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The Dynamics of Income Growth and Poverty: Evidence from Districts in India

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This article examines the dynamics of the income-distribution pattern in India during the post-1991 economic reforms. It considers district-level per-capita income data across agriculture, manufacturing, services, and various constituent sub-sectors, and finds evidence in favour of a uniform process of growth across sectors and regions, which has helped to reduce poverty. In particular, the article finds that growth in agricultural income and access to finance are important for this.

Key words: Districts of India, income, poverty, twin peaks

1 Introduction

In 2004, the Congress-led United Progressive Alliance (UPA) came to power in India after defeating the National Democratic Alliance (NDA) government led by the Bharatiya Janata Party (BJP). This NDA defeat occurred in spite of the fact that the Indian economy was growing at a rate of 8.5% in 2003-4. A popular perception explaining the ousting of the then NDA government was its inability to check the rise in regional income inequality and the sluggish rate of poverty reduction.

How true is this perception about economic reform enhancing regional income disparity? In this article we examine whether income disparity across regions (districts) has changed since the reform, and the effectiveness of growth in reducing poverty, as measured by the Headcount Ratio (HCR). We use district-level per-capita income data spread across all economic sectors, namely, agriculture, manufacturing, and services, to examine the connection between growth and poverty. To our knowledge no attempt has been made to examine the dynamics of income distribution and growth-poverty interaction using such data from India. The aim of this article is to fill this gap in the literature.

If pan-India growth is not uniform, we would see the emergence of twin peaks in the underlying income-distribution function: a clustering of rich and poor districts, with pockets of economic growth pulling up the national average income. On the other hand, a uniform growth process at a pan-India level would lead to the disappearance of such clusters. This idea is in the spirit of work done by Quah (1993, 1996), who introduces the notion of twin peaks in the cross-country

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distribution of income and finds evidence of persistence, and stratification of income-density functions.[1] The emergence of twin peaks implies polarisation of the cross-country income distribution into rich and poor convergence groups.

Our results suggest that between 1999-2000 and 2005-6 there is no evidence supporting an emergence of twin peaks in the underlying income-distribution function: a clustering of rich and poor income districts.[2] The growth process is uniform. There has been a reduction in income disparity among districts and a fall in poverty. Although there has been an increase in per-capita district-level income but at a disaggregated level in the light of considering income data from agriculture, manufacturing, and services, we find that the growth of per-capita income is predominantly driven by the growth of the services sector alone.[3] The agriculture and manufacturing sectors have contributed marginally to the growth of per-capita income. We do find evidence of a bi-modal density function especially for the banking and insurance and telecommunications sectors. However, the overall per-capita income-density function remains unimodal.

As regards poverty, we find evidence of first-order stochastic dominance, suggesting that all districts experienced faster growth between 1999-2000 and 2005-6.[4] At a pan-India level, the HCR, measured as the proportion of the population living below the poverty line, fell from 36% in 1993-4 to 27.5% in 2004-5. India's official poverty lines in 1993-4 were Rs205.84 and Rs281.33 for rural and urban India, respectively. In 2004-5, they were Rs356.30 and Rs538.60 respectively (Ministry of Rural Development, 2012). Hence, it is important to examine whether this growth has been 'pro-poor' i.e., poverty-reducing.

Our findings suggest that agricultural income growth and access to finance are important for reducing district-level poverty (both urban and rural). The rest of the article is organised as follows. Section 2 discusses the literature survey. In Section 3 we state our empirical model. Section 4 contains a brief description of the data. Section 5 discusses results from our analysis. Section 6 concludes.

2 Related literature

There are a number of studies that indicate that India is spatially heterogeneous in terms of level of development. Singh et al. (2010) give a detailed account of this

1. Quah (1993) considers the log of per-capita income data for 118 countries between 1962 and 1985. Although our analysis contains data for a shorter time span, we argue that, given India's experience of rapid growth within this period (average annual growth rate exceeding 7% between 1999 and 2005), it might be possible to capture the emergence of any cluster in the underlying income-distribution function, especially at a sub-regional level.
2. We are referring to distribution of per-capita income across districts, and not within a particular district.
3. At a pan-India level, during the tenth five-year plan (2002-6) compound annualised growth rates of agriculture, manufacturing and services were 2%, 8% and 9.5%, respectively, according to the Central Statistical Organisation (CSO) (Government of India).
4. During the seventh five-year plan (1985-9), India's annual growth rate of gross domestic product (GDP) was around 5.5%. During the eighth five-year plan (1992-6) it increased to 6.5%, and during the tenth plan (2002-6) it increased further to 7.7% (CSO, Government of India).

literature. These studies merely stop at classifying districts and/or States on the basis of some development indicators without quantifying the linkages between the growth and development indicators. For instance, on the basis of the 1991 Census (Office of Registrar General and Census Commissioner, 1991), Kurian (2000) finds evidence of widening regional disparities when measured in terms of gender ratio (females per 1000 males), female literacy, infant mortality, and level of infrastructural development. He finds that the advanced group of States (Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab, and Tamil Nadu), with higher per-capita income, have moved ahead in terms of performance on the aforementioned parameters relative to the backward group of States (Assam, Bihar, Rajasthan, Uttar Pradesh and West Bengal), i.e., the States with lower per-capita income. On the basis of data obtained from the Planning Commission, Mehta (2003) finds that spatial inequalities exist at all levels of disaggregation; a given State may perform extremely well on all indicators but there may be districts within that State that are among the most deprived in the country, or a State may have very high levels of attainment on certain specific development indicator(s) but not on all of them.

More specifically, with regard to whether economic reforms have widened the gap between rich and poor States, we find mixed evidence. While comparing the growth performance of 14 major States during the pre-reform period (from 1980-81 to 1990-91) with the post-reform period (from 1991-2 to 1998-9), Ahluwalia (2002) finds that not all the rich States have become richer relative to the poorer States. Except for the three poorer States (Bihar, Uttar Pradesh, and Orissa), all the other States narrowed the distance between themselves and two of the richest States (Punjab and Haryana) during the 1990s. Middle-income States such as Karnataka, Kerala, Tamil Nadu and West Bengal actually grew faster during the post-reform period relative to their growth rates during the pre-reform period.

However, Bhattacharya and Sakthivel (2004) find evidence in favour of increasing regional inequality, with the State domestic product (SDP) widening more drastically during the post-reform period. They argue that the comparison in Ahluwalia (2002) is based on two different sets of SDP data.[5] Bhattacharya and Sakthivel extend the new SDP data series backwards to compare growth and regional variation across States with a common database. Their results show that the coefficient of variation (CV) in the per-capita SDP growth rate increased from 0.19 during the 1980s to 0.29 in the 1990s, and the correlation coefficient between the average growth rates of SDP between the two decades across States was 0.50. This implies that the States with higher SDP growth rates in the 1980s continued to experience higher growth rates in the 1990s.

Our study fits well with this strand of the literature. We analyse whether during the period between 1999-2000 and 2005-6 the district-level income-density function changed uniformly, and the factors responsible for reducing district-level poverty.

5. The new 1993-4 base year SDP data series used for doing post-reform-period analysis is different from the old 1980-1 base year SDP data series used for analysing performance during the pre-reform period. There has been a change in product classification in the new SDP data series, with more sectors included from the financial services, the real estate and the agricultural allied services, than there were in the old series (see Bhattacharya and Sakthivel, 2004).

3 Empirical model

The empirical analysis is in two parts. In the first part we examine how per-capita district-level income distribution (absolute and median (relative) adjusted) changed between 1999-2000 and 2005-6. To examine the dynamics further, we draw density of district per-capita income for the fiscal years 1999-2000 and 2005-6,[6] and run a Kolmogorov-Smirnov (KS) test to ascertain whether there is any statistically significant difference in the median adjusted per-capita income distribution between the different fiscal years. The KS test is a non-parametric test that examines whether two samples are drawn from the same population. To explicate, 'KS statistic is the maximum absolute value of the difference between the two sample cdfs' (Higgins, 2004: 57). We repeat this exercise for the major constituent sectors of agriculture, manufacturing, services, and their sub-sectors.

The second part of our analysis is a follow-up from the first part. We find evidence of growth in per-capita income between 1999-2000 and 2005-6, and examine the factors responsible for this increase in income, and the resultant reduction in poverty in both urban and rural areas. In particular, we consider the following two equations:

$$HCR_u = \alpha_u + \Delta Y_0\gamma_1 + Y_0\gamma_2 + X_0\beta_1 + \varepsilon_u \ldots \quad (1)$$

$$HCR_r = \alpha_r + \Delta Y_0\gamma_1 + Y_0\gamma_2 + X_0\beta_1 + \varepsilon_r \ldots \quad (2)$$

where HCR_u and HCR_r indicate Poverty headcount ratios in urban and rural areas, respectively; Y_0 is a matrix of per-capita district-level income in 1999-2000 for three sectors, namely, agriculture, manufacturing, and services; ΔY_0 is a matrix representing growth rates of per-capita income from these three sectors between 1999-2000 and 2005-6; and X_0 is a matrix of baseline development indicators obtained from the 2001 Census (Office of Registrar General and Census Commissioner, 2001).[7] All the data are at district-level, and are measured at a per-capita level.[8] In addition, we conduct sensitivity analysis à la Levine and Renelt (1992) to test the robustness of our key results.

4 Data

The data on district-level per-capita income, both at sectoral (agriculture, manufacturing and services) and sub-sectoral level were taken from the Planning Commission (2010). We followed standard definitions of the agriculture (primary), manufacturing

6. We compute the density estimates using the Epanechnikov kernel, which, compared with other kernels (Gaussian, Uniform, Triangular, and Bi-weight), minimises the asymptotic mean integrated square error (MISE), and hence is chosen for this analysis.
7. It should be noted that the 2001 Census was conducted in two phases. Information related to the development indicators was collected during April and September, 2000. Hence, our model does not have any endogeneity problem.
8. Except for the variables, such as literacy rates and percentage of households with banking access, which are reported in %.

(secondary) and services (tertiary) sectors as defined by the Central Statistical Organisation (CSO). We verified the reliability and accuracy of the district-level figures in the following way: for any given year, we summed all the District Domestic Product (DDP) estimates at constant prices for all the districts in a particular State, and compared this aggregated figure with the State Domestic Product (SDP) figure provided by the CSO. Ideally, this aggregated figure should be approximately equal to the SDP estimate. For any given State in India, we find a negligible difference between the two.[9] It is pertinent to note that

> the estimates of SDP are compiled through a combination of production and income approaches, depending on the data availability at the state-level. SDP estimates using expenditure approach are not compiled, as detailed data required for such compilations, particularly on the inter-state movement of goods and services and exports and imports, are not available at the state level. (National Accounts Statistics, 2008: 44)

We included districts from 29 States in India, and considered the period between 1999-2000 and 2005-6. For Bihar and Orissa, we used sectoral and sub-sectoral data for 2004-5 whenever data for 2005-6 were not available. This was done to make the number of data points the same across all relevant regressions. Data for the years after 2005-6 are not available for all the districts, resulting in a significant drop in the number of observations.[10] Also many districts are newly formed, and information about per-capita income for them is not available for the earlier years.[11] Therefore, to maintain uniformity, and to get a more robust result, we considered the aforementioned time period. For fiscal year 1999-2000 an important omission in the Planning Commission data was district-level income for the State of Gujarat. During 1999-2000, we have 508 income data points (out of 585 districts) in India, and for 2005-6, data for 536 districts. This increase in the number of observations is due to the inclusion of per-capita district-income data from Gujarat, not available for 1999-2000. These data were taken from Indicus Analytics, Delhi.[12]

The development indicators (see Table A1) that we used for this study are: literacy rate (for both rural and urban areas), life expectancy at birth (LEB), and proportion of households with access to banking services. We used HCR data

9. According to the National Accounts Statistics (2008: 92), 'broadly the methodology of computation of [district-level] sectoral estimates is the same as adopted for estimates of State Domestic Product (SDP).'
10. The Planning Commission does not report data on district-level per-capita income for the period after 2006-7.
11. In 2000 there were 585 districts, and in 2011 627 districts in India. A case in point is Delhi. The 2001 Census contains information about many variables related to north, north-east, north-west, south, south-west, west, east, and central Delhi. However during 2001, with regard to per-capita income we find information only relating to Delhi as a whole, and not its constituent districts (Planning Commission, 2010).
12. Indicus Analytics collect data from the CSO database, which collates data from the respective State governments. The Planning Commission database also uses the CSO database. Therefore introducing per-capita district-level income data for Gujarat and Delhi for 2001/2 and 2004/5 is not going to affect (bias) our results.

(for both urban and rural areas) from Chaudhuri and Gupta (2009).[13] The design of the stratified random sampling was modified during the 61st Round of the Consumer Expenditure Survey (2004-5) where 'the sampling design defined rural and urban parts of districts as strata for selection of sample villages and urban blocks respectively. This had paved the way for generating unbiased estimates of important socio-economic parameters at the district level adequately supported by the sample design' (ibid.: 94). To merge the data suitably across indicators missing observations for certain districts were dropped from the final data set. In total, we had 439 observations for HCR-urban (equation 1) and 434 observations for HCR-rural (equation 2). The results were generated using statistical software package Stata.

5 Results

5.1 Overall analysis of growth and income

First, we do not find evidence in support of twin peaks, or clustering of the rich and poor income districts, across India. There has been a uniform increase in income across all the districts.

Table 1: Per-capita income summary statistics (in 1999 Rupees)

All sectors (logGDDP) per capita	Mean	Median	Standard deviation	Kurtosis	Skewness
1999-2000	9.6338	9.6322	0.41988	0.093591	2.8048
2005-6	9.8274	9.8231	0.47943	0.11775	3.2624

We see from Table 1 that there is an increase in the mean and median per-capita district income. We also note that there is an increase in standard deviation, skewness, and kurtosis measures of income. In fact, as kurtosis has become high during the latter period, 2005-6, the assumption of normality may not be valid. So we used the non-parametric sign-test to test for the increase in income across different time periods.

Table 2: Tests for significance of difference in mean and median per-capita district-level income between 1999-2000 and 2005-6

	1999-2000 and 2005-6
t-test of Mean Difference: Income	13.18 (0.00)[a]
t-test of Mean Difference: Log Income	23.64 (0.00)
Z-Value of sign test of median: Income	16.16 (0.00)
Z-Value of sign test of median: Log Income	16.05 (0.00)

Note: (a)p-values are in parenthesis

13. To compute rural and urban HCR, Chaudhuri and Gupta use Consumer Expenditure Data obtained from the 61st round of the National Sample Survey (2004-5) conducted by the Ministry of Statistics and Programme Implementation.

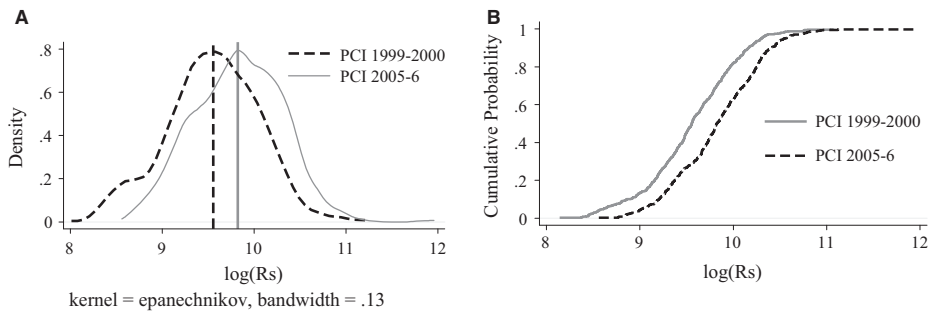
The results in Table 2 show that there is a significant increase in the mean and median per-capita district-level income between 1999-2000 and 2005-6. Since the income distribution is skewed and has a high kurtosis (evident from Table 1), we performed the same set of tests for the log per-capita income. Here also, we get similar results, indicating that there is an overall increase in the level of per-capita income.

Does this increase in mean and median per-capita income indicate that districts with high per-capita income have become well-off relative to those with low per-capita income? In other words, do we find any evidence in favour of clustering or divergence of income between the richer and poorer districts? To analyse this we plotted the income-density function.

We observe that, as regards district income data, there is definitely no evidence of twin peaks emerging. There is, however, a shift in the per-capita income-density function between the two time periods. This is due to a significant increase in the mean and median per-capita income, from 1999-2000 to 2005-6.

The income-distribution functions also show evidence of first-order stochastic dominance: the income-distribution function for 2005-6 lies everywhere below (that is, to the right of) that for 1999-2000 (see Figure 1B). An income-distribution function stochastically dominates another if the percentage of people below any given income is higher in the first (1999-2000) than in the second period (2005-6). This result is not surprising. Between these two years, all the districts became better-off in terms of per-capita income. What is more interesting is to examine whether among the districts there is any significant change in the median adjusted per-capita income-distribution function. We ran a KS test to ascertain this and found a result of 0.035 (p-value of 0.93), suggesting that between 1999-2000 and 2005-6 there was no statistically significant difference in the median adjusted income-distribution functions.[14] In fact, a glance at the median adjusted per-capita income densities drawn for 1999-2000 and 2005-6 reveals that these distribution functions are more or less similar (Figure 2).

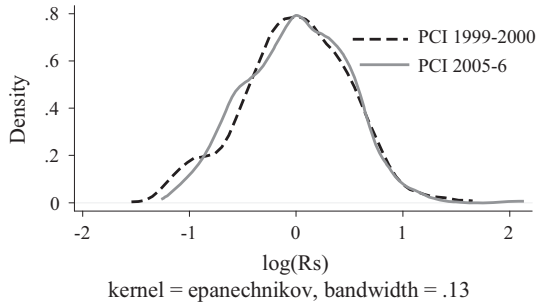
Figure 1: (A) Kernel density plots of per-capita income (PCI) 1999-2000 and 2005-6; (B) Cumulative density plots of PCI, 1999-2000 and 2005-6



Note: The vertical lines represent the median level of income

14. Running a KS test on per-capita income data also yielded similar results to log per-capita income data.

Figure 2: Median adjusted kernel density plots of PCI, 1999-2000 and 2005-6



The finding suggests that both the rich and poor districts have become well-off. There has been no increase in income disparity among districts. Analysis of district-level per-capita income does not tell us what has happened at the sectoral level. For this we constructed per-capita income densities for three constituent sectors, namely, agriculture, manufacturing, and services.

5.2 Sectoral analysis of growth and income

The results show that for agriculture and manufacturing there has been no change in income-density function (both median adjusted and unadjusted). We infer that between 1999-2000 and 2005-6, which was a period of high income growth, these two sub-sectors did not contribute much to the overall growth process. On the contrary, a kernel density plot of the log of the per-capita service sector (median unadjusted) reveals that there has been a significant increase in income for the people engaged in the services sector, which has been the major contributor to growth in India, with a share in GDP in 2005-6 at 54.1% (Ministry of Finance, 2006). The non-parametric sign test also confirms this (Table 3).

We did four non-parametric tests (see Table 3) to check the robustness of our findings: a standard median test, a Wilcoxon signed ranksum test, a KS test, and a Kruskal-Wallis (KW) test. The Wilcoxon test is a non-parametric test that examines the difference in medians of two sampling distributions. Since the median is not sensitive to the presence of extreme values in the sample, we used this test for testing differences in medians (Gibbons and Chakraborti, 2003: 215). The KW test is a natural extension of the Wilcoxon test to k-($k \geq 2$) samples, and we used this as an additional robustness test (ibid.: 363). Both the median and Wilcoxon tests suggest a marginal increase in per-capita median income for the agriculture and manufacturing sectors, and a large and significant increase for the services sector. However, the KS and KW tests suggest that there has not been any statistically significant change in the distribution of any of the sectors in terms of other higher-order moments.

Table 3: Non-parametric test results

	Median test (χ^2)	Wilcoxon signed ranksum test statistic (z-stat)	KS Test Statistic (Median -adjusted)	KW (Median -adjusted) (χ^2)
Per-capita agriculture (primary sector) (log terms)	**4.05 (0.04)**	**3.37 (0.00)**	**0.05 (0.57)**	**0.72 (0.40)**
Agriculture only (log terms)	5.16 (0.02)	4.30 (0.00)	0.04 (0.79)	0.02 (0.90)
Forest (log terms)	5.79 (0.02)	6.40 (0.00)	0.05 (0.69)	0.35 (0.55)
Fishing (log terms)	0.56 (0.45)	0.55 (0.57)	0.06 (0.42)	0.59 (0.44)
Per-capita manufacture (secondary sector) (log terms)	**23.68 (0.00)**	**7.01 (0.00)**	**0.04 (0.84)**	**0.22 (0.64)**
Mining (log terms)	11.63 (0.00)	5.01 (0.00)	0.06 (0.34)	0.29 (0.59)
Manufacture only (log terms)	6.40 (0.01)	4.92 (0.00)	0.04 (0.84)	0.04 (0.83)
Electricity (log terms)	18.90 (0.00)	4.96 (0.00)	0.04 (0.74)	0.37 (0.54)
Per-capita services (tertiary sector) (log terms)	**44.67 (0.00)**	**10.02 (0.00)**	**0.05 (0.63)**	**0.01 (0.91)**
Construction (log terms)	59.62 (0.00)	10.70 (0.00)	0.08 (0.08)	0.14 (0.70)
Trade & hotel (log terms)	24.96 (0.00)	7.18 (0.00)	0.08 (0.08)	0.84 (0.36)
Railways (log terms)	19.23 (0.00)	5.81 (0.00)	0.04 (0.90)	0.09 (0.76)
Transport (log terms)	30.42 (0.00)	8.08 (0.00)	0.06 (0.33)	1.62 (0.20)
Storage (log terms)	3.63 (0.06)	3.16 (0.00)	0.03 (0.97)	0.005 (0.94)
Communications (log terms)	163.40 (0.00)	17.54 (0.00)	0.06 (0.33)	0.37 (0.54)
Banking & insurance (log terms)	11.83 (0.00)	9.75 (0.00)	0.03 (0.98)	0.04 (0.84)
Real ownership & business services (log terms)	7.07 (0.00)	4.19 (0.00)	0.07 (0.15)	0.009 (0.92)
Public administration services (log terms)	17.78 (0.00)	8.7 (0.00)	0.04 (0.43)	0.10 (0.75)
Other services (log terms)	44.67 (0.00)	8.51 (0.00)	0.05 (0.53)	0.09 (0.76)

Notes: All tests compare 2005 series with 1999 series; KS: Kolmogorov-Smirnov; KW: Kruksal-Wallis; Wilcoxon Signed Ranksum test (Two tailed); H_0: Median (2005 series) = Median (1999 series); H_a: Median (2005 series) $\neq$ Median (1999 series); Two-tailed p-value is in parenthesis.

5.3 Sub-sectoral analysis of growth

Next we focus on the constituent sub-sections (for descriptive statistics, see Tables A2 and A3). Except for three services sub-sectors – banking and insurance, telecommunications, and real ownership business services – all the other sub-sectoral density functions are unimodal.

The bimodal density function for the banking and insurance sector is a reflection of the fact that the existing guidelines of the Reserve Bank of India (RBI) require 40% of the demand and time liabilities of the commercial banks to be allocated for priority-sector finance such as agriculture (RBI, 2008). The bimodal density reflects the lending pattern to both rich and poor cohorts of customers; the rich such as large business houses obtain credit because of the bankers' preferences, the poor such as in agriculture because of compulsion arising from the RBI guidelines. However, the middle ones, such as small and medium-scale manufacturing units, are being deprived. A recent study by the Associated Chambers of Commerce and Industry of India (ASSOCHAM) finds that about 25% of small and medium manufacturing units have either closed down or are struggling to survive because of non-availability of easy credit and delayed payments by large firms. Out of 500 manufacturing units surveyed from different States such as Uttar Pradesh, Haryana, Punjab, West Bengal and Bihar, over 70% of the respondents said that they do not have access to institutional credit to operate competitively.[15] A uniform density in the banking and insurance sector will require removing imperfections in the capital market, with more loans and insurance products targeted towards small and medium enterprise finance.

For the communications sector, we find the emergence of twin peaks for fiscal year 2005-6. Between 1999-2000 and 2005-6 communications spread more to the richer districts in comparison with the poorer ones. Between 2000 and 2005, some radical reform measures were undertaken for the telecommunications sector. Factors such as privatising the operation of the Department of Telecommunication Services and increasing the stake of foreign investors from 49% to 74% have led to increased competition, and reduction in telephone call charges. Many private operators emerged, and the number of telephone handsets sold increased from 19 million in 2003 to 32 million in 2005 (Telecom Regulatory Authority of India, 2006). This sudden spurt in reform-led activities has resulted in per-capita income originating from the telecommunications sector growing faster in the richer districts than in the poorer, and this has led to the emergence of twin peaks. Jones (1997) observes that this can be a temporary phenomenon, and can happen because of high frequency growth miracles data, or because of a sudden spurt in economic activities as stated above.

In fact, for the real ownership business services[16] we find a disappearance of clustering, indicating that these services have spread from the richer to poorer

15. Source: http://www.thehindubusinessline.com/industry-and-economy/credit-scarcity-hits-small-units-hard-says-assocham/article4027901.ece (accessed 24 October 2012).
16. Real ownership and business services consists of real estate services, IT and IT enabled services (ITeS), accounting and auditing services, R&D services, legal services, and consultancy services.

districts. This may be because the private sector (without depending too much on the government) is taking the lead in moving capital and labour to areas with lesser input costs (that is, investing more in backward districts, or second- and third-tier cities), thus contributing to uniform growth.

5.4 Poverty and growth

As the growth process has been uniform, it is necessary to examine whether this growth has been 'pro-poor'. Before undertaking the regression analysis (equations 1 and 2) we look at the correlation matrix (see Table 4) involving sectoral income growth and poverty. The correlation matrix brings out some important observations. First, correlation coefficients between growth of the services, manufacturing, and agriculture sectors are positive and significantly related.[17] Growth in one sector is expected to help growth in the other two sectors. Second, among the sub-sectors, the degree of association between manufacturing and services sector growth is the strongest. As the economy develops (with rising per-capita income), the growth linkages between manufacturing and services become stronger because of the high income elasticity of demand for services. Third, the correlation coefficient between urban and rural poverty is positive and significantly related. Poverty in urban and rural areas co-exists because of the free movement of labourers between the two. Fourth, the correlation coefficients between growth of services, manufacturing and agriculture, are negative and significantly related to HCR – suggesting that economic growth reduces poverty.

Table 4: Correlation matrix

	Agri-growth rate	Mfg-growth rate	Srv-growth rate	HCR-rural	HCR-urban
Agri-growth rate	1				
Mfg-growth rate	0.136*	1			
Srv-growth rate	0.139*	0.357*	1		
HCR-rural	-0.170*	-0.074	-0.209*	1	
HCR-urban	-0.100*	-0.138*	-0.186*	0.446*	1

Notes: Agr: agriculture; Mfg: manufacturing sector; Srv: Services sector. All sectoral growth rates were calculated as compound annualised growth rate between 1999 and 2005. * indicates significant at 5% level of significance. N = 491.

Regarding the factors which reduce poverty, we take note of various growth models[18] and the existing literature on India's growth and development dynamics. For instance, Rosenzweig (1990) finds that schooling has a positive effect on income. Burgess and Pandey (2004) find that the expansion programme of rural bank branches

17. Significant, henceforth, refers to a 5% statistical significance level.
18. Solow growth model, endogenous growth models, or models dealing with the micro-foundation of macroeconomics like rational expectation-type models.

has a significant effect on reducing rural poverty and increasing non-agricultural output. Accordingly, we consider the literacy rate (proxy for human capital), life expectancy at birth (proxy for health), access to banking (proxy for access to finance), growth rates of the log of per-capita income for agriculture, manufacturing and services between 1999-2000 and 2005-6, and the initial level of per-capita income from these three sectors as independent variables. The dependent variables that we considered for our study are HCR-rural and HCR-urban (proxy for poverty). The results from equation (1) and (2) are reported in Table 5.

Table 5: HCR-urban and HCR-rural on sectoral growth rates (Base Regression)

	(1) HCR-Rural	(2) HCR-Urban
Agri-Growth rate(1999-2005)	-123.12**	-65.07**
	(22.4527)	(23.7662)
Manufacturing growth rate(1999-2005)	41.59*	12.00
	(17.7027)	(20.4761)
Services growth rate(1999-2005)	14.91	-67.28
	(41.4827)	(44.3204)
Log(Per-capita-Agri-1999)	-7.04**	0.59
	(1.4903)	(1.6247)
Log(Per-capita-Mfg-1999)	-2.13	-4.05**
	(1.1973)	(1.3295)
Log(Per-capita-Srv-1999)	-10.65**	-8.64**
	(2.6754)	(2.8783)
Literacy Rate-Rural	-0.10	
	(0.0866)	
LEB	-0.27	-0.35
	(0.1982)	(0.2188)
HH with Banking Access-Rural	-0.21**	
	(0.0617)	
Literacy Rate-Urban		0.29*
		(0.1458)
HH with Banking Access-Urban		-0.21**
		(0.0660)
Constant	227.80**	152.99**
	(15.8869)	(20.3823)
R^2	0.3487	0.1919
Adjusted R^2	0.3349	0.1749
No. of Observations	434	439

Note: Robust standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$

Our results suggest that growth of agriculture is an important factor in reducing urban and rural poverty. With the majority of the Indian population still earning their livelihood from the agricultural sector (close to 58% of the population in 2010-11) (see Ministry of Finance, 2012), it will be difficult to reduce rural poverty

without improving agricultural productivity. With a lower contribution of the agricultural sector to the national income, labourers from rural areas migrate to urban areas in anticipation of higher expected income (Harris and Todaro, 1970). And, with limited employment opportunities in the organised manufacturing and services sectors in the urban areas, migration is also contributing to urban poverty. We also find that districts with a higher initial level of services per-capita income in 1999-2000 continue to have less poverty (both urban and rural). Similarly, higher initial levels of per-capita income from the agricultural and manufacturing sectors are responsible for reducing rural and urban poverty, respectively.

The other finding from our study is that access to banks reduces poverty. Increasing access to credit by providing 1% more bank branches can help to reduce HCR (both urban and rural) by 0.21%. We get a counter-intuitive result for the urban literacy rate. Our sensitivity analysis (see below) shows that this relationship is not robust. Also, the rural literacy rate and life expectancy at birth are not able to explain any reduction in poverty. This is not surprising. For education and health variables to have any discernible impact on poverty we require data over a longer time horizon, and these are unfortunately not available in our case.

5.6 Sensitivity analysis

To check the robustness of our results we performed sensitivity analysis as outlined in Levine and Renelt (1992). The idea was to see whether the inclusion of additional explanatory variables affects the regression outcome. The coefficient of a variable originally considered is robust if its sign and level of significance do not change.

The regression models reported in Table 5 are the original regressions (base regression). To do the robustness check we re-estimated the original models with additional explanatory variables. The sensitivity analysis was done for both the HCR-rural and HCR-urban. The results are reported in Table 6.

The additional control variables that we considered for sensitivity analysis are population growth rate between 1999 and 2001, number of factories per one lakh population (in rural and urban areas) and proportion of households using electricity as a source of light (in rural and urban areas). According to the Harrod-Domar model, a higher population growth rate dampens the rate of growth of per-capita income, and hence adversely affects poverty (Ray, 2004). Khandker et al. (2012) find evidence of rural electrification reducing poverty. Number of factories is considered to be a proxy for level of industrialisation. The effect of industrialisation on poverty eradication can go either way. If large numbers of households which are marginally above the poverty line are displaced because of industrial expansion without commensurate rehabilitation and compensation packages, then industrialisation may lead to a rise in HCR. On the contrary, if industrial expansion is labour-intensive where Below Poverty Line (BPL) households find employment, then such expansion will be 'pro-poor', and may reduce poverty. Because of a lack of labour-market reforms most labourers in India fail to get jobs in the organised manufacturing sector. In fact, all the successful manufacturing businesses in India employ capital-intensive modes of production (Panagariya, 2008). Prominent names in India's

Table 6: Sensitivity analysis of regression with HCR-rural and urban as dependent variables

Covariates of interest	Dependent variables: HCR-Rural and -Urban								
	Base regression		Augmented regression-1		Augmented regression-2		Augmented regression-3		Conclusion
Explanatory variables in baseline regression	Sign	Significant	Sign	Significant	Sign	Significant	Sign	Significant	
Agri-growth rate (1999-2005)	–	Yes	–	Yes	–	Yes	–	Yes	Robust
	(–)	(Yes)	(–)	(Yes)	(–)	(Yes)	(–)	(Yes)	(Robust)
Manufacturing growth rate (1999-2005)	+	Yes	+	Yes	+	Yes	+	Yes	Robust
	(+)	(No)	(+)	(No)	(+)	(No)	(+)	(No)	
Services growth rate (1999-2005)	+	No	+	No	+	No	+	No	
	(–)	(No)	(–)	(No)	(–)	(No)	(–)	(No)	
Log(Per-capita-Agri. 1999)	–	Yes	–	Yes	–	Yes	–	Yes	Robust
	(+)	(No)	(+)	(No)	(+)	(No)	(+)	(No)	
Log(Per-capita-Mfg. 1999)	–	No	–	No	–	No	–	No	(Robust)
	(–)	(Yes)	(–)	(Yes)	(–)	(Yes)	(–)	(Yes)	
Log(Per-capita-Srv. 1999)	–	Yes	–	Yes	–	Yes	–	Yes	Robust
	(–)	(Yes)	(–)	(Yes)	(–)	(Yes)	(–)	(Yes)	(Robust)
Literacy rate	–	No	–	No	–	No	–	No	(Fragile)
	(+)	(Yes)	(+)	(Yes)	(+)	(No)	(+)	(yes)	
LEB	–	No	–	No	–	No	–	No	
	(–)	(No)	(–)	(No)	(–)	(No)	(–)	(No)	
HH with banking access	–	Yes	–	Yes	–	Yes	–	Yes	Robust
	(–)	(Yes)	(–)	(Yes)	(–)	(Yes)	(–)	(Yes)	(Robust)

Table 6: Continued

Covariates of interest	Dependent variables: HCR-Rural and -Urban								Conclusion
	Base regression		Augmented regression-1		Augmented regression-2		Augmented regression-3		
Explanatory variables in baseline regression	**Sign**	**Significant**	**Sign**	**Significant**	**Sign**	**Significant**	**Sign**	**Significant**	
Additional explanatory variables in the augmented regression									
Population-growth rate (1999-2001)			– (+)	No (No)	– (+)	No (No)			
No. of factories			– (–)	No (Yes)			– (–)	No (Yes)	
HH with electricity					– (+)	Yes (No)	– (+)	Yes (No)	
No. of observations	434 (439)		432 (437)		432 (437)		434 (439)		

Notes: HCR-urban in parentheses. Average adjusted R^2 of augmented regressions = 0.3 (0.18) and the augmented models are jointly significant (Prob > F = 0.000). The last column indicates the robustness or fragility of estimated coefficients which are significant in the base regression. The coefficient of a variable of interest is considered to be robust if its sign and significance do not change across all augmented regressions.

manufacturing sector – Reliance Industries in the petrochemical sector; TATA motors, Bajaj, and Mahindras in the automobile sectors; or even Godrej, Birlas, and Videocon, in the consumer durables sector – rely on a capital-intensive mode of production.

We refer to the original regression as the base regression, and the model with newly added explanatory variables for sensitivity analysis as the augmented regression. To check robustness we added two additional variables at a time to our base regression. Since actual magnitudes are of little interest, we report only the sign and statistical significance of the coefficients. The results from the augmented regressions are no different from the original regressions, showing that our results are robust. Results for HCR-rural from Table 6 indicate that districts with higher initial per-capita agricultural income have lower rural poverty, but the table shows that the agricultural growth rate is also important for reducing urban poverty. Districts with a higher initial level of per-capita manufacturing and services income have a lower incidence of poverty. Access to banking reduces both urban and rural poverty. All these results are robust as the sign and level of significance of the coefficients are not affected by the addition of new explanatory variables. The effect of the urban literacy rate on urban poverty is counter-intuitive but, as the sensitivity analysis shows, this relation is fragile. Among the variables added for sensitivity analysis, we find that electrification and number of factories reduce rural and urban poverty, respectively.

5.7 Policy implications

Policy-makers in India can reduce poverty better by concentrating on the agricultural sector. The share of the agricultural sector supporting the livelihoods of 57% of the Indian population in 2009-10 fell from 56.9% in 1950-51 to 14.7% in 2009-10. On the other hand, the services sector (excluding construction) supporting the livelihoods of around 24% of the population in 2009-10 increased from 29.8% during 1950-51 to 54.7% during 2009-10 (Ministry of Finance, 2012). Since India has leapfrogged into skill-intensive services bypassing the manufacturing sector, there are three obvious policy choices. The first is to increase agricultural productivity so that the return to the people dependent on the agricultural sector increases. The second is to remove capital-market imperfections so that small entrepreneurial activities, agriculture and agriculture-related allied activities such as fishing, dairying, etc., can grow and flourish. The results from our study highlight these two factors, namely, growth of the agricultural sector and access to finance, as important factors for reducing poverty. The third choice is about longer-term policy prescription which is imparting skills so that excess labour from the agriculture and allied sector can be meaningfully absorbed into the services sector.

6 Conclusion

This article finds that during the post-reform period India witnessed a period of high income growth, and the regional growth process has been uniform. In analysing district-level data for the period between 1999-2000 and 2005-6, we find no divergence

in inter-district income disparity. The income dynamics provide no evidence in support of the twin-peaks hypothesis, namely, clustering of the rich income districts and the poor income districts at a pan-India level. There has been a reduction in income disparity among districts. Although there has been an increase in per-capita district-level income, we find, when we look at the disaggregated income data from agriculture, manufacturing and services, that growth of this per-capita income is predominantly driven by the growth of the services sector alone. Agriculture and manufacturing have contributed marginally to the growth of per-capita income. We do find evidence of a bimodal density function, especially for the banking and insurance and telecommunications sub-sectors. However, the overall per-capita income-density function remains unimodal. Along with growth, there has also been a reduction in poverty. Faster growth during the post-reform period has helped to reduce poverty. We find that increased agricultural income (productivity) and access to finance are the important variables that have contributed to this reduction in poverty.

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Appendix

Table A1: Description of development indicators (urban and rural)

Variables	Definition/how calculated
Literacy rate	% of population who are literate in the total population aged 7 and over (male and female)
Life expectancy at birth (LEB)	Average number of years a newborn is expected to live, if subject to age-specific mortality rates for a given period
Proportion of households with banking services	% of households with banking services
Proportion of households with access to electricity	% of households using electricity as source of light
No. of factories	Per one lakh population.

Source: Office of Registrar General and Census Commissioner (2001).

Table A2: Descriptive statistics of per-capita sectoral incomes (log median adjusted)

	Min.	Max.	Mean	Median	SD	Skewness	Kurtosis	N
Agriculture								
1999-00	-2.80	1.79	-0.039	0	0.535	-0.51	5.64	475
2005-06	-4.30	1.37	-0.020	0	0.582	-1.39	10.85	475
Manufacturing								
1999-00	-2.31	3.09	0.028	0	0.92	0.273	2.85	475
2005-06	-2.47	3.06	-0.014	0	0.95	0.137	2.99	475
Services								
1999-00	-1.63	1.49	-0.026	0	0.576	-0.137	2.71	475
2005-06	-1.83	1.73	-0.027	0	0.641	-0.165	2.68	475

Note: SD is Standard Deviation, and N is number of observations.

Table A3: Sub-sectoral descriptive statistics (log median adjusted)

	Min.	Max.	Mean	Median	SD	Skewness	Kurtosis	N
Agriculture								
1999-00	-3.99	1.83	-0.144	0	0.58	-0.97	9.01	475
2005-06	-4.19	1.45	-0.018	0	0.61	-1.33	9.88	475
Mining								
1999-00	-6.17	6.61	-0.046	0	2.35	-0.01	3.12	447
2005-06	-7.53	6.63	0.02	0	2.26	-0.11	3.47	447
Manufacturing								
1999-00	-6.97	2.93	-0.016	0	1.09	-0.43	5.92	475
2005-06	-2.70	3.11	-0.020	0	1.07	0.09	2.78	475
Electricity & gas								
1999-00	-4.05	3.68	-0.11	0	0.972	-0.21	4.06	475
2005-06	-5.09	3.61	-0.07	0	1.06	-0.35	4.75	475
Construction								
1999-00	-1.88	2.70	-0.02	0	0.74	0.07	3.2	475
2005-06	-2.09	2.54	0.04	0	0.75	0.15	3.01	408
Trade & hotels								
1999-00	-3.83	2.12	-0.11	0	0.90	-1.13	5.18	475
2005-06	-1.99	2.65	-0.001	0	0.83	0.07	2.79	475
Transport								
1999-00	-3.43	2.46	-0.05	0	0.90	-0.53	3.74	475
2005-06	-4.65	2.19	-0.15	0	1	-0.80	4.38	475
Banking								
1999-00	-2.32	2.89	0.10	0	0.92	0.17	2.33	475
2005-06	-2.38	2.85	0.12	0	0.93	0.20	2.43	475

Note: ibid.