the period. The study on the association between initial foodgrain output and growth rates has shown a pattern of divergence rather than convergence during 1971-1988.

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