

Study
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Development Research Group

**REGIONAL INEQUALITY IN INDIA IN
THE 1990s: TRENDS AND POLICY
IMPLICATIONS**



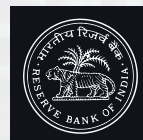
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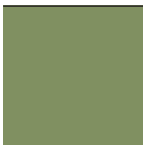
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EXECUTIVE SUMMARY

This study examines regional inequality in India with a particular focus on data below the state level. There are concerns that regional inequality in India has been increasing after the economic reforms that began in 1991. These concerns are supported by several statistical analyses, conducted mostly with state level data, which, however, does not reveal anything about what might be taking place within states. More disaggregated studies are typically qualitative or use only descriptive statistics.

We tackle this gap in analysis by performing a systematic empirical analysis that admits of some causal interpretation. The main methodology is the use of cross-section growth regressions, which seek to explain longer run growth rates in terms of initial conditions of output and development. In turn, these regressions are derived from, and interpreted in the light of neoclassical growth theory, which in its basic form, suggests that diminishing returns to capital accumulation will drive convergence in income levels across geographic units. We use specific proxy measures for physical infrastructure, financial development and human capital, and the regressions identify the connections between these measures and growth. Hence, the study illuminates the role of aspects of physical infrastructure, financial development and human capital in influencing regional patterns of growth below the state level. In turn, this may have implications for government policies at the national and state levels.

Using region and district level data, we find no evidence for divergence, but evidence for conditional convergence in some cases. At the region level, while partial measures of economic activity do not indicate any strong evidence for conditional convergence or divergence, there is clear evidence of conditional convergence in per capita consumption levels. Three points are noteworthy in these results. First, the convergence result is strongest for urban households. Second, the main significant conditioning variable is petrol consumption, which could be an indicator of the quality and quantity of road infrastructure (and which could also be related to access to urban areas). Third, dummy variables for the poorer states do not indicate that they were doing worse than the benchmark average state (Andhra Pradesh), though some of the regions with the largest negative residuals were in the poorer states.



The district level results also indicate conditional convergence, but not absolute convergence. The conditioning variables used are measures of roads, literacy and credit, so the results are supportive of the importance of infrastructure and human development, as well as access to finance. These results are quite robust across a wide variety of specifications, and are consistent with a well-understood model of development, that emphasizes human capabilities and appropriate access to markets as determinants of growth. This study can be used to identify districts which require additional policy intervention along the three dimensions used, as well as districts where the performance is worse than the average, even after conditioning on development measures. In the latter case, social backwardness or policy implementation shortcomings may be the problem. The results for conditional convergence hold across states, as well as within most of the states in the sample, indicating that attention to improving these variables in districts where they are at relatively low levels can have a growth payoff, and improve the inclusiveness of growth, as measured by convergence of income levels across geographic regions.

REGIONAL INEQUALITY IN INDIA IN THE 1990S: TRENDS AND POLICY IMPLICATIONS

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1. Introduction: Issues and Policy Relevance

There are concerns that regional inequality in India has been increasing after the economic reforms that began in 1991. These concerns are supported by several statistical analyses, conducted mostly with state level data, which show that per capita state domestic products – already highly unequal – are moving further apart. However, state-level analysis does not reveal anything about what might be taking place in different regions within states. On the one hand, the state, as the main subnational political unit in India, is an appealing level of analysis. Intergovernmental transfers are decided in terms of allocations to the states, they have strong cultural identities, and they are strong political units, with considerable powers assigned to them by the Constitution of India.

On the other hand, states are in some ways too large to allow a full understanding of regional patterns of economic activity and development. India's larger states would rank high among the world's countries, ranked by population. Even the medium-sized states have populations larger than many European nations. Many of India's states are also quite heterogeneous, despite strong degrees of linguistic and cultural homogeneity. Within-state heterogeneity arises in characteristics such as geographic features, degree of urbanization, infrastructure, and human development. Solely focusing on differences in economic development across states misses these aspects of initial conditions and development potential and patterns.

Of course, national government policy has recognized the need to operate at more decentralized levels. Administrative structures have long emphasized the district and *taluk* (block) as significant units of governance. In the last decade, major constitutional amendments have sought to develop more autonomous and effective local governments, both rural and urban. Nevertheless, systematic empirical examinations of regional inequality based on data below the state level have been extremely limited. This study seeks to correct this gap in existing empirical analysis, to provide a more fine-grained, quantifiable understanding of trends in regional inequality in India.

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In some ways, this analysis fills a key gap between academic analyses and policy understanding. Policy makers and implementers often have a deep understanding of conditions at the ground level. Politicians and bureaucrats operate within their geographic regions of responsibility, and accumulate considerable local knowledge. Academics have examined data at the district level in India, but often focusing on description or summary statistics, rather than formal, empirically-based causal analysis. Causal analysis has been chiefly aimed at state level data, which is more easily obtainable. This study therefore uses disaggregated data to provide an empirical causal analysis that can be instructive for policymakers at the national and state levels.

2. Theoretical Framework and Empirical Methodology

Our basic framework comes from the neoclassical economic theory of growth, which explains growth in terms of factor accumulation. If growth is expressed in per capita terms, and absent continual technical progress, diminishing returns to factor accumulation ensure that there is a long run steady state with constant per capita output, i.e., asymptotically, there is no growth in per capita output. Thus, economies starting with different factor endowments will converge to the same steady state, as long as there are no differences in technologies or other productive opportunities. If, instead, there is exogenous technological progress, then economies will grow at the rate dictated by this technological change. Typical neoclassical growth models (Barro and Sala-i-Martin, 1992, 1995) yield a log-linearization around the steady state of the form:

$$\ln y(t) - \ln y(0) = - (1 - e^{-\lambda t}) \ln y(0) + (1 - e^{-\lambda t}) \ln y^*$$

Here y is the measure of income or output per capita, and the parameter λ is the rate of convergence to the common steady state of the system.

If there are persistent differences in technologies, then long run convergence to a steady state still takes place, but these steady states can differ, their characteristics being conditional on the differences in productive potentials. Where faster growth is also affected by other variables besides initial income levels, the convergence is said to be conditional: in other words, a poorer country (or region) may converge to a steady state that is different

from that of the richer country (or region). Thus, one can identify three possible scenarios: absolute convergence, where different entities are moving toward the same steady state, conditional convergence, where they are converging to (possibly very) different steady states, and divergence, where there is no evidence of convergence. The last case is inconsistent with neoclassical growth models, but conceivably fits some endogenous growth models.¹ Note that conditional convergence is quite consistent with increasing disparities across entities. Variables such as literacy, health and physical infrastructure may be the conditioning variables, as well as the economic policies followed. Clearly, the conditioning variables themselves may be endogenous. However, if one uses these variables at their initial values, they are predetermined over the growth period being studied, and one can posit a causal relationship. The empirical implementation of a convergence regression, allowing for the impact of different initial conditions, then takes the following form:

$$\ln(y_{i,t}) - \ln(y_{i,t-\tau}) = \gamma \ln(y_{i,t-\tau}) + \sum_{j=1}^k \pi^j x^j_{i,t-\tau} + \mu_i + \varepsilon_{it}$$

Here, i denotes the cross-sectional units (countries, states, regions), τ the initial time period, t the final time period, the x^j are the various conditioning factors, and μ_i are possible additional fixed effects not captured by those factors. The parameter γ is approximately equal to the theoretical parameter λ , and therefore measures the rate of convergence if negative, or divergence if positive. The final term is an error component, reflecting unobservable factors. All our empirical estimations will be of this form.

Studies of convergence across countries have focused on catching up by poorer nations through faster growth. While the evidence for any type of convergence across disparate countries is quite weak, one might expect greater possibilities for convergence across similar regions or constituent units of a federation such as India. One problem with this conjecture, however, is that India itself is extremely large and heterogeneous, and state-level convergence regressions, even when restricted to the 14 'major' states, are subject to some of the same potential shortcomings as cross-country

¹ The bibliography provides extensive references on neoclassical and endogenous growth theory and empirical applications to convergence issues.

regressions. As will be seen from a review of state-level studies in the next section, divergence across states may be a serious issue for India. At the same time, we have relatively little empirical knowledge of how patterns of growth have been shaping up at the level of geographic regions smaller than the states.

3. State-Level Convergence Studies

In one of the first studies of convergence within India, Cashin and Sahay (1996), examined data for the period 1961-91, thus excluding the reform period of the last decade and a half, but including the Rajiv Gandhi reform period of the 1980s. The analysis is performed on 20 states, thus including some of the special category states, which receive central transfers according to different, and typically much more generous, formulae than the major states. This is important to note because the authors use state disposable income per capita, adding in all central transfers, except for shared taxes, to SDP. They find some evidence for unconditional convergence in the period of analysis, with the strongest effect being identified in the 1961-71 decade. These results are not changed in essence by controlling for other variables. Furthermore, the results indicate much slower convergence than that found across regions of developed countries such as the US and Japan. This meant that cross-sectional dispersion of per capita incomes across states actually increased over the three decades studied, despite the inclusion of center-state transfers (though dispersion was greater when these were excluded). Cashin and Sahay also examine the role of internal migration in convergence, and find it to be weak.

Several analyses followed Cashin and Sahay. Rao and Sen (1997) argue that the inclusion of four special category states in the Cashin-Sahay sample muddies their analysis. Furthermore, they argue that adding of transfers to SDP involves some double counting. Finally, Rao and Sen also take issue with the analysis of the equalizing effect of transfers, arguing that excluding shared taxes gives misleading results. Cashin and Sahay's response, however, disputes these criticisms on empirical and conceptual grounds. Marjit and Mitra (1996) independently analyze a data set similar to Cashin and Sahay's,


but with different empirical methods: they argue that the evidence for convergence is weak. Ghosh, Marjit and Neogi (1998) also find evidence for divergence across states, over the period 1961-62 to 1995-96.

Nagaraj, Varoudakis and Véganzonès (NVV, 1998) examine data on 17 states for 1970-94 (including three special category states). They find no evidence for absolute convergence. Using panel data (rather than a cross-section as in Cashin-Sahay) and per capita SDP (excluding transfers), NVV find that there is evidence for conditional convergence, with the conditioning being done on the share of agriculture and the relative price of agricultural and manufactured goods. Adding infrastructure indicators substantially strengthens the estimated rate of conditional convergence. While NVV do not explicitly consider transfers, they emphasize the importance of infrastructure² and non-measured political and institutional factors (captured in state fixed effects) in explaining differences in steady state growth rates across states. To the extent that center-state transfers have a potential role in affecting these determinants of growth, they are important in this analysis.

Rao, Shand and Kalirajan (RSK, 1999) examine data for the 14 major states, for the period 1965-95, using SDP as the output measure. RSK find evidence for absolute as well as conditional divergence, a result that is quite robust across sub periods as well. They suggest that the speed of divergence increased in the last half-decade of their sample. However, this does not seem to be the decisive factor in explaining the difference from Cashin-Sahay: instead, the exclusion of special category states, and of center-state transfers are of greater importance. The differences in conditioning variables and estimation methodology from NVV (who use a fixed-effects panel model) may explain the difference in conditional convergence results between RSK and NVV. RSK emphasize the role of private investment in explaining growth differences across states. They find that private investment goes disproportionately to higher-income states, as well as to states that have higher per capita public expenditures.³ RSK also argue

² Ghosh and De (1998) and several other studies discussed in this section emphasize the role of various aspects of infrastructure in explaining differential growth performances across the states.

³ Marjit and Ghosh (2000) obtain results quite consistent to those of RSK, for the period 1970-96, using a slightly different sample of states and somewhat different data. Interestingly, they exclude most of the special category states 'endogenously', based on an outlier analysis. Commenting on Rao et al (1999), Subrahmanyam (1999) has argued for inclusion of capital formation, work participation and technology as factors influencing growth across states.



that explicit center-state transfers have had moderate impacts on interstate inequalities, and that these effects have been outweighed by implicit transfers through subsidized (public and private) lending and through interstate tax exportation.

Two other similar studies of possible convergence among India's states are those of Bajpai and Sachs (1999) and Aiyar (2001). The former study examines data for a sample of 19 states for 1961-93. For the sub-period 1961-71, they find some evidence of convergence, but not for later sub-periods or for the period as a whole. Allowing for conditional convergence does not qualitatively alter these results. Aiyar also uses the 19-state sample, for 1971-96. He finds weak evidence of absolute convergence for the 1970s, but divergence for later sub-periods (especially the 1990s), as well as for the overall period. He estimates a panel with fixed effects, as do NVV, in which he does find evidence of conditional convergence. His conclusions are similar to those of NVV and RSK, emphasizing the importance of infrastructure, private investment, and non-measured institutional factors.

Singh and Srinivasan (2005) examined the effects of foreign direct investment (FDI), as well as credit availability, in state-level convergence regressions (Table 1). They obtain several interesting results. First, the evidence for convergence or divergence is inconclusive, since the coefficient of base-year GDP is never significantly different from one.⁴ Second, any one of the financial variables taken individually is estimated to have a significant impact on growth of GDP. When two or more financial variables are included, there is evidence of multicollinearity, but otherwise the results are robust. They are consistent with a story where domestic and foreign capital are complements, and with data on credit-deposit ratios and of FDI approvals (both suggesting greater regional concentration of credit and investment),⁵ the evidence is suggestive of mobile domestic and foreign capital driving growth.

⁴ This is true whether one uses a one-sided or two-sided test.

⁵ See Singh and Srinivasan (2005) for further details.

Table 1: State Level Growth Regressions**Dependent variable is log of 1998-99 per capita GDP
(t-statistics in parentheses)**


Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	-0.86 (-0.94)	-0.02 (-0.02)	-0.70 (-0.76)	-1.16 (-1.65)	0.13 (0.11)	0.84 (0.79)	1.18 (1.12)
1990-91 ln GDP per capita	1.14 (9.75)	1.02 (9.79)	1.08 (9.71)	1.14 (12.71)	0.96 (6.41)	0.90 (6.21)	0.85 (5.95)
FDI approvals p. c. 1991-2001		5.4E-05 (2.76)	2.4E-05 (0.81)		6.3E-06 (0.19)	3.3E-05 (1.25)	
Credit-deposit ratio 1990			0.35 (1.34)	0.52 (3.10)	0.33 (1.26)		
Credit per capita 1990					8.9E-05 (1.12)	9.7E-05 (1.19)	16.6E-05 (2.71)

Adabar (2005) uses data for the 14 major states of India from 1976-77 to 2000-01 and employs a dynamic fixed effects panel growth regression. Once per capita investment, population growth and human capital, along with state-specific effects are controlled for, he finds evidence of conditional convergence at the rate of about 12% per five-year span. Purfield (2006) also uses dynamic panel estimates with data for the 15 largest states for 1973/74–2002/03 (averaged over six non-overlapping five-year periods). She finds slow absolute convergence, somewhat faster conditional convergence, and, somewhat surprisingly, negative impacts on growth of the size of state government.⁶ Some of the other results are also puzzling, illustrating the difficulty of reaching definitive conclusions with state-level data.

4. Inter-State Inequality in India: Additional Perspectives

Ahluwalia (2000) examines the most recent data on the performance of India's states. He uses the Gini coefficient for the 14 major states, and finds that interstate inequality, after being stable for most of the 1980s, increased, starting from the late 1980s, and even more in the 1990s. Many of the factors that he identifies as affecting growth performance are those emphasized earlier by NVV and RSK, suggesting that the fundamental

⁶ Sinha and Sinha (2000) consider political stability at the state level, rather than size, and find that it has a positive impact on growth. They do not find any evidence of absolute or conditional convergence.



situation that India faced earlier in the reform period has persisted through the decade of the 1990s.⁷ Ahluwalia (2001) adds some simple regressions to his earlier analysis, but these do not change the overall analysis or conclusions.⁸


Dasgupta *et al* (2000), covering a period from 1960-61 to 1995-96, find a clearly diverging pattern amongst the states in terms of the coefficient of variation of per capita SDP as also the growth in per capita SDP. In terms of the rank correlation matrix (in respect of per capita SDP) as also the index of rank concordance, the position of states turned out remarkably stable for any chosen pair of years. The sectoral contribution, viz., from primary, secondary and tertiary sectors, to the overall divergence indicates that the divergence between states is least in terms of infrastructural development and largest with respect to agriculture. Considering the structural features defined in terms of sectoral shares, this study has, however, brought out a case against divergence.

Based on a careful review of a multitude of factors relating to demographic indicators, female literacy, SDP, poverty, development and non-development expenditure by state government, shares in plan outlay, investments, banking activities and infrastructure development, Kurian (2000) argues that the accelerated economic growth since the early 1980s with increased participation by the private sector has aggravated regional disparities. The ongoing economic reforms since 1991, with stabilization and deregulation policies as their prime instruments and a very significant role for the private sector, seem to have further accentuated the disparities.

By using a non-parametric kernel density for poverty estimation, Dhongde (2004) decomposes the changes in poverty across regions for the year 1999-00 and observes that differences in state and national poverty levels were largely explained by differences in the state and national mean income levels rather than differences in the state and national distributions

⁷ See also Shand and Bhide (2000) for further empirical analysis, including sectoral decompositions. Chaudhuri (2000) also profiles Indian states' growth experience, amplifying the work of Ahluwalia, and highlighting some of the differences between the 1990s and earlier decades.


⁸ Ahluwalia's regressions are effectively restricted versions of convergence regressions, with the parameter of initial income level set to zero.



of income. An important policy implication of the study is that states with extremely high levels of poverty would have reduced poverty significantly by raising their mean income levels to the national mean income, instead of changing their distribution of income to match the national income distribution. In other words, growth toward the average income level is more important for poverty reduction than redistribution toward the average distribution.

Lall and Chakravorty (2004) suggest that spatial inequality of industry location is the primary cause of spatial income inequality in developing nations. In this context, the contribution of economic geography factors to the cost structure of firms in eight industry sectors in India was examined and the local industrial diversity was found to have significant and substantial cost reducing effects. Since new private sector industrial investments in India are biased toward existing industrial and coastal districts while state industrial investments (in deep decline after structural reforms) are far less biased toward such districts, the study concludes that structural reforms lead to increased spatial inequality in industrialization, and therefore, in income.

Dholakia (2003) has examined the trends in regional disparity in economic and human development in India over the last two decades. His study points out that while per capita income does not show any significant trend in regional disparity over the last two decades, seven out of nine human development indicators display a declining trend in regional disparity. Similarly, 12 of the other 16 related social and human development indicators show a marked decline in regional disparity during 1981-91. The concept and measurement problems involved in Indian data on state domestic product are briefly discussed in Dholakia (2003) to point out the limitations of past studies on the subject. In a cross-sectional setting, Granger causality or precedence is tested by considering lags in the independent variable and interchanging the variables. Using this method, Dholakia (2003) finds a two-way causality between human and economic development. The structure of the relationship was found to be varying over time when human development indicators (HDIs) are the cause and per capita SDP is the effect, but in the reverse causality case, the structure



of the equations is stable over time. Moreover, HDIs have been found to positively influence per capita GDP with a lag of about eight years, whereas per capita GDP affects the HDIs within two years. Therefore, according to this analysis, emphasis on economic growth is likely to address the issue of twin disparities in income and human development in the shortest time. This analysis also suggests that emphasis on human development in states may lead to the postponement of rapid economic growth and also to some inefficiencies cropping up in the delivery of output, resulting in a further shifting of the structure of relationship between per capita GDP (effect) and HDIs (cause).⁹

Jha (2000) examines the empirical relationship between economic inequality, poverty and economic growth in the Indian states. Gini coefficient, real mean consumption and the head count ratio for rural and urban sectors and average for 14 major Indian states has been computed using NSS data on consumption for the 13th to the 53rd Rounds. The study finds that there is (conditional) convergence (in terms of levels) in inequality and poverty measures across states. The coefficients of variation do not show any tendency to fall over time. Based on the observation of a rising coefficient of variation of the rural head count ratio, the study points towards greater dispersion in rural poverty across states over time. Inequality was found to be acting as a constraint on growth in the states with high Gini coefficients as well with poor growth performance. Therefore, the author recommends that economic growth should be used for reduction of inequality and poverty. For equitable distribution of consumption, he suggests widespread tax reform to increase tax revenues and economic growth and make the tax structure more redistributive; improvement of efficiency of public expenditure and of the social safety net; and design of a good social sector policy framework promoting agricultural growth as opposed to non-agricultural growth, protecting the poor from the effects of macro-economic shocks and building up of pressure groups of the poor.

⁹ To the extent that the HDI better measures what we care about – including material standards of living as one component, in addition to access to basic needs – it could be argued that this tradeoff is tolerable, if not too steep. Note also that Singh et al (2003) find no evidence of divergence in HDI across states, for the 1990s. Choudhury (1993), in an earlier study, also finds that inter-state variations in consumption are less severe than those in income: again consumption may be preferable over income as a short-term measure of welfare.

5. Regional Inequality: Disaggregated Studies


Kurian (2000) has examined intra-state disparities and drawn attention to the fact that the newly created states develop faster than the pre-partition states. The study highlights a few successful cases where intra-state regional disparities were reduced considerably through public policies such as in Malabar region (Kerala), drought-prone districts of Haryana and the remotest villages of Himachal Pradesh. Tamil Nadu was identified as the most successful state in reducing intra-state disparities even with substantial variation in natural endowments across different parts of the state.

In an attempt to estimate the district health accounts in Karnataka for the year 1997-98, Annigeri (2003) observes that in terms of sources of funds, private funds account for about 52 per cent of the resources flowing into the district. Interestingly, both state and union governments are found to have spent less on medicines than on salary.

Gulmoto and Rajan (2002) have provided district level indirect estimates of birth and fertility rates for all districts of India using population aged 0-6 years as observed in 2001. While the fertility is lower than 3 children per woman for the southern and coastal states along with Punjab, Himachal Pradesh, Tripura and Manipur, high fertility districts (i.e., with more than 5 children per woman) are still widespread in north India. Nonetheless, there is evidence to believe that India is passing through the last phase of fertility transition, moving towards moderate to low fertility.

Debroy and Bhandari (2003) identify 69 backward districts based on six indicators, viz., poverty ratios, hunger, infant mortality rate, immunization, literacy rate and enrollment ratios. Sources of data include both primary and secondary sources. Each indicator throws up a set of districts. Based on poverty ratios, they find that backward districts are present, apart from the BIMARU states (Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh),¹⁰ in Gujarat,

¹⁰ This acronym was coined because of its similarity to the Hindi word *bimar*, meaning 'ill.' There are two points to note. First, the coinage was meant to apply to the undivided states, including, therefore, what are now the new states of Chhattisgarh, Jharkhand and Uttarakhand. Second, it excluded Orissa, which is in many ways in the same category of most backward or poorest states. In any case, the purpose of the current study is to go below these state-level characterizations, because seemingly better-off states such as Maharashtra, Karnataka and Andhra Pradesh may also have portions that are quite backward in terms of human and economic development.



Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and the North-East. Hunger has a similar spatial distribution with less universality and more concentration in the East and the North-East. Backward districts based on infant mortality rates are concentrated in the BIMARU states and Orissa with some presence in Karnataka and Andhra Pradesh. Lack of immunization was found to be prevalent in the BIMARU states. Districts with low literacy rates and enrollment ratios are found to be spread all over the country. Given that each indicator selected a different set of districts, a backward district has been defined by them as one which is backward as per four out of the above six indicators. The 69 districts so identified are distributed as follows: 26 in Bihar, 13 in UP, 10 each in Jharkhand¹¹ and Orissa, 6 in Madhya Pradesh, 3 in Arunachal Pradesh, and 1 in Karnataka.

Debroy and Bhandari (2003) observed that connections between 69 backward districts and the rest of the economy are grossly inadequate, with poor national highways, state highways and railway networks. Poor infrastructure deters the private sector, making development dependent on public funds. Flood problems in Bihar, UP and Orissa are also considered as the cause for their backwardness. Thus, addressing these two issues among others is crucial for uplift of these backward districts. As we shall see in subsequent sections, our district-level analysis provides a quantitative analysis of the the linkages informally explored by Debroy and Bhandari.

Using the estimation procedure of the NSS 55th round on variables for monthly household consumer expenditure and household size, Sastry (2003) has made district level poverty estimates, and shows that it is feasible to derive valid distributions for a majority of districts on the basis of Relative Standard Errors criteria. Finally, Singh et al. (2003) use NSS region level data to examine issues of convergence, though performance has to be measured by alternatives to income, which is not available at this level of disaggregation. This kind of data forms the basis for part of our analysis, and is discussed further in the next section.

¹¹ Given that Jharkhand was part of the undivided Bihar state (and therefore part of the BIMARU group), this count yields the remarkable fact that over half of the most backward districts of India are in that specific region, once, very long ago, the center of Indian civilization.

6. Data Description and Summary Indicators

We use two sets of data for the analysis conducted in this report. First, we use data from the National Sample Survey (NSS), which is at the level of agro-climatic regions. There are 78 such regions in India, but we have complete data for 59 regions, which forms the basis for the analysis here. This analysis extends the work of Singh et al (2003). The data used here include six variables: consumption expenditure, petrol sales, diesel sales, bank credit, bank deposits and cereal production. Consumption expenditure provides the broadest measure of economic activity among these. There are issues with respect to differences in data collection methodology across rounds, but we believe the analysis is still valid. In particular, since we are examining cross-sectional variation in growth rates, rather than time trends, data collection methodology changes are less important, and less likely to be a source of bias.

The most novel aspect of the analysis performed here is the use of district level data to conduct a convergence analysis of growth. We use data on district level domestic product (DDP), along with data on population, road kilometers, literacy rates, and credit and deposit levels. DDP data was obtained from individual state governments, credit and deposit levels from RBI regional offices, and the other variables from the Indian Census. The main data constraint was in availability of DDP data, and this restricted us to nine states. The relevant states are **highlighted** in Table 2, with some summary statistics. The nine states covered account for over 60 percent of the country's population and domestic product.¹² The sample states are on average slightly above the national average per capita NSDP. There is also some regional variation in the sample, although with relatively greater coverage of the southern states (4), followed by northern states (3) and one each from the west and east. Maps of the states with districts named as in 1991 are shown in Appendix 1. The data used are for 1991 and 2001, allowing a ten-year snapshot of growth across the districts in our sample.

¹² Missing data for some districts within Uttar Pradesh and West Bengal also slightly reduce the coverage of our sample.

Table 2: Basic Characteristics of States (2001)

	Area (Sq. Km)	Population (in '000)	Density of Popn.	NSDP 1999-00 Rs. Million	Per capita NSDP (1999-00)	Percentage of Total Area	Percentage of Total population	Percentage of Total NSDP
Andhra Pradesh	275000	75728	275.4	1117530	14878	8.36	7.37	7.9
Bihar	94000	82879	881.7	383260	4813	2.86	8.07	2.71
Chhattisgarh	135100	20796	153.9	213310	10405	4.11	2.02	1.51
Goa	3800	1344	353.7	58620	44613	0.12	0.13	0.41
Gujarat	196000	50597	258.1	896060	18685	5.96	4.93	6.33
Haryana	44000	21083	479.2	424880	21551	1.34	2.05	3
Jharkhand	79700	26909	337.6	232270	9223	2.42	2.62	1.64
Karnataka	192000	52734	274.7	862980	16654	5.84	5.13	6.1
Kerala	39000	31839	816.4	569260	17709	1.19	3.1	4.02
Madhya Pradesh	308000	60385	196.1	677780	11626	9.37	5.88	4.79
Maharashtra	308000	96752	314.1	2131510	22604	9.37	9.42	15.07
Orissa	156000	36707	235.3	311950	8733	4.75	3.57	2.21
Punjab	50000	24289	485.8	554700	23254	1.52	2.37	3.92
Rajasthan	342000	56473	165.1	710200	13046	10.4	5.5	5.02
Tamil Nadu	130000	62111	477.8	1143090	18623	3.95	6.05	8.08
Uttar Pradesh	241000	166053	689	1493520	9323	7.33	16.17	10.56
Uttarakhand*	53500	8480	158.5	na	na	1.63	0.83	0
West Bengal	89000	80221	901.4	1175070	14874	2.71	7.81	8.31
Special Category States	540500	55182	102.1	639300	12339	16.44	5.37	4.52
All States	3276600	1010562	308.4	13595290	14359	99.67	98.4	96.11
UTs	10974	16453	1499.3	549870	31211	0.33	1.6	3.89
States in Sample	1719500	654680	380.7	9757860	14905	52.3	63.75	68.98
Total	3287574	1027015	312.4	14145160	13778	100	100	100

Source: Rao and Singh, 2005, Table 4.1

* Uttarakhand is technically included in Uttar Pradesh for the decade analyzed, but the districts comprising it are not in our sample.

There are issues of comparability across states in DDP data, but this is addressed to some extent by analyzing the data state by state (in addition to pooling across states). Indira et al. (2002) looks at the 'far from settled' conceptual and availability issues of data on income and poverty estimates at the district level. It is based on discussions at a UNDP sponsored workshop in July 2001 to develop a common methodology for calculation of district level income and poverty estimates. Some issues that were debated and discussed are as follows. While some states limit district


income to commodity producing sectors ('district product') others include non-commodity producing sectors as well ('district income'). Animal husbandry needs to be clubbed with agriculture. District level prices need to be developed. Estimation of services is very difficult due to no estimates of income accrued in a district. Remittances from another state need to be distinguished from remittances from abroad. Thus, for various conceptual differences, DDP across states may not be strictly comparable. Issues relating to the definition, database and methodology to be used for estimation of poverty at the district level are also far from settled.

Despite the data comparability and other measurement issues, we would argue that district-level analysis still has validity. Certainly, individual-state regressions avoid issues of comparability across states. To some extent, comparability can also be handled by including state dummies in pooled regressions. Overall, we would argue that even imperfect measurement is better than none at all, and to the extent that biases in data can be identified, one can also point out potential biases in the results. Methodologically, it is also worth noting that measurement error in the dependent variable (here, DDP, which is most subject to data problems) does not lead to biased coefficients, only to greater imprecision. The omission of relevant explanatory variables in the regressions may therefore be a greater practical source of bias.

7. Analysis of NSS Regional Data

The NSSO divides the Indian states into 78 homogenous agro-economic regions that are groups of contiguous districts, demarcated on the basis of agro-climatic homogeneity. Each region is contained within a state or union territory. Together these regions cover all of India. For each region, Bhandari and Khare (2002) constructed an economic performance index based on five variables: petrol sales, diesel sales, bank credit, bank deposits and cereal production. They compared the years 1991-92 and 1998-99, and reported how each region did over this period, in terms of share of the overall economy.

The Bhandari-Khare calculations revealed several interesting patterns. First, a clear West-East divide emerges in their analysis, with the West



increasing its economic share. Second, there is no obvious North-South or coastal-inland divide. Third, most of the regions that do the best are centered on urban areas, which appear to be acting as growth poles. Fourth, many of the areas that lag are rain-fed agricultural regions, consistent with the general consensus that agriculture has been bypassed by the reform program to date.¹³ Fifth, Punjab, Haryana and Kerala do relatively well in this analysis (better than when per capita SDP is used as a measure of performance), consistent with a possible impact of international remittances for these states. Finally, while some states are doing consistently well, in terms of all regions within the state increasing their relative share (e.g., Karnataka, Kerala, Punjab and Haryana), there are other states with marked internal disparities in regional performance (e.g., Andhra Pradesh, Madhya Pradesh and Maharashtra). Thus, going down to the NSS region level provides a considerably more nuanced picture of the geographic patterns of economic change in the post-reform period.

Singh et al (2003) performed convergence analysis using the five individual components (diesel consumption, petrol consumption, credit, deposits, and cereal production) of the Bhandari-Khare index. Due to data gaps, 59 of the NSS regions were used for the regressions, covering all the 14 major states, plus Assam and Himachal Pradesh. Thus, the coverage at the region level exceeds what we are able to achieve in subsequent sections at the district level, which, on the other hand, provides greater disaggregation. Therefore, this tradeoff further justifies analysis at both levels. In the absence of dummies, growth of credit and diesel consumption show evidence of absolute divergence, while only the latter result persists when conditioning variables are included. Including zonal dummies for north, west and south completely removes any absolute or conditional divergence effects, but the three zonal dummies are all statistically significant (except in the case of cereal production), indicating otherwise unexplained differences in the growth processes across these zones of the country.

¹³ To the extent that rural India and poorer regions are lagging in relative shares of the economy, this picture is consistent with increasing regional inequality of economic outcomes. However, this is not a direct inference from the results of Bhandari-Khare, since they are given in terms of changing relative shares, not absolute performance. It should also be noted that agriculture's growth would in any case be slower in an economy undergoing development and structural change. Finally, the data do not cover the most recent period of rapid growth and the latest policy attempts to boost rural incomes.

Here we present a more detailed examination of interstate variation by including state level rather than zonal dummies. Andhra Pradesh is used as the base state, and its dummy variable is therefore omitted. The results are summarized in Table 3, with standard errors reported in parentheses below coefficient estimates. Statistically significant positive and negative coefficients (excluding the constant terms) are marked in blue and yellow respectively with asterisks. Of the five variables used to measure economic activity, two, namely petrol consumption and cereal production (each in per capita terms), indicate statistically significant evidence of conditional convergence. In each of the regressions, none of the economic variables used for conditioning are statistically significant, indicating that the initial conditions that influence growth performance are not being captured in this data set.


The chief variables of interest, however, are the state level dummies. In a cross-section regression with state-level data, there is limited scope to include such dummies. Here, we are able to examine the entire pattern of base-level growth differences across the states with dummies. We use Andhra Pradesh as the control state, as it is a state with an intermediate growth performance in the period under examination. Hence, each state dummy represents growth performance compared to Andhra Pradesh, controlling for all measurable effects with the data available. According to this criterion, we see that Assam, Orissa and Bihar are by far the worst performers among the states in the sample. All these states are in Eastern India. Orissa has statistically significant (at least at the 5% level) negative coefficients for all five of the variables, while the other two states have statistically significant coefficients for four of the variables – excluding deposits for Assam and cereal production for Bihar – though in each case the coefficients are still negative.

For each of Madhya Pradesh, Rajasthan and Uttar Pradesh, petrol consumption and credit are both negative and significant. Diesel and petrol consumption are both negative and significant for West Bengal. Gujarat, Haryana and Maharashtra each have a single negative and significant dummy coefficient among the five regressions, without any positive and significant coefficients. In the case of Kerala, the dummy in the cereal production regression is negative and significant, while the coefficient for the petrol

Table 3: Regional convergence of development indicators with state dummies

Dependent Variable Independent Variable	Diesel Consumption	Petrol Consumption	Deposits	Credit	Cereal Production
Constant	0.2776 (0.1593)	0.2093 (0.1075)	0.5190 (0.1537)	0.6987 (0.1848)	-0.2060 (0.4525)
Diesel Cons. 1991	-0.1086 (0.1160)	0.1374 (0.1038)	-0.0853 (0.0720)	-0.1672 (0.1084)	-0.1248 (0.2100)
Petrol Cons. 1991	0.0589 (0.0521)	-0.1619*** (0.0446)	-0.0068 (0.0478)	0.1281 (0.0770)	-0.1474 (0.1515)
Deposits 1991	-0.0345 (0.1132)	-0.0273 (0.0460)	0.0288 (0.0791)	0.0492 (0.1111)	0.0426 (0.3845)
Credit 1991	-0.0235 (0.1184)	0.0210 (0.0526)	-0.0704 (0.0818)	-0.0778 (0.1173)	0.0347 (0.3953)
Cereal 1991	-0.0183 (0.0459)	0.0458 (0.0471)	-0.0437 (0.0410)	-0.0619 (0.0536)	-0.2847** (0.1373)
Assam	-0.6696*** (0.1223)	-0.5985*** (0.0767)	-0.1406 (0.1029)	-0.4087*** (0.1310)	-0.6953* (0.3473)
Bihar	-0.3547*** (0.1149)	-0.5282*** (0.0686)	-0.3489*** (0.0954)	-0.5541*** (0.1520)	-0.5945 (0.3907)
Gujarat	0.1698 (0.1185)	-0.0200 (0.0501)	0.0578 (0.0900)	-0.2135** (0.0919)	-0.5650 (0.4086)
Haryana	0.1276 (0.1337)	-0.3456** (0.1507)	0.0706 (0.1202)	-0.1790 (0.1675)	0.4168 (0.2858)
Himachal Pradesh	0.6252*** (0.1342)	0.3600*** (0.0736)	0.5864*** (0.1126)	0.0254 (0.1361)	-0.0520 (0.4212)
Karnataka	0.0493 (0.0823)	-0.0489 (0.0683)	0.1638 (0.0911)	-0.0284 (0.1109)	0.0651 (0.2400)
Kerala	0.0231 (0.0865)	0.1915** (0.0799)	0.1963 (0.1028)	-0.0790 (0.1086)	-0.8768*** (0.2991)
Madhya Pradesh	-0.1876 (0.0999)	-0.3006*** (0.0519)	-0.1035 (0.0840)	-0.2463** (0.0968)	-0.0747 (0.2139)
Maharashtra	-0.1098 (0.0585)	-0.1612*** (0.0451)	0.0207 (0.0882)	-0.1112 (0.1043)	-0.4939 (0.2681)
Orissa	-0.2371** (0.1173)	-0.2124** (0.0869)	-0.5022** (0.1980)	-0.8034*** (0.1988)	-0.4095** (0.2049)
Punjab	0.0815 (0.1691)	0.0054 (0.1523)	-0.0547 (0.2010)	-0.2224 (0.2565)	0.8912** (0.4081)
Rajasthan	0.0441 (0.1061)	-0.1580** (0.0732)	-0.0864 (0.0783)	-0.2180* (0.1087)	-0.2098 (0.2334)
Tamil Nadu	0.0524 (0.0597)	0.1431 (0.1126)	0.1373 (0.0708)	0.1390 (0.0821)	0.1361 (0.2140)
Uttar Pradesh	-0.1948 (0.1032)	-0.3985*** (0.0567)	-0.1516 (0.0988)	-0.4706*** (0.1156)	-0.2176 (0.3798)
West Bengal	-0.2256** (0.0908)	-0.5017** (0.0573)	-0.1497 (0.0901)	-0.1796 (0.1061)	-0.1208 (0.3121)

Note: Standard errors are in parentheses. ***p<0.01, **p<0.05, *p<0.1



consumption regression is positive and significant. The only other positive and significant coefficients are for Punjab in the cereal production regression, and for Himachal Pradesh in the diesel and petrol consumption regressions and the deposits regression. Overall, therefore, the picture that emerges from these regressions is consistent with the view of the Eastern states and the BIMARU states as the worst performers in terms of economic growth. The caveat to this observation is that each individual performance measure only provides a very partial indicator of economic activity.

Further understanding of the growth performance of regions comes from examining the residuals for the different regressions. Table 4 summarizes the five best and worst performing regions in terms of magnitudes of negative residuals. A large negative residual indicates that a region does worse than would be predicted by the explanatory variables in the regressions. There is some degree of pairing among regions within states, for best and worst regions. This is a consequence of the inclusion of state level dummies in the regressions. However, the presence of certain states and not others within these extreme residuals is perhaps indicative of greater disparities within these states relative to other states. Other possible factors are the size of the state (larger states being more heterogeneous, with more regions) and greater heterogeneity independent of size (e.g., Maharashtra may be especially heterogeneous in terms of urbanization and climatic variety). Perhaps the most important observation is to note that some regions are among the worst performers, even controlling for the states they are in. In particular, Orissa is the worst performer in terms of credit and deposits, with the largest negative dummy coefficients, and Coastal Orissa is the worst performer, even beyond the state average. Other cases of extreme outliers appear to be Southern Orissa for diesel consumption, and Western Haryana for petrol consumption.

We also have data on personal consumption expenditure from the 50th and 55th rounds of the NSS, for rural, urban and all households.¹⁴ While these data are for 1993-94 and 1999-2000, they can be used to perform convergence regressions with the same conditioning variables that were used above. We present a sequence of results with this data. We also explore one

¹⁴ We are indebted to Laveesh Bhandari and Indicus Analytics for making this data available to us.



Table 4: Five largest positive and negative residuals

Dependent Variable	Diesel Consumption	Petrol Consumption	Deposits	Credit	Cereal Production
Best Regions					
	Northern Madhya Pradesh	Southern Tamil Nadu	Northern Orissa	Northern Orissa	Inland Eastern Karnataka
	Plains Southern Gujarat	Inland Eastern Karnataka	Northern Punjab	Jharkhand	Saurashtra Gujarat
	Southern Rajasthan	Coastal Orissa	Coastal Maharashtra	Northern Punjab	South Western Andhra Pradesh
	Malwa Madhya Pradesh	Central Madhya Pradesh	Inland Northern Andhra Pradesh	Coastal Maharashtra	Inland Western Maharashtra
	Northern Orissa	Eastern Haryana	Plains Southern Gujarat	South Madhya Pradesh	Inland Northern Maharashtra
Worst Regions					
	South Madhya Pradesh	Chhattisgarh	Coastal Orissa	Coastal Orissa	Inland Eastern Maharashtra
	Plains Northern Gujarat	Coastal Northern Tamil Nadu	Southern Punjab	Uttarakhand	Plains Southern Gujarat
	Chhattisgarh	Inland Northern Karnataka	Inland Northern Karnataka	Coastal and Ghata Karnataka	Southern Uttar Pradesh
	North Eastern Rajasthan	Western Rajasthan	Central Madhya Pradesh	Southern Punjab	Inland Southern Andhra Pradesh
	Southern Orissa	Western Haryana	Plains Northern Gujarat	Chhattisgarh	Inland Northern Karnataka

additional alternative in this case, calculating credit and deposits as ratios of consumption expenditure in addition to using them in per capita terms. This is more in line with typical measures of financial development as used in the literature on cross-country growth convergence. Estimation is carried out with linear regression allowing for heteroskedasticity-robust errors.

Table 5 presents results using the base specification, with credit and deposit estimated as per capita figures. For all households, the conditional convergence coefficient is negative and statistically significant, but small in magnitude, indicating slow convergence. The financial variables are insignificant, while the measures of economic activity captured in petrol and diesel consumption are the correct sign, and, in the case, of petrol, significant. The coefficient of cereal production has the wrong sign, and is marginally significant. For rural households alone, the evidence of conditional convergence is weaker. The financial variables have the wrong signs from what would have been expected (though this may be consistent with overall credit in a region being more reflective of urban credit). The other variables have coefficient signs, magnitudes and significance similar to the regression for all households. For urban households, the evidence for conditional convergence of consumption expenditure is somewhat stronger, and the financial variables have signs more in keeping with expectations (the negative sign for deposits is similar to that for district level data, and is discussed in the next section in that context).

Table 6 presents alternative results where the financial variables are calculated as ratios of consumption expenditure: some approximation is involved there because we use 1991 population data available to us rather than 1993 or 1994 data, to convert per capita consumption figures to totals. The scaling allows one to capture the idea that financial variables may simply track standards of living as measured by consumption, and provides a robustness check since some of the financial variables in Table 5 have signs opposite to what would have been expected. The results in Table 6 are qualitatively similar, however, suggesting that they are not sensitive to the particular specifications of the financial variables.

Tables 7 and 8 present corresponding results for the two different specifications in Tables 5 and 6, but now include state-level dummies as well. The conditioning variables have effects roughly similar to the previous regressions. As one would expect, now the conditional convergence speeds are somewhat higher, as a result of controlling for different base growth rates through the state dummies. The omitted dummy is for Andhra Pradesh. Only one of the state dummies is significant for urban households,

Table 5: Convergence Regressions: Per capita credit and deposits			
	All Households	Rural Households	Urban Households
	2001 consumption expenditure (all)	2001 consumption expenditure (rural)	2001 consumption expenditure (urban)
1993 Consn. Exp. (all)	-0.00078 * (0.0004)		
1993 Consn. Exp. (rural)		-0.00063 (0.0005)	
1993 Consn. Exp. (urban)			-0.0011 ** (0.0004)
1991 Deposit	-0.000038 (0.0002)	0.00032 ** (0.0002)	-0.00025 (0.0002)
1991 Credit	-0.00014 (0.0003)	-0.00095 *** (0.0003)	0.00028 (0.0003)
1991 Cereal	-0.24 * (0.1)	-0.28 * (0.2)	-0.15 (0.1)
1991 Petrol	0.30 *** (0.1)	0.32 ** (0.1)	0.28 *** (0.10)
1991 Diesel	0.023 (0.02)	0.026 (0.02)	0.0087 (0.03)
Constant	0.24 ** (0.1)	0.17 * (0.10)	0.52*** (0.2)
Observations	59	59	59
R-squared	0.28	0.29	0.38
F (6, 52)	4.75	8.19	3.77

Notes: All variables are per capita. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

but several are significant for rural households, and that holds true even more for the combined data. This is suggestive that differences across states in growth of per capita consumption expenditure – controlling for initial conditions – are greater for rural households.

We once again examine the outliers in terms of residuals, to see if there is any discernable pattern among the regions, after controlling for the measured factors we have used. These results are presented in Table 9. Comparing this with Table 4, we see that the pattern of best and worst districts is quite similar for consumption expenditure as for the other variables measuring

Table 6: Convergence Regressions: Credit and deposits scaled by consumption

	All Households	Rural Households	Urban Households
	2001 consumption expenditure (all)	2001 consumption expenditure (rural)	2001 consumption expenditure (urban)
1993 Consn. Exp. (all)	-0.00091 ** (0.0004)		
1993 Consn. Exp. (rural)		-0.00074 (0.0005)	
1993 Consn. Exp. (urban)			-0.0012 ** (0.0005)
1991 Deposits	-0.0035 (0.06)	0.14 ** (0.06)	-0.083 (0.07)
1991 Credit	-0.043 (0.1)	-0.39 *** (0.1)	0.15 (0.1)
1991 Cereal	-0.23 * (0.1)	-0.25 (0.2)	-0.13 (0.1)
1991 Petrol	0.26 ** (0.10)	0.26 ** (0.1)	0.21 ** (0.10)
1991 Diesel	0.028 (0.02)	0.031 (0.02)	0.013 (0.03)
Constant	0.27 *** (0.10)	0.21 ** (0.1)	0.53 *** (0.2)
Observations	59	59	59
R-squared	0.27	0.25	0.38
F (6, 52)	7.12	5.82	4.14

Notes: All variables are per capita. Deposit and credit are ratios of consumption. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

economic activity. In this case, one has the additional finding that the overall results are driven in most cases by the performance of the rural economy – this is exactly what one would expect at this level of geographic aggregation, and is a result that is difficult or impossible to obtain with state-level data.

We can summarize the results for the region-level data as follows. We estimated convergence regressions using various measures of economic activity such as petrol and diesel consumption, bank deposits and credit, and cereal production. These partial measures indicate no strong evidence

**Table 7: Convergence Regressions with State Dummies:
Per capita credit and deposits**

	All Households	Rural Households	Urban Households
	2001 consumption expenditure (all)	2001 consumption expenditure (rural)	2001 consumption expenditure (urban)
1993 Consn. Exp. (all)	-0.0018 *** (0.0004)		
1993 Consn. Exp. (rural)		-0.0020 *** (0.0004)	
1993 Consn. Exp. (urban)			-0.0021 *** (0.0003)
1991 Deposit	-0.000091 (0.0001)	0.00029 ** (0.0001)	-0.00021 (0.0002)
1991 Credit	0.00016 (0.0003)	-0.00078 *** (0.0003)	0.00024 (0.0003)
1991 Cereal	-0.46 (0.3)	-0.28 (0.3)	-0.22 (0.3)
1991 Petrol	0.29 ** (0.1)	0.26 ** (0.1)	0.44 *** (0.1)
1991 Diesel	0.033 (0.02)	0.048 *** (0.02)	0.010 (0.02)
Assam	0.048 (0.08)	0.13 (0.09)	0.12 * (0.07)
Bihar	0.041 (0.08)	0.11 (0.1)	-0.090 (0.06)
Gujarat	0.065 (0.09)	0.13 (0.09)	0.011 (0.08)
Haryana	0.36 * (0.2)	0.36 (0.2)	0.074 (0.2)
Himachal Pradesh	0.40 *** (0.07)	0.48 *** (0.09)	0.64 *** (0.1)
Karnataka	0.11 (0.08)	0.21 ** (0.1)	-0.028 (0.07)
Kerala	0.27 ** (0.1)	0.44 *** (0.1)	0.025 (0.1)
Madhya Pradesh	0.042 (0.08)	0.056 (0.10)	0.0077 (0.06)
Maharashtra	0.070 (0.07)	0.11 (0.09)	-0.0088 (0.08)
Orissa	-0.045 (0.1)	0.0026 (0.1)	-0.077 (0.08)
Punjab	0.29 (0.3)	0.20 (0.3)	0.0055 (0.2)
Rajasthan	0.14 * (0.07)	0.18 ** (0.09)	0.057 (0.07)
Tamil Nadu	0.17 ** (0.08)	0.19 ** (0.08)	0.14 (0.09)
Uttar Pradesh	0.16 * (0.09)	0.20 * (0.1)	-0.010 (0.06)
West Bengal	0.13 * (0.08)	0.19 ** (0.09)	0.13 (0.08)
Constant	0.47 *** (0.1)	0.34 ** (0.1)	0.84 *** (0.1)
Observations	59	59	59
R-squared	0.62	0.67	0.70
F (20, 37)	4.75	8.19	3.77

Notes: All variables are per capita. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

**Table 8: Convergence Regressions with State Dummies:
Credit and deposits scaled by consumption**

	All Households	Rural Households	Urban Households
	2001 consumption expenditure (all)	2001 consumption expenditure (rural)	2001 consumption expenditure (urban)
1993 Consn. Exp. (all)	-0.0019 *** (0.0004)		
1993 Consn. Exp. (rural)		-0.0021 *** (0.0004)	
1993 Consn. Exp. (urban)			-0.0021 *** (0.0003)
1991 Deposit	-0.054 (0.06)	0.12 * (0.06)	-0.079 (0.08)
1991 Credit	0.11 (0.1)	-0.31 ** (0.1)	0.12 (0.2)
1991 Cereal	-0.47 (0.3)	-0.25 (0.3)	-0.22 (0.3)
1991 Petrol	0.26 * (0.1)	0.23 * (0.1)	0.40 *** (0.1)
1991 Diesel	0.036 * (0.02)	0.045 ** (0.02)	0.014 (0.02)
Assam	0.056 (0.08)	0.12 (0.09)	0.13 * (0.07)
Bihar	0.052 (0.08)	0.073 (0.1)	-0.080 (0.06)
Gujarat	0.074 (0.09)	0.14 (0.09)	0.026 (0.08)
Haryana	0.37 * (0.2)	0.37 * (0.2)	0.086 (0.2)
Himachal Pradesh	0.42 *** (0.07)	0.47 *** (0.09)	0.67 *** (0.1)
Karnataka	0.11 (0.08)	0.21 ** (0.1)	-0.022 (0.07)
Kerala	0.28 *** (0.1)	0.46 *** (0.1)	0.037 (0.1)
Madhya Pradesh	0.047 (0.08)	0.043 (0.10)	0.015 (0.06)
Maharashtra	0.077 (0.07)	0.085 (0.09)	-0.00060 (0.08)
Orissa	-0.041 (0.1)	-0.021 (0.1)	-0.071 (0.08)
Punjab	0.31 (0.3)	0.24 (0.3)	0.021 (0.2)
Rajasthan	0.14 * (0.08)	0.18 * (0.09)	0.065 (0.08)
Tamil Nadu	0.16 * (0.08)	0.20 ** (0.08)	0.14 (0.09)
Uttar Pradesh	0.17 * (0.09)	0.19 * (0.1)	0.00045 (0.06)
West Bengal	0.14 * (0.07)	0.17 * (0.09)	0.13 * (0.08)
Constant	0.46 *** (0.1)	0.42 *** (0.1)	0.85 *** (0.1)
Observations	59	59	59
R-squared	0.62	0.65	0.70
F (20, 37)	4.75	8.19	3.77

Notes: All variables are per capita. Deposit and credit are ratios of consumption. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1



Table 9: Five largest positive and negative residuals (consumption regressions)

Dependent Variable	Consumption expenditure All households	Consumption expenditure Rural households	Consumption expenditure Urban households
Best Regions			
	Coastal Andhra Pradesh	Coastal Andhra Pradesh	Southern Tamil Nadu
	Coastal Orissa	Coastal Orissa	Eastern Maharashtra
	Central Madhya Pradesh	Inland Eastern Karnataka	Southern Rajasthan
	Southern Tamil Nadu	Southern Uttar Pradesh	Plains Southern Gujarat
	Plains Southern Gujarat	South Western Madhya Pradesh	Southern Kerala
Worst Regions			
	Eastern Gujarat	Southern Orissa	Inland Central Maharashtra
	South Madhya Pradesh	South Madhya Pradesh	South Eastern Rajasthan
	Southern Orissa	Eastern Gujarat	Inland Tamil Nadu
	South Western Andhra Pradesh	Chhattisgarh Madhya Pradesh	Northern Kerala
	Chhattisgarh Madhya Pradesh	Inland Southern Andhra Pradesh	Himalayan West Bengal

of conditional convergence or divergence across the 59 agro-climatic regions covered in the sample. However, several states have significantly negative dummy coefficients, indicating that their performance is markedly below that of the benchmark state (Andhra Pradesh), and these states are chiefly the poorer ones of Bihar, Orissa and Uttar Pradesh. In these regressions, the financial variables are not significant explanators of performance. We are also able to identify regions which are the worst performers in the sense of being furthest below the regression line (and therefore doing worse than would be predicted based on initial conditions as measured): these

are chiefly, though not exclusively, in poorer states, or likely to be poorer regions of states.


Similar regressions are performed for region-level data, using per capita consumption expenditure as the dependent variable. Consumption expenditure is an appealing measure of well-being, though it is not the outcome variable that fits with the standard growth model – that would be income, which includes saving as well. Interestingly, in contrast to simple inequality measures, which suggest that urban inequality has been increasing, here we find that the strongest conditional convergence effect occurs for urban households. There is weaker conditional convergence for rural households, but for all households the convergence result is still quite strong.

Of the conditioning variables, the only strong and clear effect comes from initial petrol consumption, which may plausibly be an indicator of the quality and quantity of road infrastructure in the regions. This result can therefore be considered in conjunction with the impact of road kilometers per capita, to be considered in the district-level regressions. The financial variables are either insignificant, or sometimes have the wrong signs (compared to what would be expected) for rural households – this might be an indication of problems with channeling credit to rural areas for improving standards of living, or it may simply be an indicator that bank credit is not meant to improve rural consumption outcomes. Nevertheless, the negative and significant coefficient bears further investigation. In terms of state-level performance relative to the benchmark, the signs of the dummy coefficients are now actually less of a cause for concern: there are no negative and significant coefficients, and some of the poorer states have positive dummy coefficients. The worst regions in terms of residuals, however, do seem to be similar to the regressions with partial measures of economic activity.

8. District Level Analysis: Pooled Results

We first performed a convergence analysis for the entire data set, which consists of 210 districts spread across nine states.¹⁵ In addition to the

¹⁵ The original data set that was collected consisted of 215 districts, but after inspection, we omitted five districts where there appeared to be inconsistencies in the data. The regression results are not qualitatively affected by the omission or inclusion of these five districts, but individual residuals for the omitted districts were deemed to be unreliable, favoring exclusion from the analysis.



benefits of disaggregated analysis, there is a significant econometric advantage to working with district level data. Districts are much more homogeneous in size than are the states themselves. Hence, a cross-sectional analysis with district level data avoids the problem of unevenness in the underlying size of the units represented by different observations.¹⁶

While the pooled regressions constrain the coefficients to be equal across states, we can test for differences in error variances, and estimate the convergence regression with some form of generalized least squares (GLS). To mitigate various forms of heteroskedasticity, we employ Huber-White (robust) estimates of variance in some specifications. A likelihood ratio test rejects the null hypothesis that all the states in the sample have the same error variances. Hence we also employ the clustered, robust error estimator where the error variances have been clustered at state level. The basic absolute convergence regression is presented in columns 1 and 2 of Table 10. Column 1 features estimates using robust standard errors, while column 2 features clustered, robust errors. In particular, the estimates in the second method are robust to any type of correlation within the observations of each cluster (i.e., state).

We present both sets of estimates to check the robustness of our results. The results suggest no statistically significant indication of absolute convergence or divergence at the usual significance level. In general, we find that the coefficients across the two estimation methods (robust and robust cluster) are not qualitatively different in sign and statistical significance. It should be noted that the explanatory power of the absolute convergence regressions is extremely low: clearly, initial conditions beyond initial income levels matter for predicting future growth.

Later, we also perform regressions with state-level dummies included, to allow for differences across states in the base growth rates (as captured in the constant terms of the regression), while still restricting the impacts of initial conditions to be the same across states.

Table 10 (column 3) also presents results for absolute convergence, allowing for differences across the states. This is accomplished by including

¹⁶ This problem also exists in cross-country convergence regressions, where countries as disparate in size as India and Nepal will each be treated as equally influential observations in a regression.

Table 10: Pooled District Level Absolute Convergence Regressions

LHS = Growth	Robust Errors	Clustered Errors	State Dummies
	(1)	(2)	(3)
ln(DDP/Pop.)91	-0.11 (0.1)	-0.11 (0.2)	-0.36 ** (0.2)
Kerala			0.054 (0.04)
Karnataka			0.15 *** (0.05)
Maharashtra			-0.051 (0.04)
Punjab			0.072 (0.10)
Rajasthan			-0.21 *** (0.03)
Tamil Nadu			0.15 *** (0.04)
Uttar Pradesh			-0.41 *** (0.06)
West Bengal			0.054 (0.05)
Constant	1.24 (1.2)	1.24 (1.7)	3.52 ** (1.4)
Observations	210	210	210
R-squared	0.02	0.02	0.52

Note: Standard errors are in parentheses.*** p<0.01, ** p<0.05, * p<0.1

state level dummies to capture differences in base growth rates. The dummy for Andhra Pradesh is omitted, so it serves as the benchmark state. The results indicate significantly higher base growth for Karnataka and Tamil Nadu, and lower base growth for Rajasthan and Uttar Pradesh, relative to the benchmark state. Allowing for state dummies, even though it imposes the restriction that all states have the same convergence rate, increases the estimated convergence rate substantially, as well as dramatically increasing the explanatory power of the regression. The results in Table 10 illustrate the value of the disaggregated approach pursued in this analysis, since state-level regressions impose the restriction that the base growth rate is

Table 11: Pooled District Level Absolute Convergence Regressions with State Dummies and Interaction Terms

State	N	Convergence parameter	Constant
Andhra Pradesh	22	-0.11 (0.09)	1.38 * (0.8)
Kerala	14	0.067 (0.3)	-0.55 (2.5)
Karnataka	20	-0.20 (0.2)	1.91 (1.5)
Maharashtra	29	-0.59 * (0.3)	5.25 * (3.0)
Punjab	12	-0.51 ** (0.2)	4.66 ** (1.8)
Rajasthan	27	-0.28 ** (0.1)	2.22 * (1.2)
Tamil Nadu	20	0.17 * (0.1)	-1.41 (0.9)
Uttar Pradesh	50	-0.033 (0.1)	-0.052 (1.2)
West Bengal	16	0.26 (0.3)	-2.13 (2.2)
	N = 210		R-squared = 0.61

Note: Standard errors are in parentheses.*** p<0.01, ** p<0.05, * p<0.1

the same for all the states.¹⁷ It should be noted that allowing for state-level dummies also addresses to some extent data definition differences across the states. Hence, the low base growth rate for Uttar Pradesh may be partly due to data issues. However, without further data collection and analysis, it is impossible to isolate this effect.

It is also possible to extend the assumed differentiation across states further, by including interaction terms as well as state dummies. Table 11 presents results for absolute convergence, with state level dummies, and interacting these dummies with initial year DDP per capita (in logarithms),

¹⁷ At most, one can include something like zonal dummies (e.g., for north, south, east and west), but unless a panel is used, the degrees of freedom are very limited in state-level regressions.

to capture differences in convergence speeds. In this case, rather than omitting Andhra Pradesh, we omit the overall constant term for symmetry, so that each state has dummy coefficients. Allowing for differing convergence rates across states changes the earlier results quite a bit. The results in Table 11 indicate higher base growth for Punjab, and to some extent Andhra Pradesh, Maharashtra and Rajasthan. The interaction terms indicate faster convergence for Punjab and Rajasthan, and to some extent Maharashtra, but also suggest weak evidence for divergence of districts within Tamil Nadu. Note that this regression is similar in effect to running separate regressions for the individual states, which we also present later in the report, but it imposes additional restrictions on the error structure, vis-à-vis single-state regressions. The results in Table 11 further illustrate the value of the disaggregated approach pursued in this analysis, since state-level regressions impose the restriction that the convergence rate is the same for all the states.

Next, we turn to conditional convergence regressions. These regressions, by using conditioning variables other than initial year DDP per capita, provide information on what aspects of initial conditions are supportive of growth, and what their impact may be. We use three categories of conditioning variables. First, we include district road kilometers as a measure of physical infrastructure. To allow for differences in area across districts, we normalize the total road kilometers by the district area. Second, we include literacy rates as a measure of human capital. Third, we include either credit per capita and deposits per capita, or a single credit-deposit ratio, in either case measuring district-level availability of financial capital or financial development. Another way to think about our conditioning variables is in terms of access to key aspects of economic activity. The road variable potentially measures access to markets, the literacy rate can be thought of as measuring access to jobs, and the financial variables capture access to credit. We would expect all the conditioning variables to have positive impacts on the level of economic growth.

Table 12 presents GLS (with the standard heteroskedasticity adjustment) results, as well as the results of cluster regressions: the alternative methods allow us to check robustness of the results across

Table 12: Pooled District Level Conditional Convergence Regressions				
(1)	GLS method		Cluster method	
	(2)	(3)	(4)	(5)
ln(DDP/Pop.) '91	-0.27 * (0.2)	-0.30 ** (0.1)	-0.27 (0.2)	-0.30 (0.2)
Roads/Area	-0.0034 (0.004)	0.0068 (0.009)	-0.0034 (0.008)	0.0068 (0.01)
Literacy '91	0.0059 *** (0.002)	0.0061 *** (0.002)	0.0059 * (0.003)	0.0061 * (0.003)
Credit/Pop. '91	4.95 *** (1.7)		4.95 ** (2.1)	
Deposits/Pop. '91	-2.24 ** (1.1)		-2.24 (1.6)	
Cred./Dep. '91		0.35 *** (0.09)		0.35 * (0.2)
Constant	2.39 * (1.3)	2.37 ** (1.2)	2.39 (1.9)	2.37 (1.5)
Observations	210	210	210	210
R-squared	0.20	0.27	0.20	0.27

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

different assumptions on the error terms. The table also presents results from two different specifications of the financial variables.

The two methods give the same coefficient estimates, but different sizes of standard errors. Estimates from both methods indicate conditional convergence, with the rates of convergence being very high: 35.5 percent and 20.7 percent respectively. This finding is in stark contrast to most state level studies, which find little or no evidence for conditional convergence, and never such rapid convergence. Note, however, that the sample excludes the states of Madhya Pradesh, Orissa and Bihar,¹⁸ where some of the most persistent pockets of poverty and underdevelopment are located. Thus the positive result with respect to convergence is not contradictory to other studies; rather, it suggests that problems of growing regional inequality may be geographically quite concentrated.

¹⁸ The period is such that Bihar would include Jharkhand and Madhya Pradesh would include Chhattisgarh.

The conditioning variables in Table 12 mostly have the expected signs. The density of road kilometers is not significant, but the literacy rate and the credit per capita are positive and significant at the 5 percent level or better. Thus, districts with greater human capital, and access to credit grew faster, according to these regressions. The methodology does not allow one to distinguish which of these factors might be most important – however, it is a plausible position that all of them go hand-in-hand in affecting growth. The negative coefficient on the deposits per capita is not consistent with the hypothesis that it measures one aspect of overall financial development. However, the variable may be proxying for an effect where a district is unable to absorb funds locally, as a result of other constraints. When the specification is modified to using the credit-deposit ratio as a sole measure of credit access and/or financial development, it is positive and significant.

In fact, the significance of the deposits per capita variable, and the minor puzzle of its negative sign, disappears when state level dummies are allowed for. Those results are presented in Table 13. Now the conditional convergence rate across districts is even higher, while the measures of financial access and human development all remain positive and significant. The measure of market access is marginally significant and of the wrong sign in the first specification, but this result is not robust to the alternative specification for the measure of financial access. The omitted state dummy is for Andhra Pradesh, which had an intermediate rate of growth in this period, among all the major states. Several of the state dummies are significant: Karnataka has a significant positive dummy coefficient (i.e., a base growth rate above that of the benchmark state, Andhra Pradesh), while Kerala, Maharashtra, Rajasthan and Uttar Pradesh have significant negative coefficients. There is still a minor puzzle in the Table 13 results, in that the variable measuring access to roads (road km. divided by district area) is negative and now also statistically significant in the first specification, with two separate financial development variables.

To examine the sensitivity of our results to the specification of the roads variable, we also estimated the equations in Tables 12 and 13 using total road kilometers instead (in logarithms). These results are presented in Tables 14 and 15. It may be seen in Table 14 that the alternative roads/

Table 13: Pooled District Level Conditional Convergence Regressions with State Dummies

	GLS method		Cluster method	
	(1)	(2)	(3)	(4)
ln(DDP/Pop.) '91	-0.51 *** (0.2)	-0.49 *** (0.2)	-0.51 ** (0.2)	-0.49 ** (0.2)
Roads/Area	-0.0086 * (0.004)	0.0023 (0.007)	-0.0086 * (0.004)	0.0023 (0.008)
Literacy '91	0.0074 ** (0.003)	0.0097 *** (0.003)	0.0074 * (0.004)	0.0097 ** (0.004)
Credit/Pop. '91	3.05 * (1.6)		3.05 * (1.6)	
Deposits/Pop. '91	-0.58 (1.0)		-0.58 (1.1)	
Cred./Dep. '91		0.20 ** (0.09)		0.20 ** (0.09)
Kerala	-0.30 ** (0.1)	-0.39 ** (0.2)	-0.30 (0.2)	-0.39 * (0.2)
Karnataka	0.14 *** (0.05)	0.15 *** (0.05)	0.14 *** (0.008)	0.15 *** (0.01)
Maharashtra	-0.17 *** (0.06)	-0.18 *** (0.06)	-0.17 *** (0.05)	-0.18 *** (0.05)
Punjab	0.028 (0.07)	0.039 (0.07)	0.028 (0.08)	0.039 (0.05)
Rajasthan	-0.17 *** (0.03)	-0.13 *** (0.04)	-0.17 *** (0.01)	-0.13 *** (0.03)
Tamil Nadu	-0.019 (0.06)	-0.070 (0.07)	-0.019 (0.06)	-0.070 (0.08)
Uttar Pradesh	-0.44 *** (0.06)	-0.38 *** (0.04)	-0.44 *** (0.06)	-0.38 *** (0.04)
West Bengal	-0.066 - (0.06)	0.013 (0.05)	-0.066 (0.06)	-0.013 (0.05)
Constant	4.59 *** (1.4)	4.17 *** (1.3)	4.59 ** (1.6)	4.17 ** (1.2)
Observations	210	210	210	210
R-squared	0.63	0.63	0.63	0.63

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

access variable is always of the expected sign and statistically significant, supporting the conjecture that access to roads matters for economic development. It is also the case that none of the other coefficients are qualitatively affected by the new specification of the roads variable, since the magnitudes and statistical significances are essentially the same as in Table 12. Some coefficients are higher (e.g., literacy), and some are lower (e.g., credit in the first specification), but these differences are not economically or statistically significant.

In Table 15, compared to Table 13, the puzzle of the sign of the roads variable disappears entirely, since in the alternative specification the logarithm of total road kilometers is always positive and statistically significant. Again, the coefficients of the other conditioning variables and the rates of convergence are essentially unchanged in this new specification.

Table 14: Pooled District Level Conditional Convergence Regressions (Total Road Kilometers)

	GLS method		Cluster method	
	(1)	(2)	(3)	(4)
Ln(DDP/Pop.) '91	-0.37 ** (0.2)	-0.36 ** (0.2)	-0.37 (0.2)	-0.36 ** (0.2)
Ln(Road Km.)	0.11 *** (0.03)	0.086 *** (0.03)	0.11 ** (0.04)	0.086 * (0.04)
Literacy '91	0.0061 *** (0.002)	0.0065 *** (0.002)	0.0061 ** (0.002)	0.0065 ** (0.003)
Credit/Pop. '91	4.68 *** (1.5)		4.68 ** (1.6)	
Deposits/Pop. '91	-1.72 (1.1)		-1.72 (1.2)	
Cred./Dep. '91		0.33 *** (0.08)		0.33 ** (0.1)
Constant	2.41 ** (1.2)	2.26 ** (1.1)	2.41 (1.8)	2.26 (1.4)
Observations	210	210	210	210
R-squared	0.27	0.31	0.27	0.31

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 15 : Pooled District Level Conditional Convergence Regressions with State Dummies (Total Road Kilometers)

	GLS method		Cluster method	
	(1)	(2)	(3)	(4)
Ln(DDP/Pop.) '91	-0.51 *** (0.2)	-0.49 *** (0.2)	-0.51 ** (0.2)	-0.49 ** (0.2)
Ln(Road Km.)	0.068 ** (0.03)	0.069 ** (0.03)	0.068 ** (0.03)	0.069 *** (0.02)
Literacy '91	0.0073 ** (0.003)	0.0099 *** (0.003)	0.0073 * (0.003)	0.0099 ** (0.004)
Credit/Pop. '91	2.59 * (1.6)		2.59 (1.5)	
Deposits/Pop. '91	-0.40 (1.0)		-0.40 (1.0)	
Cred./Dep. '91		0.22 *** (0.08)		0.22 ** (0.08)
Kerala	-0.19 * (0.1)	-0.31 ** (0.1)	-0.19 (0.1)	-0.31 (0.2)
Karnataka	0.25 *** (0.06)	0.24 *** (0.06)	0.25 *** (0.04)	0.24 *** (0.03)
Maharashtra	-0.13 ** (0.06)	-0.16 *** (0.06)	-0.13 ** (0.04)	-0.16 *** (0.04)
Punjab	0.056 (0.07)	0.067 (0.07)	0.056 (0.08)	0.067 (0.05)
Rajasthan	-0.086 * (0.05)	-0.050 (0.06)	-0.086 * (0.04)	-0.050 (0.04)
Tamil Nadu	0.061 (0.05)	-0.0070 (0.06)	0.061 (0.05)	-0.0070 (0.07)
Uttar Pradesh	-0.31 *** (0.06)	-0.25 *** (0.05)	-0.31 *** (0.04)	-0.25 *** (0.04)
West Bengal	0.058 (0.06)	0.10 * (0.06)	0.058 (0.04)	0.10 ** (0.05)
Constant	3.91 *** (1.2)	3.50 *** (1.1)	3.91 ** (1.4)	3.50 ** (1.1)
Observations	210	210	210	210
R-squared	0.64	0.64	0.64	0.64

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The coefficients of the state dummies, too, are mostly unaffected by the change. Three states do stand out, however. The coefficient for Rajasthan, by far the most sparsely populated state, is considerably reduced in magnitude, and is no longer consistently statistically significant. The coefficient for Kerala, the most densely populated state, also reduces in magnitude and in statistical significance. For West Bengal (also with a high population density), the coefficient actually switches in sign, and in the specification with a single financial development variable, it is now marginally statistically significant. These observations suggest that the relationship between road density and population density bears further investigation. It should also be borne in mind that some of the districts in the sample are heavily urban, which can also have implications for the measured relationship between road kilometers and economic activity and growth. This is also a subject for further investigation.

One aspect of the impact of financial depth or financial access on growth is the presence of large outliers in the data, namely cities which are financial centers. Table 16 presents the mean and the ten highest values for the credit-DDP ratio. These outliers may also be biased measures, because

Table 16 : Districts with Highest Credit-DDP Ratios

State	District	Credit-DDP Ratio
KNT	Dakshin Kannada	0.3441
PUN	Ludhiana	0.3988
UPR	Lucknow	0.4410
UPR	Kanpur Nagar	0.5591
KER	Ernakulam	0.5732
APR	Hyderabad	0.6149
KNT	Bangalore Urban	0.7495
MAH	Greater Bombay	1.0987
TND	Chennai	1.2926
WBN	Kolkata	1.9789
All Sample		0.1405

credit is obtained through corporate headquarters based in major cities, and counted there in the data, while investments are made in wider geographic areas. In that case, the impact of the credit-DDP variable might be understated in the previous estimates. On the other hand, if these outliers represent a true, strong effect of credit on local growth, then the strong positive coefficient of credit may be driven by these few observations, and therefore higher than if the outliers are omitted. We examine the robustness of the previous results by omitting the seven most extreme outliers as measured by the credit-DDP ratio.

The results for regressions omitting the credit outliers are presented in Table 17, for the standard GLS estimation method.¹⁹ We estimate the conditional convergence regression using the two alternative specifications of the credit and deposit variables. Comparing Table 17 with Table 12, we

**Table 17 : Pooled District Level Convergence Regressions
(Outliers Omitted)**

	(1)	(2)
ln(DDP/Pop.) '91	-0.35 (0.2)	-0.33 (0.2)
Roads/Area	0.061 (0.07)	0.099 (0.07)
Literacy '91	0.0054 * (0.003)	0.0056 * (0.003)
Credit/Pop. '91	17.1 * (8.4)	
Deposits/Pop. '91	-4.99 (2.8)	
Cred./Dep. '91		0.37 ** (0.2)
Constant	3.03 (2.1)	2.64 (1.6)
Observations	203	203
R-squared	0.24	0.28
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

¹⁹ The cluster method gives results that are not substantially different, and those are not reported.

note that the credit and deposit coefficients, or the ratio in the alternative specification, are all somewhat higher in magnitude when the outliers are omitted. However, the statistical significance of the coefficients tends to go down. The latter effect suggests that the outliers indeed were driving some of the earlier results. However, the signs and magnitudes of the coefficients in Table 15 suggest that the credit effect is present, even when the outliers are omitted. Importantly, all the other coefficients are extremely stable, in the sense that they are little changed by omitting the outliers. This supports the robustness of the earlier results with respect to convergence and the impact of human capital in particular on growth.

We also examine the robustness of the results to restricting the sample to the four southern states: Andhra Pradesh, Kerala, Karnataka and Tamil Nadu. These results are presented in Table 18. The convergence coefficients are smaller for this subsample, but are significantly different from zero. In the first specification, the roads variable is negative and significant, but that result is not robust to changing the specification of the financial variables. For the southern states, the literacy rate no longer matters in affecting convergence: this result is consistent with the higher and more even literacy rates in the southern states. Most importantly, the financial variables have the right signs in general, and are significant, indicating that financial access matters for growth. This conclusion is tempered slightly by the results in the last column of Table 18, where state dummies are added to the specification of column (1). Andhra Pradesh is the state with an excluded dummy, and therefore the benchmark. The financial variables have the correct signs, but are no longer significant. The dummy coefficients for Karnataka and Tamil Nadu are significant, indicating faster average growth in those states' districts.

Next, we explore the possibility that there are interactions among the conditioning variables. For example, there might be complementarities between access to credit and human capital, in positively affecting growth. In addition, there may be interactions between the conditioning variables and initial per capita DDP, in which case the speed of convergence will depend on the combination of initial conditions. These results are presented in Table 19, again for cluster estimates as well as an iterated GLS method which is

Table 18: Pooled District Level Convergence Regressions: Southern States Only			
	(1)	(2)	(3)
ln(DDP/Pop.) '91	-0.20 ** (0.09)	-0.14 * (0.08)	-0.18 * (0.1)
Roads/Area	-0.010 *** (0.004)	-0.0020 (0.003)	0.024 (0.04)
Literacy '91	-0.00063 (0.0008)	-0.00033 (0.0007)	-0.00069 (0.002)
Credit/Pop. '91	2.61 * (1.4)		1.30 (1.4)
Deposits/Pop. '91	-0.24 (1.5)		0.087 (1.8)
Cred./Dep. '91		0.13 *** (0.05)	
Kerala			0.11 (0.1)
Karnataka			0.18 ** (0.07)
Tamil Nadu			0.15 ** (0.06)
Constant	2.28 *** (0.8)	1.59 ** (0.7)	1.80 * (1.0)
Observations	76	76	76
R-squared	0.12	0.11	0.28

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

similar to maximum likelihood estimation.²⁰ We restrict attention to the specification that uses the credit-deposit ratio, as a measure of financial resource access. The results for the two estimation methods are qualitatively similar, though there are differences in magnitudes, and marginal differences in significance levels. Only the roads variable is robust to this change in specification, remaining positive and significant. The literacy and financial variables now both have negative signs.

²⁰ We also tried iterated GLS for several other specifications reported earlier, and found that the results were qualitatively similar to those from the standard heteroskedasticity-robust estimation, which we have mainly reported.

Furthermore, the interaction terms between the credit-deposit ratio and the roads and literacy measures are negative, though only significant in the iterated GLS estimation. The interpretation of these effects would be as follows. For example, given a particular level of road kilometers, an increase in the credit-deposit ratio has no significant direct effect, but reduces the positive impact of the roads measure on the growth rate. However, interpretation is complicated by the other interaction terms. Thus, the interaction between the credit-deposit ratio and initial per capita DDP is positive (though not statistically significant), implying an increase in the

Table 19: Pooled District Level Convergence Regressions, with Interaction Terms

	Iterated GLS	Cluster
	(1)	(2)
ln(DDP/Pop.) '91	0.50 (0.4)	0.88 (0.6)
ln(Roads) '91	1.32 *** (0.4)	2.23 ** (0.9)
Literacy '91	-0.020 (0.02)	-0.053 (0.05)
Cred./Dep. '91	-0.43 (1.1)	0.55 (2.4)
DDP91_road	-0.13 ** (0.05)	-0.23 ** (0.10)
DDP91_lit	0.0031 (0.002)	0.0086 * (0.004)
DDP91_fd	0.20 (0.1)	0.12 (0.3)
lit_road	-0.000079 (0.001)	-0.0013 (0.002)
lit_fd	-0.0043 * (0.002)	-0.011 (0.007)
road_fd	-0.12 * (0.06)	-0.093 (0.2)
Constant	-6.10 * (3.6)	-9.85 * (5.2)
Observations	210	210
R-squared	n.a.	0.40

Note: Standard errors are in parentheses. ***p<0.01, **P<0.05, *p<0.1

growth rate (and lower speed of convergence). In fact, the interaction of the roads variable with initial per capita DDP is negative and significant. Thus, the results seem to suggest that roads play an important role in increasing growth, and more so for initially poorer districts. Thus, the results in Table 19 tend to favor the importance of roads in equitable development.

One potential problem with the specification in Table 19 is that the interaction terms may make it difficult to isolate the impacts of the conditioning variables. An alternative specification allows for interactions, but of the state dummies with initial DDP per capita. Thus, rather than allowing base growth rates (the constant terms) to differ across states, as in Table 15, this specification admits the possibility that convergence rates differ across the states, beyond what is captured by differences in the infrastructure or access variables. The specification is therefore similar to that of Table 11, but with the inclusion of the conditioning variables. These results are presented in Table 20. Again, Andhra Pradesh serves as the benchmark state. Now all three conditioning variables are significant, with the expected positive signs. The interaction terms indicated that convergence was significantly slower than the benchmark state for Karnataka and for West Bengal, and faster for Maharashtra and Uttar Pradesh. These comparative rates of conditional convergence are thus somewhat different than the comparative rates of absolute convergence reported in Table 11.

The district level results presented so far use different data than the region-level analysis of the previous section. Hence, we also provide some analysis using data on the variables from region-level analysis, disaggregated to the district level.²¹ This results in some reduction in sample size, due to missing observations. Table 21 presents results for DDP per capita growth convergence regressions, with the addition of initial year petrol consumption and cereal production per capita as conditioning variables. The results are somewhat hard to interpret, in that the new variables have negative signs, suggesting that districts that were doing well in the base year, as measured by these two economic indicators, have grown more slowly over the subsequent decade. However, the results for the financial variables and for

²¹ We are grateful to the report referee, Laveesh Bhandari, for suggesting this exercise to link the two levels of analysis, and for providing us with the data.

Table 20: Pooled District Level Convergence Regressions, with State Dummy Interaction Terms

	Iterated GLS	Cluster
	(1)	(2)
ln(DDP/Pop.) '91	-0.28 *** (0.04)	-0.47 ** (0.2)
KER*DDP 91_ln	-0.016 ** (0.007)	-0.033 (0.02)
KNT*DDP 91_ln	0.025 *** (0.006)	0.029 *** (0.003)
MAH*DDP 91_ln	-0.018 ** (0.007)	-0.019 *** (0.005)
PNJ*DDP 91_ln	-0.00070 (0.004)	0.0065 (0.006)
RAJ*DDP 91_ln	-0.012 ** (0.005)	-0.0050 (0.005)
TND*DDP 91_ln	0.0056 (0.004)	0.00022 (0.008)
UPR*DDP 91_ln	-0.030 *** (0.006)	-0.028 *** (0.006)
WBG*DDP 91_ln	0.014 ** (0.006)	0.014 ** (0.005)
ln(Roads) '91	0.050 ** (0.02)	0.076 *** (0.02)
Literacy '91	0.0056 *** (0.001)	0.0098 ** (0.004)
Cred./Dep. '91	0.14 *** (0.03)	0.22 ** (0.08)
Constant	2.13 *** (0.4)	3.27 ** (1.1)
Observations	210	210
R-squared	n.a.	0.64

Note: Standard errors are in parentheses. ***p<0.01, **P<0.05

literacy rates are quite robust to the new specification. The results are also not very inconsistent with those in Table 5 of the previous section, with the exception of the sign of the coefficient of base-year petrol consumption.

Table 22 provides district level regressions for petrol growth and cereal growth, paralleling the region-level regressions of the previous section. At

Table 21 : Pooled District Level Convergence Regressions, with Additional Conditioning Variables

	(1)	(2)	(3)	(4)
ln(DDP/Pop.) '91	-0.14 ** (0.06)	-0.22 *** (0.06)	-0.31 *** (0.05)	-0.28 *** (0.05)
Roads/Area	-0.024 *** (0.007)	-0.012 *** (0.003)	-0.0076 (0.005)	-0.0039 (0.003)
Literacy '91	0.0040 *** (0.001)	0.0043 *** (0.001)	0.0025 * (0.001)	0.0040 *** (0.001)
Credit/Pop. '91	19.2 *** (4.6)		1.00 (3.0)	
Deposits/Pop. '91	-14.6 *** (3.7)		2.36 (2.5)	
Cred./Dep. '91		0.39 *** (0.07)		0.098 (0.07)
Petrol/Pop. '91	-0.0032 *** (0.0006)	-0.0029 *** (0.0006)	-0.0040 *** (0.0005)	-0.0038 *** (0.0005)
Cereal/Pop. '91	-1069 *** (218)	-981 *** (204)	-200 (170)	-347 ** (160)
Karnataka			0.13 ** (0.05)	0.14 *** (0.05)
Maharashtra			-0.067 (0.04)	-0.100 *** (0.04)
Rajasthan			-0.18 *** (0.03)	-0.16 *** (0.03)
Tamil Nadu			0.081 ** (0.04)	0.033 (0.04)
Uttar Pradesh			-0.38 *** (0.03)	-0.34 *** (0.03)
West Bengal			0.014 (0.03)	0.024 (0.03)
Constant	1.56 *** (0.5)	1.94 *** (0.5)	3.02 *** (0.4)	2.73 *** (0.4)
Observations	177	177	177	177
R-squared	0.52	0.55	0.77	0.77

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note : Kerala and Punjab are absent from this regression, since data on the added variables (cereal and petrol consumption) were not available for these states at the district level.

the district level, we are able to include the measures of human and physical capital that were not available at the region level. The results suggest conditional convergence, and the estimated impacts of literacy and road density are roughly in keeping with the regressions for DDP per capita growth that have formed the main focus of this section. In particular, the financial variables' estimated impacts seem to be quite robust compared to the DDP growth regressions, especially with the specification using the credit-deposit ratio.

Table 23 repeats the specifications of Table 22, but with state dummies included. The effect of this inclusion is somewhat similar to that in Table

**Table 22 : Pooled District Level Convergence Regressions:
Petrol and Cereal Growth**


Dependent Variable	Petrol Growth	Cereal Growth	Petrol Growth	Cereal Growth
	(1)	(2)	(3)	(4)
ln(Petrol) '91	-0.1 *** (0.02)		-0.11 *** (0.02)	
ln(Cereal) '91		-0.13 *** (0.04)		-0.14 *** (0.04)
Roads/Area	-0.0068 (0.007)	-0.090 *** (0.02)	-0.000085 (0.006)	-0.082 *** (0.02)
Literacy '91	0.0014 * (0.0008)	-0.0019 (0.003)	0.0015 ** (0.0007)	-0.0013 (0.003)
Credit/Pop. '91	2.65 ** (1.2)	7.37 (7.9)		
Deposits/Pop. '91	-1.28 (1.3)	-1.83 (6.3)		
Cred./Dep. '91			0.11 ** (0.05)	0.22 * (0.1)
Constant	-2.49 *** (0.3)	0.96 *** (0.3)	-2.54 *** (0.3)	0.87 ** (0.3)
Observations	207	177	207	177
R-squared	0.20	0.10	0.20	0.11

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

**Table 23 : Pooled District Level Convergence Regressions:
Petrol and Cereal Growth with State Dummies**

Dependent Variable	Petrol Growth	Cereal Growth	Petrol Growth	Cereal Growth
	(1)	(2)	(3)	(4)
ln(Petrol) '91	-0.11 *** (0.02)		-0.11 *** (0.02)	
ln(Cereal) '91		-0.051 (0.05)		-0.010 (0.07)
Roads/Area	0.019 (0.03)	-0.22 ** (0.1)	0.016 (0.03)	-0.23 ** (0.1)
Literacy '91	0.0024 (0.002)	0.0036 (0.004)	0.0031 * (0.002)	0.0023 (0.004)
Credit/Pop. '91	0.66 (1.9)	-12.9 (9.0)		
Deposits/Pop. '91	0.051 (1.8)	4.71 (7.0)		
Cred./Dep. '91			-0.0044 (0.06)	0.081 (0.2)
KER	-0.071 (0.10)		-0.11 (0.10)	
KNT	-0.0073 (0.06)	0.10 (0.2)	-0.0086 (0.06)	0.064 (0.2)
MAH	-0.037 (0.05)	-0.35 *** (0.1)	-0.051 (0.05)	-0.28 ** (0.1)
PNJ	-0.093 (0.2)		-0.100 (0.1)	
RAJ	0.14 ** (0.06)	-0.48 *** (0.2)	0.13 ** (0.06)	-0.43 *** (0.2)
TND	-0.034 (0.07)	-0.36 ** (0.2)	-0.045 (0.07)	-0.36 * (0.2)
UPR	-0.11 * (0.07)	-0.50 ** (0.2)	-0.12 * (0.07)	-0.46 ** (0.2)
WBG	-0.20 ** (0.08)	-0.42 * (0.2)	-0.22 *** (0.08)	-0.34 (0.2)
Constant	-2.60 *** (0.4)	2.24 *** (0.8)	-2.57 *** (0.4)	2.04 *** (0.8)
Observations	207	177	207	177
R-squared	0.34	0.23	0.34	0.22

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1



21, in which adding the state dummies reduced the significance of the conditioning variables. The result of adding state dummies in Tables 21-23 is thus somewhat different than was obtained in the base specifications of Tables 13 and 15, where the state dummies did not affect the significance of the conditioning variables. Since the effect of state dummies is greatest in the case of Table 23, this tampering of conclusions with respect to the conditioning variables applies chiefly to the growth of petrol and cereal consumption, rather than to overall growth as measured by DDP per capita.

Finally, in Table 24 we present the ten worst districts across the entire data set, based on the most negative residuals. Thus, these represent the districts that are furthest below the regression line, and are therefore districts which performed worse than would have been predicted based on the initial conditions incorporated in the regression. We present results from several alternative specifications in order to provide a sense of the robustness of the results. Variations in the lists indicate that different combinations of initial conditions may be more important in different districts. The results do not necessarily dictate policy responses, but are suggestive of where particular policy attention might be focused, if the objective is to make growth inclusive. Note that the first and fourth set of results for worst districts include state dummies in the specifications. Hence, poor performance relative to the regression line in these cases is relative to the average for that state. In the other two sets of results, poor performance is relative to the overall sample, but still controlling for initial conditions.

With the exception of some of the extreme cases, the ranking of the districts appears to be quite sensitive to the particular specification chosen. However, the signs of the residuals are mostly unaffected by the choice of specification. The poor performance of Uttar Pradesh shows up in Table 24, since many of the districts in each set of results are from that state. Of course, the state provides a significant fraction of the sample, but it is noteworthy that districts from Punjab, Tamil Nadu, and West Bengal are not featured in *any* of the four lists. The results for UP partly reflect the district-level data, which seem to indicate overall poor performance of the state, but note that the predominance of the state is robust to the inclusion of state



Table 24 : Ten Worst Districts Relative to Regression Line							
Table 13, col. (3) specification		Table 14, col. (3) specification		Table 21, col. (1) specification		Table 21, col. (3) specification	
State	District	State	District	State	District	State	District
MAH	Gadchiroli	MAH	Gadchiroli	APR	Hyderabad	KNT	Bidar
KNT	Bidar	UPR	Pratapgarh	RAJ	Kota	UPR	Jalor
UPR	Pratapgarh	UPR	Deoria	MAH	Nasik	APR	Adilabad
KER	Malappuram	UPR	Basti	UPR	Fatehpur	UPR	Pratapgarh
UPR	Basti	UPR	Ghazipur	UPR	Bijnor	MAH	Nasik
UPR	Ghazipur	UPR	Rae Bareilly	RAJ	Jalor	UPR	Basti
UPR	Deoria	UPR	Fatehpur	UPR	Pratapgarh	KNT	Chikmagalur
KNT	Uttar Kannad	UPR	Azamgarh	UPR	Agra	RAJ	Jaipur
UPR	Azamgarh	UPR	Faizabad	UPR	Rae Bareilly	KNT	UttarKannad
RAJ	Jalor	UPR	Bahraich	UPR	Jalaun	UPR	Bahraich

dummies. Examining the geographic distribution of the districts in the four lists (see Appendix 1: District Maps), there is no clear pattern, with the exception of UP. The districts identified as worst performers in this manner are concentrated in the eastern part of the state, which is known to be significantly poorer than the west. Unfortunately, we do not have data for Bihar in our sample, otherwise one might be able to clearly identify a region of worst performance, even after controlling for economic initial conditions.²²

To summarize, the implication of the residuals analysis is that the districts thus identified are doing worse or better than the average, conditional on observable variables included in the regressions. The reasons for deviation from the regression line may be random factors, or unobserved characteristics of those districts, including endogenous policy decisions. Hence, the residual analysis creates guidelines for further investigation of the causes of economic performance, on a case-by-case basis, or possibly for a focused regional strategy (for example, for the eastern Gangetic plain).

²² It is also important to note that there is some missing data, even for the states in our sample. In some cases, the data was simply not available, while in a handful of cases, the data did not seem reliable enough to us, and we omitted those districts as a result. Appendix 2 lists all the districts in our sample, and a comparison with the district maps allows determination of which districts are excluded. In particular, all the districts of Uttarakhand, shown in the district map as part of Uttar Pradesh, are excluded from our sample.

This section has presented a wide variety of specifications, all involving pooling of district level data. In closing it is useful to summarize what seem to be the main lessons. First, the district-level data for the states in our sample indicates evidence of conditional convergence. This is true across a variety of specifications, including ones without state-level dummies. Hence, the conditional convergence is across the states in the sample, and not just within states. At the same time, there is no evidence for absolute convergence. This result is important, because it suggests that there are identifiable initial conditions that can be affected by policy, and which influence the rate of growth. Hence, targeting these initial conditions provides a basis for policy that leads to more inclusive growth.

The most important and robust conditioning variable appears to be the credit-deposit ratio, as a measure of financial access and/or development. Good access to finance appears to be favorable to growth. Second, the literacy rate as a measure of basic human capital, also appears to have an important positive impact on subsequent growth, though this result is somewhat less robust to alternative specifications. Finally, road density as a measure of market access or physical infrastructure in general appears not to have a positive impact on subsequent growth. However, specifications with total road kilometers indicate that access as measured by that variable is a significant positive determinant of future growth. None of these results is surprising, but the empirical analysis presented here allows for an estimation of quantitative impacts, as well as identification of districts where the growth performance lags beyond what is explainable by the conditioning variables used. As noted, our choice was limited by data availability, but the analysis suggests a two-pronged approach, based on first addressing straightforwardly observable growth determinants such as access to credit, education and markets, and, secondly, looking for special factors in particular districts or regions. These factors may include social structures, governance or agro climatic conditions.

9. District Level Analysis: Individual States

In this section, we present results for the individual states. In some cases, the number of observations is quite small (as few as 12 for Punjab, for example). Furthermore, intra-state variation in the dependent and

independent variables is much less in some cases than inter-state variation. Hence, the results for individual states are less strong, and the regressions are estimated less precisely. However, the differences across states are revealing, in that we impose no restrictions on equality of coefficients across the states. We first present results for each individual state, and then summarize some cross-state comparisons. Since the cluster and GLS techniques used for the pooled regressions are no longer relevant, we present only linear regression results, and we focus on the more parsimonious specification for the credit and deposit variables, using their ratio. However, standard errors are calculated to be robust to intra-state heteroskedasticity in the error terms. Note that, from a national perspective, even each state's absolute convergence regression can be interpreted as examining convergence conditional on the district being in that state, thereby reflecting state-specific factors that may not be directly measurable.

Andhra Pradesh

Absolute and conditional convergence regressions for Andhra Pradesh are presented in Table 25. The explanatory power of the overall regressions

	(1)	(2)
ln(DDP/Pop.) '91	-0.11 (0.09)	-0.24 (0.2)
Roads/Area		-0.0039 (0.004)
Literacy '91		0.0014 (0.004)
Cred./Dep. '91		0.29 (0.2)
Constant	1.38 (0.8)	2.23 * (1.2)
Observations	22	22
R-squared	0.05	0.24

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

is fairly low, and individual coefficients are never statistically significant. Hence, there is not too much one can say, except that Andhra Pradesh's intra-state growth pattern is not well-explained by the regression method used here. One can also assert that there is no obvious evidence for convergence or divergence within the state: although the estimated convergence coefficient is negative and quite large in magnitude, it is not estimated very precisely, and the confidence interval is quite wide. This is somewhat less true of the absolute convergence regression, and since the conditioning variables are insignificant, one may take the absolute convergence estimates as the best explanatory relationship given the data we have.

Karnataka

Absolute and conditional convergence regressions for Karnataka are presented in Table 26. The results have some interesting features not present at all in those for Andhra Pradesh, or the pooled regressions. In particular, the roads variable has the expected sign, and is significant at the 5 percent level. The conditional convergence coefficient is negative and very large in magnitude, and it is significant at the 10 percent level.

Table 26: Convergence Regressions for Karnataka		
	(1)	(2)
ln(DDP/Pop.) '91	-0.31 ** (0.1)	-0.50 * (0.3)
Roads/Area		1.31 ** (0.4)
Literacy '91		0.0048 (0.006)
Cred./Dep. '91		0.13 (0.3)
Constant	3.30 ** (1.3)	4.32 * (2.1)
Observations	20	20
R-squared	0.17	0.38
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

The absolute convergence coefficient is significant at the 5 percent level, but somewhat smaller in magnitude. This ranking of magnitudes of the two convergence coefficients is typical, though one might expect the standard error in the conditional convergence regression to be somewhat smaller. It is possible that eliminating the two insignificant conditioning variables, might yield the most effective specification of the intra-state growth comparisons.

Kerala

The results for Kerala are presented in Table 27. The sample size is now quite small, since Kerala has relatively few districts. The absolute convergence regression is a particularly poor fit. In the conditional convergence regression, the variables capturing infrastructure, human development or initial income are insignificant, but the credit variable is highly statistically significant in both specifications. In this case, there is no evidence for intra-state convergence or divergence, as opposed to the weak result in support of convergence for Andhra Pradesh, and stronger result for Karnataka.

Table 27: Convergence Regressions for Kerala

	(1)	(2)
ln(DDP/Pop.) '91	-0.046 (0.3)	0.086 (0.2)
Roads/Area		-0.043 (0.2)
Literacy '91		0.00063 (0.008)
Cred./Dep. '91		0.14 *** (0.04)
Constant	0.84 (2.5)	-0.47 (1.8)
Observations	14	14
R-squared	0.00	0.49
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Maharashtra

The results for Maharashtra are presented in Table 28. There are two striking features of the regressions. First, the convergence coefficient is extremely high in magnitude, and negative, indicating rapid convergence within the state. Second, the literacy variable is positive and highly significant in the conditional convergence regressions. The roads variable has the right sign, though it is statistically insignificant, while the financial variable is significant at the 10 percent level, with the correct sign. Inclusion of the conditioning variables improves the significance of the convergence coefficient, in contrast to the previous three states. The overall explanatory power of the regression is quite high. Given the presence in Maharashtra of rich urban areas as well as very poor districts in the eastern part of the state, the convergence results are quite striking and bear further investigation.

Punjab

Results for Punjab are presented in Table 29. Like Maharashtra, Punjab displays high levels of convergence. This is less surprising in the case of Punjab, because it is a smaller state, more homogeneous to begin with. Much of the state is rural, but with a relatively even distribution of mid-sized towns

Table 28: Convergence Regressions for Maharashtra

	(1)	(2)
ln(DDP/Pop.) '91	-0.70 ** (0.3)	-0.78 *** (0.1)
Roads/Area		0.072 (0.05)
Literacy '91		0.025 *** (0.005)
Cred./Dep. '91		0.34 * (0.2)
Constant	6.63 ** (2.9)	5.53 *** (1.1)
Observations	29	29
R-squared	0.53	0.85

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1



Table 29: Convergence Regressions for Punjab

	(1)	(2)
ln(DDP/Pop.) '91	-0.62 *** (0.2)	-0.65 ** (0.2)
Roads/Area		0.037 (0.02)
Literacy '91		0.0031 * (0.002)
Cred./Dep. '91		0.14 (0.1)
Constant	6.04 *** (1.7)	6.02 ** (1.9)
Observations	12	12
R-squared	0.69	0.76

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

and economic activity. Even though the number of observations is small, the explanatory power of the regressions is quite high. The conditioning variables all have the right signs, though only literacy is significant, and only at the 10 percent level. Since the conditional convergence coefficient is quite similar in magnitude to the absolute convergence coefficient, one could argue that the absolute convergence regression may be the best descriptor of the growth pattern within Punjab given the data we have.

Rajasthan

The results for Rajasthan are presented in Table 30. They indicate strong evidence for rapid absolute and conditional convergence within the state, though the coefficients are not as large in magnitude as for Maharashtra and Punjab. Given Rajasthan's size and sparse population in its desert areas, and its relative poverty, the convergence results are quite striking. In the conditional convergence regression, all the conditioning variables have the correct signs. The physical infrastructure is somewhat close to being significant, while the human development indicator is significant at the 10 percent level. This latter result may be quite relevant for this state, given its tourism-based economy.



Table 30: Convergence Regressions for Rajasthan

	(1)	(2)
ln(DDP/Pop.) '91	-0.39 *** (0.09)	-0.49 *** (0.1)
Roads/Area		0.058 (0.4)
Literacy '91		0.0062 * (0.003)
Cred./Dep. '91		0.0074 (0.1)
Constant	3.60 *** (0.8)	4.25 *** (1.1)
Observations	27	27
R-squared	0.33	0.44

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Tamil Nadu

Results for Tamil Nadu are presented in Table 31. Both the absolute and conditional convergence regressions suggest that there may be some marginal divergence across districts in the state, though the coefficients are not statistically significant. Clearly, though, the growth pattern across districts is very different from the preceding three states' results summarized above. In fact, none of the coefficients in the conditional convergence regressions are significant, and the overall explanatory power is low.

It is worth noting that the four southern states, when examined individually, display quite different patterns of convergence. This observation may be contrasted with the pooled regression for these states, presented in Table 16 in the previous section. One could argue that the pooled regression is misspecified, since it imposes uniformity that is not justified. At the same time, one can argue that there is a regional economy, particularly for Kerala, Tamil Nadu and the southern part of Karnataka, which is better captured with a pooled regression. Clearly there is scope for further investigation of regional patterns of growth.



Table 31: Convergence Regressions for Tamil Nadu

	(1)	(2)
ln(DDP/Pop.) '91	0.057 (0.04)	0.073 (0.06)
Roads/Area		0.0049 (0.006)
Literacy '91		-0.00021 (0.002)
Cred./Dep. '91		-0.085 (0.08)
Constant	-0.023 (0.3)	-0.086 (0.5)
Observations	20	20
R-squared	0.06	0.17

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Uttar Pradesh

The results for Uttar Pradesh are presented in Table 32. Perhaps surprisingly, given the size, heterogeneity and relatively poor performance

Table 32: Convergence Regressions for Uttar Pradesh

	(1)	(2)
ln(DDP/Pop.) '91	-0.15 (0.09)	-0.25 * (0.1)
Roads/Area		-0.014 (0.06)
Literacy '91		0.0094 *** (0.002)
Cred./Dep. '91		0.21 (0.2)
Constant	1.33 (0.8)	1.76 * (1.0)
Observations	50	50
R-squared	0.07	0.25

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

of the state, there is some evidence for intra-state absolute as well as conditional convergence. The coefficients are not large in magnitude, but the conditional convergence coefficient is significant at the 10 percent level. There is also strong evidence that literacy is an important conditioning variable, while credit access has the expected sign, though it is not significant. One can conjecture that the literacy variable is more significant in states such as Uttar Pradesh, precisely because there is considerable intra-state variation in literacy, as opposed to the southern states.

West Bengal

Results for West Bengal are presented in Table 33. The absolute convergence regression is an extremely poor fit, but the conditional convergence regression dramatically improves the explanatory power. All of this improvement is due to the inclusion of the roads variable, which is significant at the 1 percent level in the conditional convergence specification. The conditional convergence coefficient is also significant at the 1 percent level, and is reasonable in magnitude. The other two conditioning variables have no explanatory power at all.

Table 33: Convergence Regressions for West Bengal

	(1)	(2)
ln(DDP/Pop.) '91	0.14 (0.2)	-0.34 *** (0.09)
Roads/Area		0.071 *** (0.007)
Literacy '91		0.00091 (0.002)
Cred./Dep. '91		-0.20 (0.1)
Constant	-0.75 (2.1)	3.43 *** (0.7)
Observations	16	16
R-squared	0.08	0.85
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Cross-state comparisons

A summary of the results for the nine states in the sample is provided in Tables 34 and 35. Table 34 also compares the individual state absolute convergence regressions with the pooled regression from Table 11. Note that the pooled regression uses dummies and interaction terms to allow the base growth rates and convergence coefficients to differ across states. Therefore the difference in the two sets of results can be attributed to differences in assumptions about error terms. The results are qualitatively quite similar, indicating that the pooled regression, imposing some homogeneity of error structure, but allowing the coefficients to be different across states, may be reasonable for the absolute convergence case.

Table 34: Pooled vs. individual regressions						
State	Separate Regressions		N	R ²	Combined Regression*	
	ln(DDP/Pop.) '91	Const.			ln(DDP/Pop.) '91	Const.
Andhra Pradesh	-0.11 (0.09)	1.38 (0.8)	22	0.05	-0.11 (0.09)	1.38 * (0.8)
Kerala	-0.046 (0.3)	0.84 (2.5)	14	0.00	0.067 (0.3)	-0.55 (2.5)
Karnataka	-0.31 ** (0.1)	3.30 ** (1.3)	20	0.17	-0.20 (0.2)	1.91 (1.5)
Maharashtra	-0.70 ** (0.3)	6.63 ** (2.9)	29	0.53	-0.59 * (0.3)	5.25 * (3.0)
Punjab	-0.62 *** (0.2)	6.04 *** (1.7)	12	0.69	-0.51 ** (0.2)	4.66 ** (1.8)
Rajasthan	-0.39 *** (0.09)	3.60 *** (0.8)	27	0.33	-0.28 ** (0.1)	2.22 * (1.2)
Tamil Nadu	0.057 (0.04)	-0.023 (0.3)	20	0.06	0.17 * (0.1)	-1.41 (0.9)
Uttar Pradesh	-0.15 (0.09)	1.33 (0.8)	50	0.07	-0.033 (0.1)	-0.052 (1.2)
West Bengal	0.14 (0.2)	-0.75 (2.1)	16	0.08	0.26 (0.3)	-2.13 (2.2)
					N = 210	R ² = 0.61

* In the combined regression, initial income is interacted with state dummies. Robust standard errors in parentheses.
 *** p<0.01, ** p<0.05, * p<0.1



Table 35: Summary of Individual State Conditional Convergence Regressions

State	Conditional Convergence	Road Kms./Area	Literacy Rate	Credit-Deposit Ratio
Andhra Pradesh				
Karnataka	yes	yes		
Kerala	yes			yes
Maharashtra	yes		yes	yes
Punjab	yes		yes	
Rajasthan	yes		yes	
Tamil Nadu				
Uttar Pradesh	yes		yes	
West Bengal	yes	yes		

In Table 35, based on the conditional convergence regressions, a 'yes' indicates significance at the 10 percent level or better. Blanks indicate no significant relationship for either specification. Two southern states in the sample, Andhra Pradesh and Tamil Nadu, are similar in that there are no statistically significant effects in the convergence regressions, and no significant evidence of convergence or divergence. Kerala is similar in the latter result, but the credit measure is significant for Kerala. In the case of Karnataka, there is evidence of convergence, as well as the importance of road infrastructure.

Of the other five states, the northern states of Punjab, Rajasthan and Uttar Pradesh do share boundaries, but are quite different in their economies and geography. Nevertheless, they all have similar results in that they display strong evidence for conditional convergence. In all three of these states literacy is a significant conditioning variable.

Maharashtra, the sole state in the west (though it shares a significant border with Karnataka), has the strongest evidence of conditional convergence, and both literacy and credit are positive and significant. In the case of West Bengal, the sole eastern state, the measure of physical infrastructure or market access, namely the density of road kilometers, is statistically significant, with the correct positive sign.

For Rajasthan and Uttar Pradesh, the results on literacy could be of particular interest, because both these states have been relatively poor. While the individual state regressions say nothing about relative state performance, they do suggest that income levels within the states are converging, i.e., poorer districts may be catching up. The results are also of interest for these two cases because both states are large, and have considerable intra-state diversity. The results suggest that it is not the case that certain regions in each state are growing faster than others, widening within-state inequality. This is also true for Maharashtra, which is much richer, but also very diverse, with a much poorer hinterland along with affluent western cities.

In Table 36, we summarize the best and worst districts for each state, in terms of residuals from the individual state absolute convergence regressions. Thus, a district with a large negative residual has done worse than the average, given its initial income levels, while a district with a large positive residual has done better than average, conditional on initial per capita income. As one might expect, many of the worst performing districts by this criterion lie in interior or remote regions, though this pattern is less relevant or applicable for states such as Kerala and Punjab. Districts that are centers of commercial activity, with thriving towns or cities, seem to do better than average, again as one would expect.

Table 36: Best and Worst Districts – Individual State Absolute Convergence Regressions

State	Andhra Pradesh	Karnataka	Kerala	Maharashtra	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal
Best Districts									
	Medak	Bangalore Rural	Wayanad	Greater Bombay	Hoshiarpur	Jaisalmer	Madurai	Bulandshahr	Kolkata
	West Godavari	Dakshin Kannada	Ernakulam	Pune	Ludhiana	Ajmer	Thanjavur	Sitapur	Purulia
Worst Districts									
	Adilabad	Gulbarga	Malappuram	Gadchiroli	Gurdaspur	Jalor	The Nilgiris	Barabanki	Bardhaman
	Kurnool	Bidar	Alapuzha	Nanded	Amritsar	Jhalawar	Dharmapuri	Fatehpur	Darjeeling

10. Policy Discussion

Recent economic policy in India has emphasized the idea of inclusive growth. In some ways, this is a return to the pre-liberalization conceptual framework, in that equity across the country and reduction of rural poverty have been receiving greater attention. Of course there has always been a governmental apparatus for addressing these issues, but they became more pressing with market-oriented economic reforms seeming to exacerbate inequalities, including regional inequalities. Much of the evidence for these trends came from very micro studies, or alternatively from comparisons across states through growth regressions. While the states are important political and policy-making entities, they are also large enough that focusing on state-level trends can miss out on more localized problems of relative or even absolute economic stagnation. This is where our study seeks to fill a gap.

Examining growth at the levels of NSSO regions and districts allows one to identify more closely the areas of good and poor performance within India. While we do not have data for all districts, the coverage is quite good, in that it includes a wide cross-section of states. There are two sorts of policy implications that can be drawn from the analysis. The first looks at the regression coefficients, and derives policy recommendations from the estimated average behavior. Thus, the district level convergence regressions are supportive of the view that improving literacy rates and road connectivity can be important factors in accelerating local growth. Similarly, there is evidence that credit access can have a positive impact on growth.

The second policy implication comes from identifying districts that are well below the estimated average relationships between growth and initial conditions. These districts may be suffering from other deficits, or particular obstructions that can potentially be identified and focused on through appropriate policy measures. Thus, the analysis allows an identification of different sets of policy recommendations for different situations at the district level.

The value of our study for policy-makers is therefore in (1) identifying types of investment that may improve the growth prospects of lagging regions


or districts, allowing better targeting by national and state-level policy makers; and (2) identifying specific districts or regions where economic performance is not fully or well explained by the initial conditions measured here, thereby suggesting where additional data collection and analysis may be beneficial.

We must also make clear the limitations of this study for policy-making. First, the set of variables used is not comprehensive, and additional broad data collection may lead to a more encompassing set of conditioning variables, which could change the policy conclusions. Social fragmentation, land systems and governance quality are all examples of factors that are likely to be important as growth determinants. Second, the analysis provides no guidance on the specific design of policies, or of institutions for policy implementation. Much of the criticism of Indian policies with respect to promoting inclusive growth has focused on issues of detailed policy design, and effectiveness of implementation. Our analysis cannot provide any lessons on how to improve literacy or improve access to credit: it merely confirms that these issues are important for understanding growth performance at a fine-grained level.

11. Conclusions

This study represents the first detailed growth analysis of Indian data below the state level. Since states in India are very large and heterogeneous, cross-state comparisons and growth regressions, of which there are many, can be of limited usefulness. This study extends previous growth analysis by examining the growth mechanisms within India at the district level, allowing a more refined understanding of India's regional disparities, and possible appropriate policy responses.

The study provides evidence that access to credit, literacy and access to roads all matter to some degree for growth, even when one examines growth performance at the district level. In many ways, the district is the most significant economic and administrative unit in the country, and mapping growth performance and determinants as we have done provides additional guidance for policy makers in terms of where to focus policy



attention. However, this empirical analysis cannot provide lessons on detailed policy design or implementation strategies.

Clearly, the study is also limited by the availability and quality of the data. Perhaps the most immediate lesson of the study is in pointing out the need for further and better data collection and for more detailed empirical analysis. Arguably, the success of India's push for inclusive growth will depend partly on better understanding of the factors that will make broad based growth more likely, and this study can be seen as an initial contribution to this effort.

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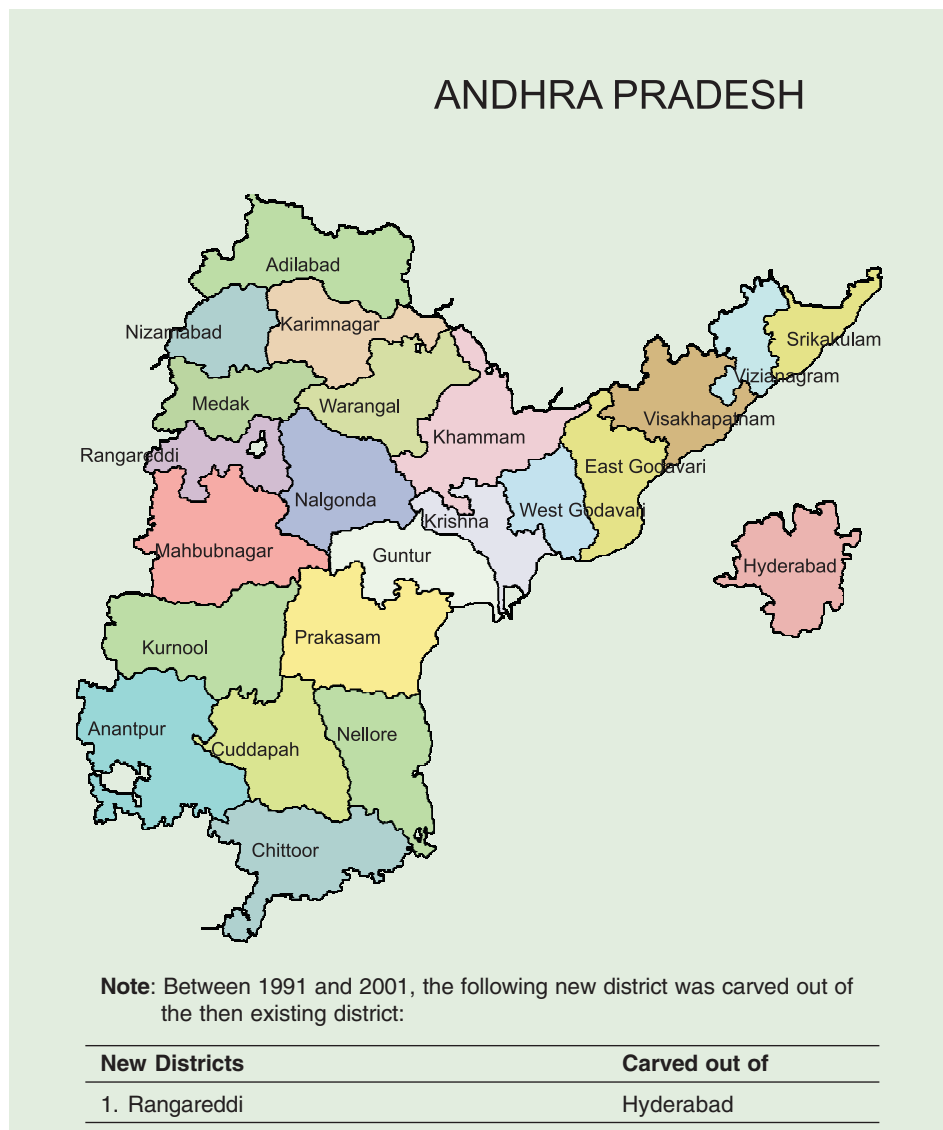
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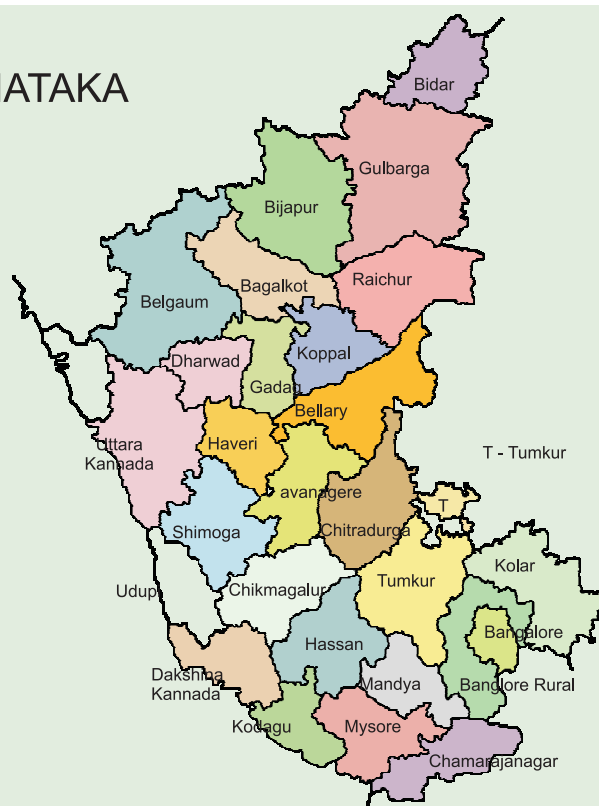
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Appendix 1: District Maps of States



KARNATAKA



Note: Between 1991 and 2001, the following new districts were carved out of the then existing districts:

New Districts	Carved out of
1. Chamarajanagar	Mysore
2. Davanagere	Chitradurga
3. Gadag	Dharwad
4. Haveri	Dharwad
5. Koppal	Raichur
6. Udupi	Dakshin Kannad
7. Bagalkote	Bijapur

