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AGRICULTURE, ECONOMIC GROWTH AND REGIONAL DISPARITIES IN INDIA

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Abstract: This paper investigates the process of convergence and catching-up among major Indian states during 1980/81–2004/05—a period of economic liberalisation and accelerated economic growth, and also analyses the factors that enhance economic growth and lead states towards an identical steady state. In particular, we examine the role of agricultural conditions in this process. Results indicate absolute divergence in income levels across states. However, after controlling for structural characteristics of states there is a strong tendency of convergence among states. Physical infrastructure and human capital are found to enhance economic growth, but alone are not sufficient for convergence. For convergence, the investment in physical infrastructure and human resources should be accompanied by a reduction in employment pressure on agriculture by improving labour market linkages of agriculture with non-agricultural sectors, and by promoting growth-enhancing labour-intensive agricultural technologies. Copyright © 2009 John Wiley & Sons, Ltd.

Keywords: convergence; income growth; agricultural employment; technology adoption; infrastructure; human capital; India

1 INTRODUCTION

Since 1960/61 India's *per capita* income grew at a modest rate of 2.3 per cent a year but with an acceleration, from 1.2 per cent during 1960s and 1970s to 3.0 per cent during 1980s and further to 3.8 per cent during 1991/92–2004/05. These trends however are not universal, and there is a growing concern that the growth is concentrated among a few rich states, and the poor states have lagged behind.

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India exhibits considerable heterogeneity in geography, climate, infrastructure, production structure and socio-cultural development; and inter-state variation in income growth could be due to significant differences in such structural characteristics across states. In recent years, a number of studies have investigated the trend in regional disparities in economic development in India and causes thereof (Cashin and Sahay, 1996; Bajpai and Sachs, 1996; Nagaraj *et al*., 1998; Rao *et al*., 1999; Aiyar, 2001; Sachs *et al*., 2002; Trivedi, 2003; Purfield, 2006; Nayyar, 2008), and most of these find a steady rise in regional disparities, and attribute this to cross-state differences in infrastructure, human capital and technology.

In this paper, we investigate (i) whether income levels across Indian states have been converging or diverging, and (ii) the factors underlying convergence or divergence with special focus on the role of agriculture, which has been recognised by development economists as an important source of economic growth since long (Lewis, 1954; Hirschman, 1958; Ranis and Fei, 1961; Johnston and Mellor, 1961; Kuznets, 1968). Their basic premise is that by releasing labour force for industrial activities, supplying cheap foodstuffs for expanding industrial labour force, creating market for domestically produced industrial products, and contributing to savings and foreign exchange through exports, the agricultural sector can contribute to the overall economic growth. Further, it is postulated that as the economies progress, share of agriculture in national income and labour force declines.

Johnston and Mellor (1961) consider linkages of agriculture within the agricultural sector and with the non-agricultural sectors crucial to economic growth. Agriculture generates forward linkages through provision of its outputs as intermediate inputs to industrial sector, and thus contributes to the growth of agro-processing and marketing activities, which in turn create opportunities for growth and import substitution. Agriculture has also strong backward linkages through its demand for industrial outputs like fertilizers, pesticides, machines and equipment, and financial, marketing and other support services. On the consumption side, rural population provides huge market for domestically manufactured products and services. Such demand-driven linkages are considered 'the strongest linkage' of agriculture in the development process, especially in economies dominated by small farmers (Mellor, 1976; Hazell and Roell, 1983; Hazell and Haggblade, 1991; Timmer, 2002; Thirtle *et al*., 2003). Expenditure patterns of small farmers are such that these favour growth of non-farm sector; small farmers spend more on rural non-traded goods, as compared to large farmers. Timmer (1996) from a perspective of political economy argues that 'agriculture can also influence process of economic growth through its potential to stabilise domestic food production and enhance food security'; and neglect of agriculture can lead to political and economic instability, which in turn can reduce level and efficiency of investment.

Some recent studies find mixed evidence regarding the role of agriculture in economic development. Yang and Zhu (2004) and Tiffin and Irz (2006) find agriculture as an important cause of economic growth, and conclude that economic growth cannot be sustained without improving agricultural productivity. Gardner (2005), on the other hand, reports no significant influence of agriculture on economic growth. Notwithstanding, Isabelle and Gardner (2007) on reviewing the development paths of some developed and developing countries conclude that agriculture has been an important source of economic growth in some countries and not in others.

Indian agriculture, consistent with the theory of economic development, witnessed a significant decline in its share in national income, but was not accompanied by a commen-

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surate decline in total workforce. Between 1970/71 and 2004/05 its share in national income declined from 44.3 to 23.1 per cent and in workforce from 69.5 to 58.2 per cent.[1] The slow rate of transfer of labour from agriculture to non-agricultural sectors is thus conjectured an important barrier to enhancing labour productivity in agriculture and thereby the overall economic growth, despite significant advances in bio-chemical and mechanical technology that facilitated a faster growth in agricultural production. Hence, with regard to the role of agriculture in the economic growth and convergence we hypothesise that (i) continued high employment pressure on agriculture is a major cause of lack of convergence among Indian states, and (ii) agricultural technology by enhancing productivity growth in agriculture can accelerate overall economic growth and reduce regional disparities.

Rest of this paper is organised as follows. The following section presents analytical approach used to investigate convergence. Section 3 describes data used to examine convergence. Section 4 presents the behaviour of cross-state disparities in both income levels and growth, and discusses causes thereof with special focus on agricultural conditions. Concluding remarks are made in the final section.

2 ANALYTICAL APPROACH

Convergence is the tendency of poor regions to grow faster and catch-up with rich regions (Barro, 1991; Barro and Sala-i-Martin, 1995). It is of two types: σ-convergence and β-convergence. σ-convergence is measured as the standard deviation in logarithm of *per capita* income across regions, and denotes behaviour of cross-sectional dispersion of income over time. It occurs if cross-sectional dispersion in *per capita* income declines over time. β-convergence shows relationship between growth rate of *per capita* income and initial level of *per capita* income of regions, and is said to occur if the relationship between the two is significantly negative. In other words, the countries/regions with initial low level of *per capita* income tend to grow faster and catch-up with the rich countries/regions. Key assumption here is the diminishing rate of returns to capital. Poor regions have low level of physical capital and hence higher rate of returns on capital, and thus for any rate of investment the poor regions will grow faster compared to rich regions. The relationship between growth rate in *per capita* income of region i and its initial level of *per capita* income can be estimated as:

$$\Delta y_{it} = \beta y_{it} + \gamma x_{it} + \varepsilon_{it} \tag{1}$$

where y_{it} is *per capita* income of region i at the beginning of the period, Δy_{it} is growth rate of *per capita* income over the period, x_{it} is a set of variables influencing growth of region i, and ε_{it} is random disturbance. For convergence, the coefficient on y_{it} must be significantly less than zero.

Equation (1) represents the notion of conditional β-convergence. Conditional β-convergence however is relevant when regional economies are not structurally similar. In other words, absolute β-convergence assumes homogeneity of structural characteristics (technology, preferences, culture, etc.) across countries/regions. Absolute β-convergence is a stronger version of β-convergence and occurs once the variation in structural

[1]Figures on workforce pertain to 1971 and 2001 respectively.

DOI: 10.1002/jid

characteristics is controlled for. Thus, $x_i s$ in Equation (1) should be jointly insignificant for absolute β-convergence. Hence, β-convergence is consistent with σ-divergence.

Equation (1) can be estimated using both cross-section and panel data specifications. We use panel data specification because of its several advantages over cross-section specification (Islam, 1995). Panel data specification provides for large number of observations, allowing for more degrees of freedom, reduced collinearity among independent variables, and increased probability of getting more reliable parameter estimates (Wooldridge, 2002). Further, with panel data it is possible to control region-specific, time-invariant characteristics using fixed effects or random effects models, which is not possible with cross-section specification.

There is also another approach developed by Bernard and Jones (1996), which examines existence or non-existence of convergence and its nature (absolute or conditional) without controlling for structural variables unlike in conditional β-convergence. This approach tests convergence against a benchmark region. Let, the benchmark region is *r*, then the difference in *per capita* income of region *i* from region *r* can be written as:

$$LnD_{it} = LnA_{rt} - LnA_{it} \tag{2}$$

where $i = 1, 2, \ldots .$ N. A_{it} is *per capita* income of region *i* in year *t*, and A_{rt} is *per capita* income of the reference region *r*, and both are in logarithms. Then D_{it} is the *per capita* income of region *i* relative to the region r. If there is a convergence between regions *i* and r, then D_{it} is stationery. The estimating equation is then:

$$LnD_{it} = (\delta_r - \delta_i) + (1 - \lambda)LnD_{it-1} + \varepsilon_{it} \tag{3}$$

If there is no convergence, then $\lambda = 0$ and $\delta_{\mathrm{i}} \neq \delta_{\mathrm{r}}$. If λ is significantly > 0 and $\delta_{\mathrm{i}} = \delta_{\mathrm{r}}$, then regions will converge to the same level of *per capita* income. The drift term $(\delta_{\mathrm{r}} - \delta_{\mathrm{i}})$ will be small but non-zero. If $\delta_{\mathrm{i}} = \delta_{\mathrm{r}}$, then convergence is absolute. In other words, for absolute convergence drift term should be insignificantly different from zero.

3 DATA

We examine the process of convergence and its underlying causes using data for 15 major Indian states for the period 1980/81–2004/05—a period of economic liberalisation, and high agricultural and overall economic growth. The sample states are: Andhra Pradesh, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamilnadu, Uttar Pradesh and West Bengal.[2] Together, these account for 94 per cent of the country's population and 88 per cent of the gross domestic product (GDP).

Data were compiled from various published sources. In this paper, we define *per capita* income as the GDP per person, and the information on GDP and population was collected from various issues of the national accounts statistics published by Central Statistical Organisation of the Ministry of Statistics and Programme Implementation, Government of India. Data on demographic variables were compiled from census of India—conducted

[2]In 2000 three new states viz. Chhattisgarh, Jharkhand and Uttarakhand were carved out from Madhya Pradesh, Bihar and Uttar Pradesh, respectively. Data on income and other variables for these states was clubbed with their parent states.

DOI: 10.1002/jid

decennially by the Government of India. Data related to infrastructure and agricultural technology was collected from the statistical abstracts published by different states.

As we use panel data specification, the entire period from 1980/81 to 2004/05 is divided into five sub-periods- each comprising of 5 years. Thus, the total number of observations for 15 states becomes 75, as against 15 in cross-section specification.

4 GROWTH PERFORMANCE OF STATES, AND CONVERGENCE

4.1 Income Levels and Growth

India's *per capita* income grew at an annual rate of 3.1 per cent during 1980/81–1991/92 and 3.8 per cent during 1992/93–2004/05 (Table 1). However, the robust growth observed at the national level is not universal, and there are considerable differences in both income levels and growth among states. Bihar, Orissa and Uttar Pradesh have continued to be at the lower end of income distribution, while Punjab, Haryana, Maharashtra and Gujarat remain among rich states. Furthermore, gap between poor and rich states has increased considerably over last 25 years. For instance, the ratio of *per capita* income of the poorest state Bihar to one of the richest states Punjab has increased to 3.5 in 2003/05 from 2.6 in 1981/83.

Table 1 also compares growth rates of *per capita* income of states for the period 1980/81–1991/92 and 1992/93–2004/05. We have taken 1991/92 as the cut-off point because India initiated a major programme of economic reforms in July 1991. Some important observations emerging from a cross-state comparison of income growth before and after reforms are as follows. Income growth of poor states (Bihar, Orissa, Uttar Pradesh and Madhya Pradesh) has remained not only sluggish, 2–3 per cent a year, but also decelerated

Table 1. Level and growth in *per capita* income in Indian states, at 1993/94 prices

	Per capita GDP (Rupees)		Annual compound growth rate in *per capita* GDP (%)	
	1981/83	2003/05	1980/81–1991/92	1992/93–2004/05
Bihar	3773(15)	5280(15)	2.3	2.2
Uttar Pradesh	4332(14)	7156(14)	2.6	1.8
Orissa	4407(13)	7557(13)	2.8	2.7
Rajasthan	4932(12)	10388(11)	3.8	2.9
West Bengal	5293(11)	12917(10)	2.6	5.6
Madhya Pradesh	5601(10)	8955(12)	2.1	1.9
Karnataka	5636(9)	14522(6)	3.5	5.6
Kerala	6068(8)	14257(8)	2.5	4.7
Tamilnadu	6098(7)	15154(5)	4.0	4.1
Himachal Pradesh	6361(6)	14347(7)	3.5	4.7
Andhra Pradesh	6470(5)	13050(9)	2.0	4.7
Gujarat	7627(4)	18735(2)	2.8	3.7
Maharashtra	8035(3)	19148(1)	3.8	3.3
Haryana	8826(2)	18146(4)	4.0	3.5
Punjab	9927(1)	18438(3)	3.4	2.7
India (15 states)	5730	11767	3.1	3.8

Figures in parentheses are ranks of states.

DOI: 10.1002/jid

marginally during 1992/93–2004/05. Income growth of rich states, except Gujarat, also decelerated in the latter period, but continues to be higher than that of poor states. Deceleration in growth is significant in Punjab and Haryana, where growth has fallen below the national average. In contrast, middle income states experienced rapid income growth after initiation of the economic reforms process in 1991. West Bengal experienced robust growth of 5.6 per cent a year—more than double the growth realised in pre-reform period. Likewise, income growth of Karnataka accelerated to 5.6 per cent after 1991/92 from 3.5 per cent since 1980/81. Kerala, Himachal Pradesh and Andhra Pradesh also experienced accelerated growth in their *per capita* incomes after 1991/92, closer to five per cent a year. *Per capita* income of Tamilnadu grew consistently at about four per cent a year throughout the last 25 years.

4.2 Convergence in *Per Capita* Income

The general pattern emerging from data presented in Table 1 is that the poor states have lagged behind and showed no tendency of acceleration or deceleration, the rich states faced a deceleration and the middle income states experienced robust yet accelerating growth in their *per capita* incomes. Has this pattern of income growth led to convergence or divergence among Indian states? First, we investigate this through the lens of σ-convergence. Figure 1 plots standard deviation in logarithm of *per capita* incomes of states for the period 1980/81—2004/05. The standard deviation increased from 0.26 in 1980/81 to 0.40 in 2004/05 indicating a clear tendency of divergence in income levels across states. This tendency was stronger in the initial years of economic reforms; the standard deviation grew 2.6 per cent a year during 1991/92–1997/98 as against 1.3 per cent during 1980/81–1991/92 and 1.6 per cent during 1997/98–2004/05.

We further investigate existence or non-existence of convergence and its nature (absolute or conditional) using Bernard-Jones' approach. We regress deviation in logarithm of *per capita* income of state *i* in year *t* from the logarithm of *per capita* income

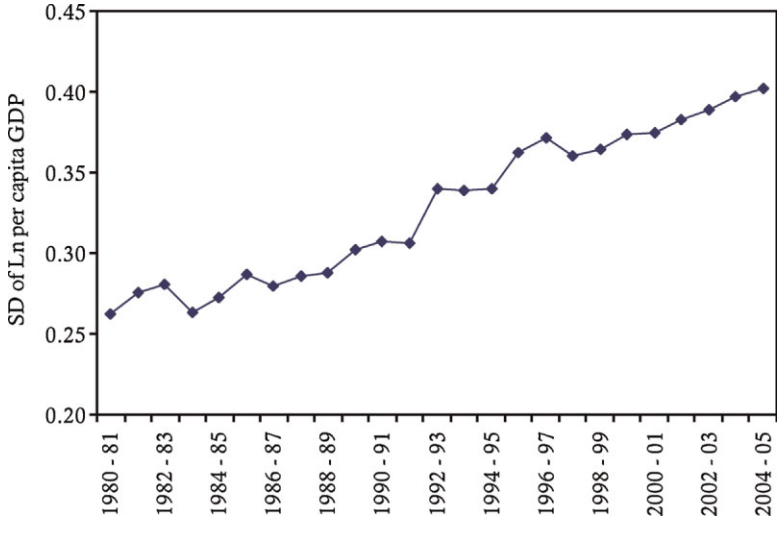

Figure 1. Dispersion of *per capita* income across Indian states, 1980/81–2004/05

DOI: 10.1002/jid

of benchmark state *r* (D_{it}) on the lagged deviation (D_{it-1}). Here, we consider Punjab as benchmark state because of its continued top rank in income hierarchy for most of the times during last 25 years, Using generalised least squares, we estimated fixed and random effects models, and based on Hausman test we chose the fixed effects model. The estimated fixed effects equation is:

$$LnD_{it} = 0.0744 + 0.8507\ LnD_{it-1}$$
$$(t = 4.22)^{***} \quad (t = 25.60)^{***}$$
$$R^2 = 0.6713, \text{F-statistic} = 655.58$$

Coefficient of the lagged deviation in *per capita* income, D_{it-1} is an estimate of $(1 - \lambda)$ in Equation (3), and is significant at less than 1 per cent level. Value of $(1 - \lambda)$ is 0.85, meaning that $\lambda > 0$. This suggests that there is a convergence in income levels across Indian states, but convergence is not absolute. For absolute convergence, drift $(\delta_r - \delta_i)$ or constant term should be insignificantly different from zero, which it is not in the estimated equation. It takes a value of 0.074 and is significant at less than one per cent level. This implies that convergence is conditional. In other words, for convergence to occur there is a need for measures that enable poor states to catch-up with rich states.

Lack of convergence in income levels can be explained by differences in physical infrastructure, human capital, technology, institutions, etc. across states. Availability of good quality public infrastructure is considered crucial to improving access to markets, to reducing transportation and transaction costs, to improving general quality of life and to stimulating private investment. Further, education is widely recognised as an important source of economic growth. By improving skills and capabilities to adopt new technologies, innovations and information it enhances economic growth. To capture effects of infrastructure and education on income growth we use road length per sq.km. of geographical area (ROAD) and per cent literate population (LITERACY) respectively as explanatory variables in convergence regressions.

Differences in production structure can also explain the differences in both income levels and growth rates across states. Generally, the economies dominated by agriculture grow slowly, because of low labour productivity in agriculture. There are two candidates to represent production structure of a region: (i) share of agriculture in GDP, and (ii) proportion of workforce engaged in agricultural sector. In convergence regressions, some studies have taken share of agriculture in GDP as a conditioning variable (Bajpai and Sachs, 1996; Nagaraj *et al*., 1998; Rao *et al*., 1999;), while others have included share of agricultural workforce in total workforce (Thirtle *et al*., 2003; Self and Grabowski, 2007). In India the share of agriculture in GDP declined considerably but not as much in the workforce (Table 2). In the poor states, employment pressure on agriculture continues to be very high than in the rich states, indicating the presence of disguised or underemployment there. In other words, labour productivity in agriculture in these states is low and also growing slowly (Ramaswamy, 2007). In this context, Gardner (2005) puts that most of the poor and seemingly underemployed people in developing countries live in rural areas, hence path to rural development must overcome insufficiency of un-remunerative employment where the employment pressure on agriculture is very high. Hence, we prefer including share of agricultural workforce (AGWORK) as the conditioning factor in our convergence regressions.

The barrier of low labour productivity in agriculture to economic growth can be overcome through growth-enhancing labour-intensive technologies at least in the short run. In the past, this has happened in many developing countries where biochemical

DOI: 10.1002/jid

Table 2. Share of agriculture in GDP and employment in Indian states

	Share of agriculture in GDP (%), at 1993/94 prices		Share of agriculture in total workforce (%)*	
	1981/83	2003/05	1981	2001
Bihar	43.6	30.7	79.1	77.6
Uttar Pradesh	44.4	30.4	74.5	69.2
Orissa	44.8	23.6	74.7	68.1
Rajasthan	43.7	24.9	68.9	67.8
West Bengal	27.3	21.6	55.0	47.7
Madhya Pradesh	36.4	24.4	76.2	75.5
Karnataka	40.0	17.3	65.0	58.1
Kerala	31.2	12.7	41.3	23.7
Tamilnadu	23.8	12.9	60.9	52.1
Himachal Pradesh	31.1	17.8	70.8	69.7
Andhra Pradesh	38.4	23.5	69.5	65.2
Gujarat	36.3	16.2	60.1	52.7
Maharashtra	22.3	10.5	61.8	56.5
Haryana	47.9	27.8	60.8	52.6
Punjab	48.6	36.9	58.0	40.4
India (15 states)	37.2	21.3	66.5	58.2

*Compiled from Census of India, 1981 and 2001.

technologies based on improved seeds, fertilizers and pesticides could accelerate agricultural growth and thereby labour productivity (Gardner, 2005; Self and Grabowski, 2007). Empirical literature uses a number of proxies like investment in agricultural research, total factor productivity, area under high yielding varieties and fertiliser consumption for technological progress. We use fertiliser consumption per ha of net sown area (FERT) to assess the role of agricultural technology in economic growth.

In Figure 1, we noticed a clear evidence of rising regional disparities in India after initiation of economic reforms programme in 1991, and more so in the initial years of reforms. To see whether economic reforms have significantly contributed to rise in disparities we include a dummy variable for reforms (REFORMS) in the convergence equations, which takes a value 1 for the years after 1991/92, zero otherwise.

Using econometric specification in Equation (1) we regressed panel growth rates of *per capita* income of states on their initial levels of *per capita* income and other variables described above using generalised least squares method. Based on Hausman test we chose fixed effects model over random effects model. Results are presented in Table 3.

Specifications I and II of Equation (1) in Table 3 provide estimates of unconditional β-convergence. Coefficient of initial *per capita* income (PGDP) in specification I is positive and significant at less than five per cent level, indicating existence of unconditional β-divergence among Indian states. In specification II we include dummy variable for reforms together with *per capita* income. Coefficient of REFORMS is negative and insignificant. But, this influences the convergence process; coefficient of *per capita* income though remains positive, turns out to be insignificant. Thus, tentatively we may infer that economic reforms have not been able to cause convergence among Indian states. This is also observed from Figure 2 that plots growth in *per capita* income of states for the entire period (1980/81 to 2004/05) against their initial levels of *per capita* income.

DOI: 10.1002/jid

Table 3. Determinants of income growth and convergence

Variable	I	II	III	IV	V	VI
Ln PGDP	0.0198 (2.458)**	0.0199 (1.485)	−0.0041 (0.315)	−0.0221 (1.290)	−0.0406 (2.293)**	−0.0475 (2.727)***
Ln ROAD			0.0527 (4.484)***	0.0407 (3.175)***	0.0432 (3.447)***	0.0414 (3.245)***
LITERACY				0.00098 (1.869)*	0.00094 (1.919)*	0.00047 (0.767)
AGWORK					−0.0017 (1.769)*	−0.0022 (2.226)**
Ln FERT						0.0189 (1.910)*
REFORMS		−0.00005 (0.008)	−0.00562 (1.027)	−0.0096 (1.709)*	−0.0086 (1.575)	−0.0154 (2.769)***
No. of observations	75	75	75	75	75	75
R-squared	0.3364	0.3364	0.4366	0.4689	0.5018	0.5335
Adjusted R-squared	0.1677	0.1534	0.2685	0.2983	0.3297	0.3607
F-statistic	1.99**	1.84**	2.60***	2.75***	2.92***	3.09***
Log-likelihood	206.610	206.616	212.752	214.971	217.368	219.829

Figures in parentheses are t-values. ***, ** and * denote significance at 1, 5 and 10% respectively.

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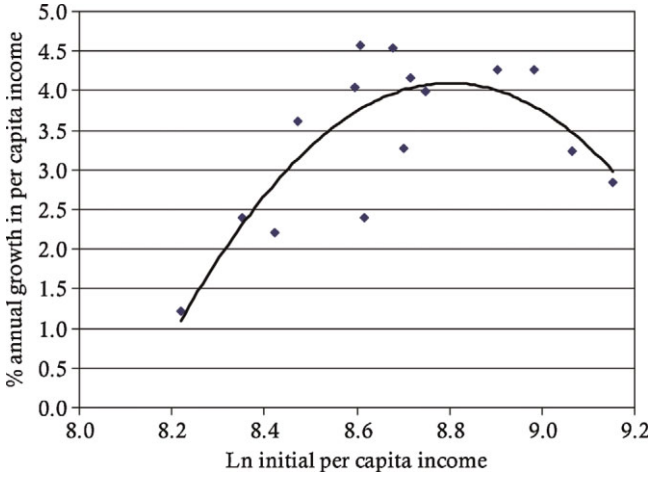

Figure 2. Relationship between growth rates in *per capita* income of states and their initial levels of *per capita* income

In specifications III–VI in Table 3 we identify factors leading to convergence. First, we look at the role of physical infrastructure and human capital, which have been widely reported to be important determinants of growth. In specification III, road density (ROAD) carries a positive and highly significant sign. Likewise, in specification IV, human capital variable, LITERACY is positive and significant at 10 per cent. These results suggest that investment in public infrastructure and human capital is critical to enhance economic growth. Further, with these variables in specification III and IV the coefficient of *per capita* income becomes negative although remains insignificant, indicating that investment in physical infrastructure and human capital alone cannot cause convergence.

We had hypothesised that high employment pressure on agriculture is one of the most important barriers to convergence in economic growth. If indeed it is so, the variable agricultural workforce should have a negative relationship with income growth in convergence equation. In specification V we find the coefficient of this variable (AGWORK) significantly less than zero. In this specification, the coefficient of *per capita* income also becomes strongly negative. This lends support to our hypothesis that very high employment pressure on agriculture is indeed an important barrier to economic growth and thereby to convergence across states. In other words, if poor states were to catch-up with rich states, it is imperative to strengthen linkages of agriculture with non-agricultural sectors through labour market by speeding-up the process of transfer of labour from agriculture to non-agricultural sectors in the poor states.

Role of technology in enhancing agricultural and economic growth is well-recognised in India. States like Punjab and Haryana, which have very high adoption rates of bio-chemical technologies, have also experienced rapid agricultural as well as overall economic growth, except in recent years. In specification VI the coefficient of fertilizer appears positive and significant at 10 per cent, and the significance level of other variables (except LITERACY) also improves. Coefficient of *per capita* income increases in magnitude and becomes significant at less than one per cent level. This implies that raising agricultural productivity through technological advances is important to accelerate economic growth of lagging states so as they can catch-up with rich states.

DOI: 10.1002/jid

Finally, we revisit the role of economic reforms in the process of convergence. Coefficient of the dummy variable for reforms (REFORMS) appears negative in all the specifications of equation 1, but turns out to be highly significant in specification VI that contains full set of the variables conditioning the growth. This is expected, because growth in *per capita* income of most rich states decelerated considerably and the poor states also did not show any improvement in their growth after initiation of the economic reforms process.

5 CONCLUDING REMARKS

The purpose of this paper was to investigate convergence and catch-up among Indian states during 1980/81–2004/05 and examine the role of agricultural conditions in this process. During this period, income growth accelerated in middle income states, decelerated in most rich states and neither accelerated nor decelerated in poor states. However, we find no evidence of σ-convergence as well as absolute β-convergence in income levels across Indian states, indicating no tendency of states to converge to an identical steady state. In contrast, we find robust evidence of conditional β-convergence. After controlling for cross-state structural factors, that is physical infrastructure, human capital and agricultural conditions the poor states were found to grow faster and catch-up with the rich states. Both road density and literacy—proxy for physical infrastructure and human capital respectively, have a significant positive relationship with income growth, implying that investment in physical infrastructure and human resources is critical to enhance economic growth in poor states.

Investment in physical infrastructure and human resources alone however does not appear to be sufficient for convergence. This needs to be accompanied by an improvement in agricultural conditions in particular with regard to employment pressure and technological change. Agriculture engages about 58 per cent of country's total workforce, which indeed is one of the most important barriers to improving labour productivity in agriculture and economic growth of states having high employment pressure on agriculture. Thus, for convergence it is imperative to reduce employment pressure on agriculture by improving labour market linkages of agriculture with non-agricultural sectors. Further, fuelled by technological change Indian agriculture although has taken rapid strides there remain considerable regional imbalances in technology adoption. Our results suggests that technology-led intensification of agriculture would promote agricultural as well as overall economic growth and speed up process of convergence.

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