Spatial Dynamics of India's Growth and Development Process

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Biography:

Nilanjan Banik is presently working as an Associate Professor with Institute for Financial Management Research, Chennai, India. He has a PhD in Economics from Utah State University, USA; and a Master in Economics from Delhi School of Economics, India. Prof. Banik works focus on the application of time series analysis in issues relating to international trade, market structure and development economics. Besides, time series econometrics his other area of work focuses on the `rules' part of WTO; especially examining the non-tariff barriers aspect of GATT/WTO agreements. Prof. Banik has project experiences with Australian Department of Foreign Affairs and Trade, Australia; Laffer Associates, USA; Ministry of Commerce, Government of India; Research and Information System for Developing Countries, New Delhi; Indian Council for Research on International Economic Relations, New Delhi; Asian Development Bank Institute, Tokyo and World Trade Organization, Geneva. Prior to joining the Graduate Program in the Department of Economics, Utah State University, Professor Banik has worked as a Research Officer with Rajiv Gandhi Foundation, New Delhi and Senior Business Analyst with DTA Consultancy Firm, New Delhi. He has publication in International Review of Economics and Finance, Journal of World Trade, Asia Pacific Trade and Investment Review, Asian Development Bank Working Paper, Economic and Political Weekly, Foreign Trade Review, etc.

Anurag Narayan Banarjee did his Master of Statistics with specialization in Quantitative Economics and Planning from Indian Statistical Institute, Delhi in the year 1989-91. He also did his Master of Economics from Universitié Catholique des Louvain in 1992-93. He did his PhD under the supervision of Prof. Dr. Jan Magnus at Katholieke Universiteit Brabant during 1994-97. Presently Anurag hold the position as Reader in Financial Econometrics and also Director of Postgraduate Research at Durham Business School, UK from 2005. He served as a lecturer in Economics at University of Southampton, UK during 2001-2005. He also served as an Econometrics Consultant, Portfolio Strategy Group for ABN AMRO, UK during 2004-05.

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Abstract

Most of the studies conducted about growth and development experiences of India during recent times are done at the States level. These studies have typically examined three related hypotheses: (i) the impact of growth on income distribution, (ii) the impact of growth on reducing poverty, and (iii) change in socio-demographic disparity. Paucity of data has restricted further analysis at a sub-regional level in India, specifically commenting about the interrelation between the growth factors and the development factors at a District level. The importance of this study lies in the fact that the analysis is carried out at a District level. We have access to district level GDP data for majority of the States in India. This will help us to comment about the evolution of India's income distribution. In addition to examining the above mentioned hypotheses, we examined, whether, since the start of great Indian reforms during early nineties, there is any evidence about emergence of cluster – the clustering of very rich Districts, the clustering of very poor Districts, and a disappearance of average income Districts in India.

Key Words: District, India, Density, Moran's Index.

1. INTRODUCTION

In recent times, much of the policy debates in India are centered on issues relating to unequal income distribution (Tendulkar, 2010; Banik, 2009), socio-demographic disparity (Kurian, 2000), poverty (Topolova, 2005; Purfield, 2006), property rights (Banerjee and Iyer, 2005), institutions (Kochar et al., 2006), and deprivation (Debroy and Bhandari, 2003). Each one of these issues has grabbed considerable media attention in India, under the garb of *Naxalism*, inclusive growth, corruption and regionalism.

Tendulkar (2010) has admitted that during the Eleventh Five Year Plan (2007-12) there has been a rise in summary measures of relative inequality (Gini coefficients), especially in the urban areas. However, he argues that such an outcome is not surprising, as even when growth leads to rising inequalities they do not necessarily generate inequitable distributional outcomes. Banik (2009) while identifying types of inequalities, and reasons for their existence, also draws a distinction between equity and equality. Measuring disparities in terms of sex ratio (females per 1000 males), female literacy, infant mortality and level of infrastructure development, Kurian (2000) found evidences about widening regional disparities in India. Clubbing States in India into two categories – the forward group (comprising of: Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab and Tamil Nadu) and the backward group (comprising of: Assam, Bihar, Rajasthan, Uttar Pradesh and West Bengal) – he finds that the 'forward'

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States have move ahead in terms of performance of the aforementioned parameters during the reform period in comparison to the 'backward' States. In a similar vein, Purfield (2006) did a State level analysis to comment about how growth and economic performance have varied across States in India. Categorizing States into rich and poor States, she finds evidence about the rich States growing faster compared to the poor States, and have been more successful in terms of reducing poverty, and capital flow (alongside with job creation), as compared to the poor States. Kochar et al. (2006), finds that States with weaker institutions and poorer infrastructure experienced lower Gross Domestic Product (GDP), and lower industrial growth.

At a sub-regional (Districts) level, Topolova (2005) examined the impact of trade reforms on poverty and inequality. She finds limited spatial (across geography), and inter-sectoral (across industry) migration has prevented income/wage convergence across region and industry. Increase in imports, resulting from trade reforms (that is, lowering of tariffs), lead to fall in wages in the import competing sectors and have resulted in slower poverty reduction. Again using District level data, Banerjee and Iyer (2005) find that areas in which proprietary land rights were historically given to the landlords had significantly lower agricultural investments and productivity post-independence than areas in which these rights were given to the cultivators. The study by Debroy and Bhandari (2003) have identified the most backward Districts benchmarking them on the attainment of Millennium Development Goals (set by UNDP) across six measures of socio-economic progress: poverty, hunger, literacy, immunization, infant mortality and elementary enrolment. This study identified:

"India's worst districts are located in Bihar, UP, Jharkhand, Orissa, MP, Assam, Maharashtra, West Bengal and Chhattisgarh, with a few districts from Arunachal, Karnataka and Tamil Nadu thrown in. Hunger has a broader geographical spread, with hungry districts also existing in Andhra, Goa, Haryana, Kerala, Manipur, Nagaland, Pondicherry, Rajasthan, Tripura and Uttaranchal. Moving on to infant mortality, the worst districts are in UP, Orissa, MP, Chhattisgarh and Rajasthan. Backwardness under the literacy criterion is concentrated in Orissa, undivided BIMARU, Arunachal, Karnataka, Andhra, Assam, Gujarat, Himachal, J&K, Punjab, West Bengal and North-East". (Debroy and Bhandari, 2003, p. 10)

The broad message from this literature review is that pocket of deprivations exist. Market is still not perfect, and there are ways to increase overall productivity through an attempt to make market works for the poor and the deprived. Imperfection in the labor and in capital market affects distribution of income. Imperfection in the goods market hurts opportunity to earn income. Imperfection in the judicial system means the deprived do not enjoy any legal right(s), leading to exploitation and discrimination. Although, economists and policymakers, in general, are worried about individual well-being, and the factors affecting this well-being, they somehow seem to have assumed market is perfect (better known as Classical Assumption). All the growth models, namely, the Solow growth model, Endogenous growth models, etc., have tried to explain higher standard of living (read, per-capita income) without explicitly accounting for market

imperfection. In fact, the fundamental assumption for these growth models to work is to assume that the capital market is perfect – so that whatever is saved can be invested for productive purposes. Considering dataset between 1977 until 1990, Burgess and Pandey (2004) find that the rural bank branch expansion program in India has a significant effect in terms of reducing rural poverty and to increase non-agricultural output.

Alkire and Santos (2010) pointed out India as a country is going to miss one of the main objectives of Millennium Development Goal (MDP), that is, to reduce its population below poverty line by half starting 1990 within the stipulated time frame of 2015. There is dearth of capability development across India, and this has varied across States and within States. Capabilities are synonymous with freedom – freedom from hunger, freedom from dying prematurely, freedom from getting oppressed, freedom from ignorance, freedom from crime, and freedom from ecological disaster. Poor people are concerned not only about lack of opportunities to earn income but also having access to quality education, health care, drinkable water, public transport system, financial intermediation, transparent bureaucracy and living in a less polluted environment.

How does then one reconcile deprivation with the fact that India is one of the fastest growing economies? In fact Government in India has diverted fund through budgetary allocation towards rural areas and less developed regions (IMF Regional and Economic Outlook, 2006). It is natural to expect that higher growth of GDP, that is, more overall income, will create opportunities for better education, health and other quality indicators of life. In the first part of the analysis we try to understand whether there is any interrelation between the growth and development indicators. This will help us to comment how well India is prepared to meet the objectives of MDP.[4] In the second part of the analysis we examine the dynamics of this growth process. We want to know, whether, since the start of great Indian reforms during early nineties, there is any evidence about emergence of cluster – the clustering of very rich Districts, the clustering of very poor Districts, and a disappearance of average income Districts in India. That is there are pockets of growth that are pulling-up the national average. The rest of the analysis is structured as follows. In Section 2 we address the issues related to heterogeneity and inequality in India. Section 3, we argue why we chose District level analysis. Section 4 deals with data and interpreting the results. Section 5 concludes with some policy recommendations.

2. HETEROGENEITY AND INEQUALITY

India is a heterogeneous country. Heterogeneity exists both across States and within a State. There exists a large geographical disparity in the sectoral distribution of economic activity. While about half of the total agricultural value added in India is produced in the northern and the central States, 40 percent of the industrial and the service sector output come from the States of Gujarat, Maharashtra, and Tamil Nadu (Purfield, 2006). In fact,

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[4] The broad objectives of the MDP are to provide universal access to primary education, eliminate gender disparity in terms of birth and education, reduce infant and maternal mortality, halt spreading of AIDS, and to reduce poverty.

poorest States are located in the north, east and central part of India, whereas, the middle and the high income States located in the coastal areas. Similarly heterogeneity also exists within a State. For example, going by the data we have, for the year 2005-06 per-capita income for the District of Gurgaon in Haryana (the richest district) was Rs 208444 – a figure nearly 53 times larger than the per-capita income of Rs 3963 for the District of Sheohar in Bihar (Planning Commission, 2010).

Policymakers should be held accountable when heterogeneity leads to inequality. Inequality (in terms of income earned) can primarily be because of circumstantial reasons, or due to policy failure. Circumstantial reasons are exogenous and cannot be controlled by policy measures. Examples about circumstances led poverty may be because of: (a) caste, (b) natural disaster, (c) gender, and (d) wars. For instance, people taking birth in some lower castes in India (schedule tribes, or castes) are most likely to start with limited opportunities and hence have a lower steady state level of income (read, poor). Backwardness in certain areas in Gujarat, Madhya Pradesh, Bihar and Orissa, are explained by preponderance of lower caste people living in these areas. Again much of the reason for backwardness in Vidharbha and Marathwada region in Maharashtra, or for that matter Telangana and Rayalaseema regions in Andhra Pradesh is because of scarcity of water (Kurian, 2000). In case of Bihar, the reason for backwardness is other way round – excess flooding in certain Districts of Bihar (Debroy and Bhandari, 2003).

In addition to these circumstantial reasons, inequality can persist because of policy failures. It happens primarily because of: lack of access to education, basic healthcare, unequal distribution of productive assets (land, livestock, etc.), and lack of legal empowerment to the vulnerable section of the population. The poor face their own development problems related to poor infrastructure (roads, electricity, telecommunication, etc.), which either prevent, or make it more costly for them to participate in the market. In addition, inefficient and corrupt bureaucracies raise transactions costs in the asset market important for the poor, besides reducing inter-regional mobility.[5] Activities like, microfinance and helping farmer direct access to market will certainly help but these activities are still relatively new in India.[6]

3. WHY DISTRICT LEVEL ANALYSIS?

Considering State as a unit and doing inter-regional analysis has a serious limitation: it will not be able to capture the intra-State disparities in economic and social development that exists today. Consider this. In the State of Uttar Pradesh the richest district is Gautam Budh Nagar (with district headquarter at Noida in the neighborhood of

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[5] For example, the recent controversy surrounding India's *First Family* being accused of land grabbing is a testimony towards how land records are poorly maintained, and the officials who have authority to certify ownerships might be corrupt. In a similar vein, the recent incidents – reflecting emergence of regionalism (thanks, to Shiv Sena a regional political party) in the State of Maharashtra – shows what can happen to a vibrant democracy if property, or legal rights, are not properly enforced. A recent search on Google generated more than 1,00,000 hits on these two issues alone.

[6] Only 2 percent of the farmers in India actually have access to Big Retailing Houses, like ITC, Reliance Fresh, Pepsi, etc. Source: Business Today (2010).

Delhi). During fiscal 2005-2006, Gautam Budh Nagar has a per-capita income of Rs 60082, which is around 9 times higher than the poorest District of Shravasti, with a per-capita income of Rs 6458 (Planning Commission, 2010). Evidence of such intra-State disparity even exists today. For example, Vidharba and Marathwada Districts in Maharashtra; Telangana and Rayalseema regions in Andhra Pradesh are still counted as one of the poorest regions in the country despite being part of what are classified as forward or rich States. The District level analysis, therefore, is expected to deliver a better analysis when it comes about understanding the linkages between growth and development indicators.

4. EMPIRICAL MODEL

The empirical model has three parts. In the first part to comment about the relationship between growth and development indicators at a District level we merely do a simple OLS type model. We start with this basic formulation:

$$X_i = \alpha + \beta_1 \times PCI_{i(1999/00)} + \sum_{j=1}^{4} \beta_2 \times D_{ij} + \varepsilon_i$$

Where, X_i represents development indicators, namely, Lorenz Ratio (LR) rural, Head Count Ratio (HCR) rural, Infant Mortality Rate (IMR), Life Expectancy at Birth (LEB), per-cent of household with electricity connection, and Literacy Rate. The independent variable is District per-capita income for the fiscal 1999-2000. For the development indicators the data for LR rural and HCR rural, are for the year 2004/05. Data on, literacy rates, IMR, LEB, and per-cent of household with electricity connection, are taken from Census 2001. The idea is higher per-capita income during the previous years, that is, 1999/00 is expected to yield better development indicators for the later years, that is, for 2001 and 2004/05. Writing the model formulation in this way, that is, dependent variable for the later year as a function of independent variable for the previous year, also help us to address issues related to endogenity. As some of the earlier studies (Kurian, 2000; Purfeld, 2006; Debroy and Bhandari, 2003) have found that the rich States are located in the western and southern part of the country, whereas the poor States are located in the east, central and northern part of India, we use 5 regional dummies to control for the spatial dispersion in income. To examine the causal relation, we also ran a regression of per-capita income on the standard development indicators. Basically trying to understand, whether better living conditions also create opportunity to earn income.

In the second part of the analysis we tried to see how per-capita District level income distribution (absolute, relative and median adjusted) has changed since 1999. To examine the dynamics, we drew density of 508 Districts for the 1999/00, 2000/01, and for the year 2004/05. Undertaking this exercise will enable us to comment about the emergence of any cluster. Districts in the neighborhood of big cities will have some positive externalities, and hence will tend to grow faster as compared to Districts located further

away. If this hypothesis holds true then we would expect Gautam Budh Nagar (a District in Uttar Pradesh bordering Delhi), and Gurgaon (a District in Haryana in the neighborhood of Delhi) to grow much fast as compared to other Districts in Uttar Pradesh and Haryana, respectively. The idea behind this hypothesis is rooted in the work of Quah (1993, 1996), and Jones (1997).

Finally, complementing with the above analysis, cross sectional data may have interesting relationships that are not always modeled with standard econometrics procedures. The essence of many cross sectional relationships is captured by Tobler's first law of geography: "everything is related to everything else, but near things are more related than distant things". We test Tobler's principle using Moran's Index.

A higher spatial correlation (Moran's Index) for a particular variable, say literacy rate, will indicate that quality of education provided across different Districts in India are similar. On the other hand, a lower spatial correlation will indicate some Districts are better in provision of quality education relative to other Districts.

Data

As the analysis has been carried out at a District level all the data are at District level. The data on development indicators, namely, literacy rates, IMR, LEB, are taken from Census 2001. Data on State-wise District Domestic Product and other measures of per-capita income between 1999-2000 and 2004-05 are taken from Planning Commission, Government of India. In total we have 508 data points for per-capita District level income.

Data on HCR and LR are taken from the results estimated by Chowdhury and Gupta (2009) on the basis of Consumer Expenditure Survey conducted by National Sample Survey Organisation, Ministry of Statistics and Programme Implementation, Government of India. For doing this exercise we have 405 data points with HCR and LR as variables, 456 data points with sex ratio, electrification and literacy rates as variables, 362 data points with IMR and LEB as variables. To merge the data suitably across indicators missing observations for certain Districts are dropped from the final data set. The results are generated using EVIEWS 6.

Results

Regression Analysis: Preliminary findings suggest that income helps to build capabilities. Growth has desired relationship with the development indicators. To be more specific, more income helps to acquire better health, more education and lower mortality. Upon regressing per-capita district income on these development indicators, all the coefficients have come out with correct signs, and most of them are statistically significant. Income is positively related to Lorenz ratio (that is inequality). Higher income in a region is associated with more inequality (See Table 1).

TABLE 1
Impact of Per-Capita Income (1999/2000) on Development Indicators

	Dependent variables								
	LR_Rural	LR_Urban	HCR_Rural	HCR_Urban	IMR	LEB	Literacy rate	HH with electricity	HH with banking access
Log PCI of 1999	0.042**	0.040**	-13.840**	-19.410**	-17.400**	3.312**	13.827**	33.433**	7.095**
	-0.007	-0.008	-2.026	-2.164	-2.522	-0.502	-1.225	-1.854	-1.287
No.of Schools and Colleges									
Dummy_East	-0.002	-0.003	3.187	-13.145**	-10.721**	2.084**	-4.558**	-36.072**	0.836
	-0.01	-0.012	-2.826	-3.019	-3.518	-0.701	-1.708	-2.586	-1.794
Dummy_North	0.022*	-0.029**	-9.147**	-15.412**	-2.312	0.394	-3.258*	-17.104**	18.710**
	-0.009	-0.011	-2.604	-2.781	-3.242	-0.646	-1.574	-2.383	-1.653
Dummy_West	0.023	-0.042**	-2.177	12.963**	-17.772**	3.570**	5.005*	-7.244*	14.668**
	-0.014	-0.16	-3.758	-4.015	-4.679	-0.932	-2.272	-3.44	-2.387
Dummy_South	0.0225*	-0.030*	-14.912**	-5.776	-18.576**	3.715**	0.887	-5.105	3.467
	-0.01	-0.012	-2.858	-3.054	-3.559	-0.709	-1.728	-2.616	-1.815
Constant	-0.165	-0.065	168.621	230.161	234.496	30.668	-66.945	-251.081	-40.632
	-0.072	-0.081	-19.211	-20.524	-23.918	-4.766	-11.616	-17.583	-12.201
R^2	0.165	0.073	0.326	0.291	0.278	0.272	0.411	0.72	0.452
Adj R^2	0.153	0.06	0.317	0.281	0.268	0.262	0.403	0.716	0.444
F(5, 356)	14.04	5.66	34.54	29.3	27.52	26.67	49.81	183.74	58.84
No of Obs	362	362	362	362	362	362	362	362	362

Note: Standard errors are indicated in parentheses
Significance at the 1 percent level of significance is denoted by **
Significance at the 5 percent level of significance is denoted by *
Each column represents separate regression

One of the surprising results is murders tend to increase with income. This surprising result might indicates about the failures of High Court as an Institution. If the perpetrators of crime know that they are going to get off with lesser punishment then they are more likely to commit crime.[7] The scatter plot of the best-fit line as reported in the Appendix bears evidence to these findings. In general, we find evidences about higher income translating into better quality life for the citizens in India.

To understand the causal relation better, that is, does better development indicators help to create more income, we regress per-capita income for 2004/05 on the standard development indicators, such as, LEB, IMR, sex ratio, literacy rates, and per-cent of household with electricity connection, for the earlier year (that is, 2001 census data). We find that a better living condition as indicated through better development indicators, might not necessarily translate into higher income in the region. This is understandable, as development indicators are supply side factors which do not change in the short term. It might take few good number of years before literacy rate in a District improves, or for that matter, a few good number years of education before the degree get translated into opportunity to earn income. Only electricity variable is statistically significant - indicating access to electricity is pre-requisite for setting up any activities (related to agriculture, industry, or services) that will create income in the region. For instance, setting up any industry, or bank, or even contract farming, require electricity.

TABLE 2
**Impact of Development Indicators on Per-capita Income 2004/05**

|	Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dependent Variable	Electricity	135.9883	22.71092	5.987794	0
	IMR	-79.13148	93.48392	-0.84647	0.3979
	LEB	-137.6169	469.9729	-0.29282	0.7698
INCOME 2004/05	Literacy	19.57336	51.97334	0.376604	0.7067
	Sex Ratio	7.02457	7.893844	0.88988	0.3741
	Constant	16828.84	36289.41	0.46374	0.6431
	R-squared	0.214236	F-statistic		18.97625
	Adjusted R-squared	0.202947	Log likelihood		-3712.86

So that the laggard Districts are easily identified we map the Districts on the basis of some policy indicators. This will be useful from the policy perspective. The interesting observation is in Panel a and Panel b of Figure 1. It shows that between 1999/2000 and

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[7] While some of the Institutions, such as, Supreme Court, Election Commission, Telecom Regulatory Authority of India (TRAI), Securities and Exchange Board of India (SEBI), Insurance Regulatory and Development Authority (IDRA) and Reserve Bank of India (RBI) has delivered well, others, such as, High Courts, Central Electricity Regulatory Commission (CERC), performance of bureaucracy, such as, customs, police, and other administrative services, have not performed well (Kapur and Mehta, 2005).

2004/05 few of the Districts mainly in the States of Rajasthan and Orissa have moved up in the income ladder. In general, the median income has increased across Indian Districts. This finding is similar to the results that have come out from the dynamic analysis (See the discussion on Kernel Densities in the next Section).

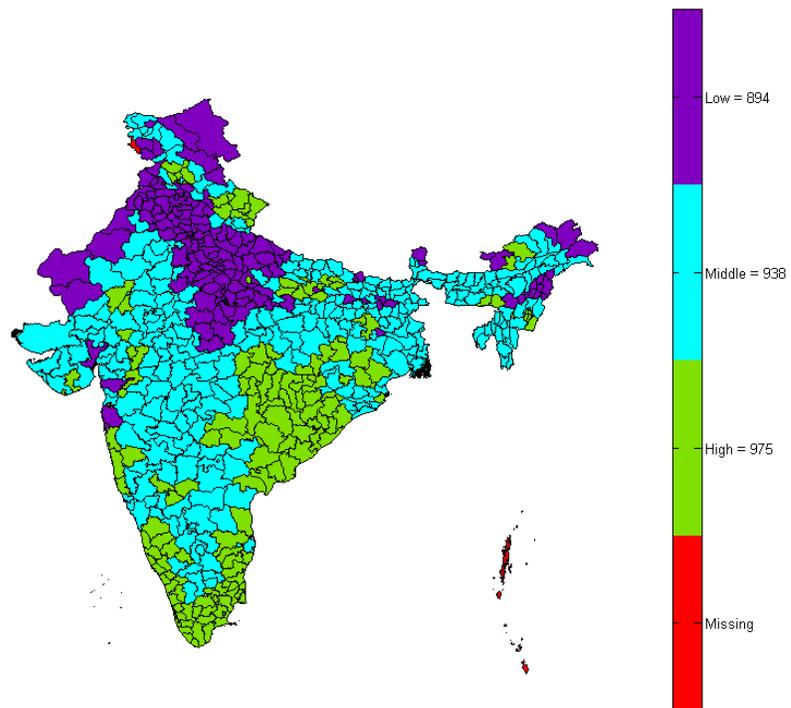**Figure 1a and 1b:** Per-capita Income for 1999/2000 and 2004/05
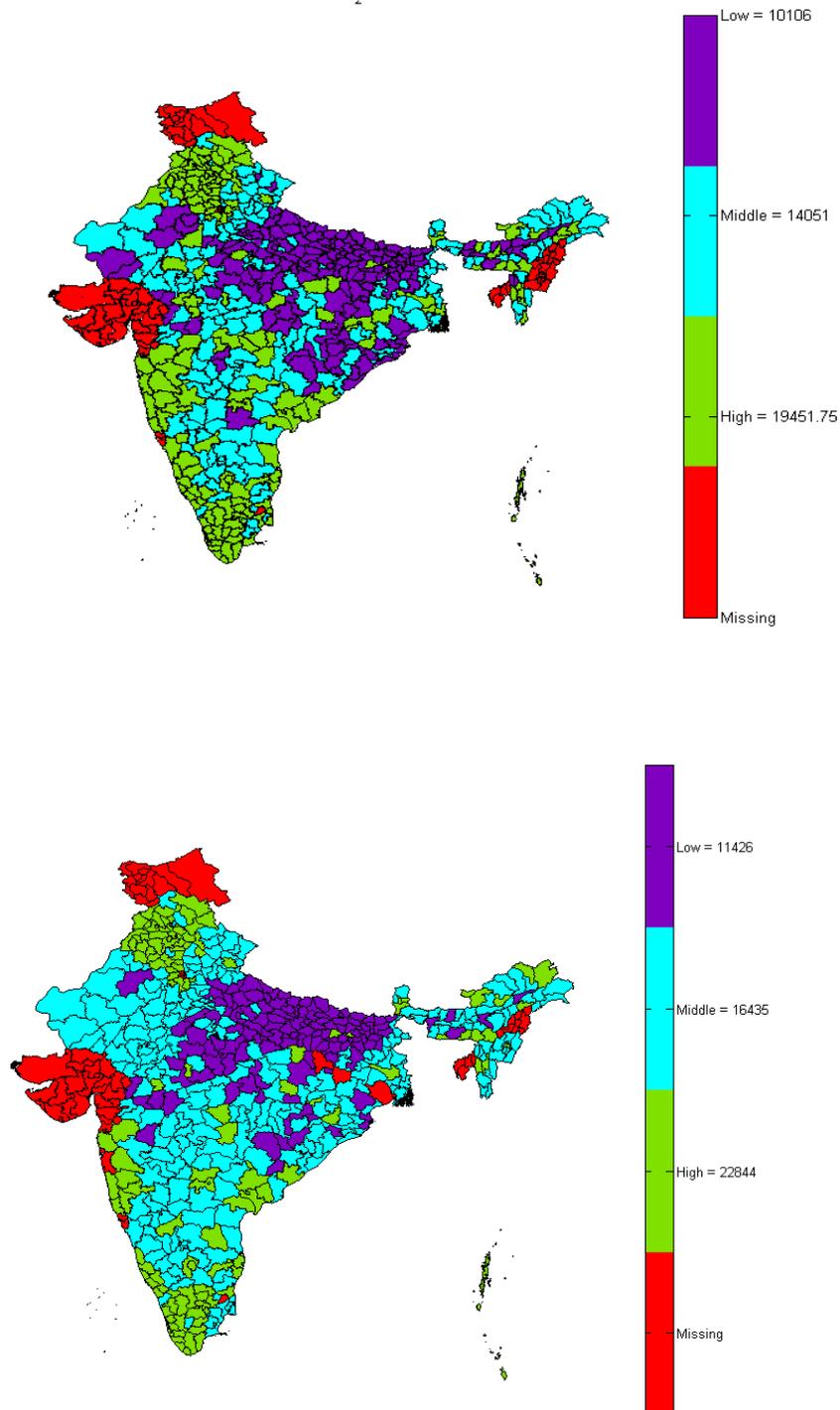
Figure 2: Per-capita Income Growth during 2000/2001.
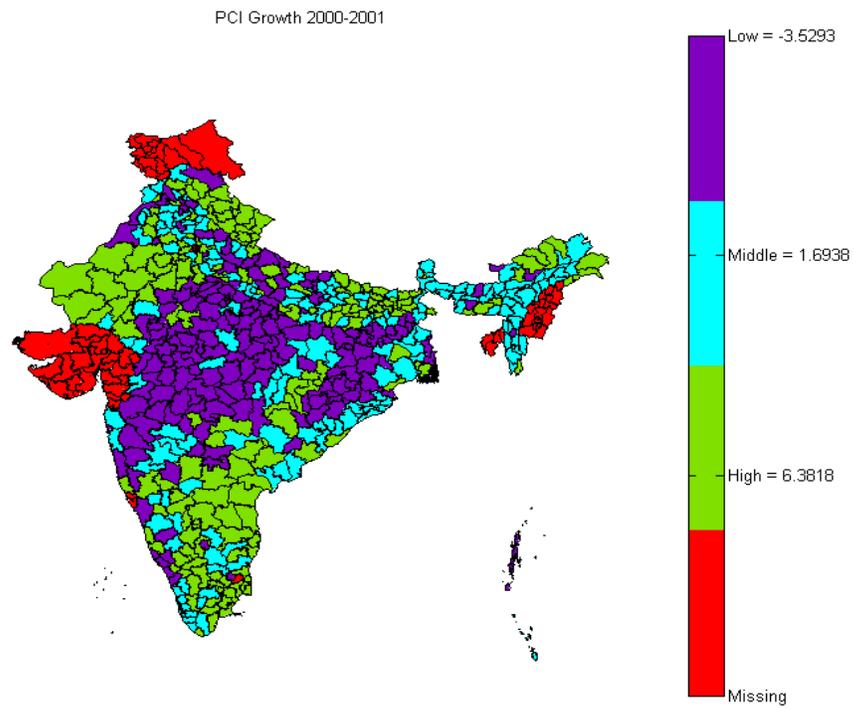
Figure 3: Lorenz Ratio 2000/2001
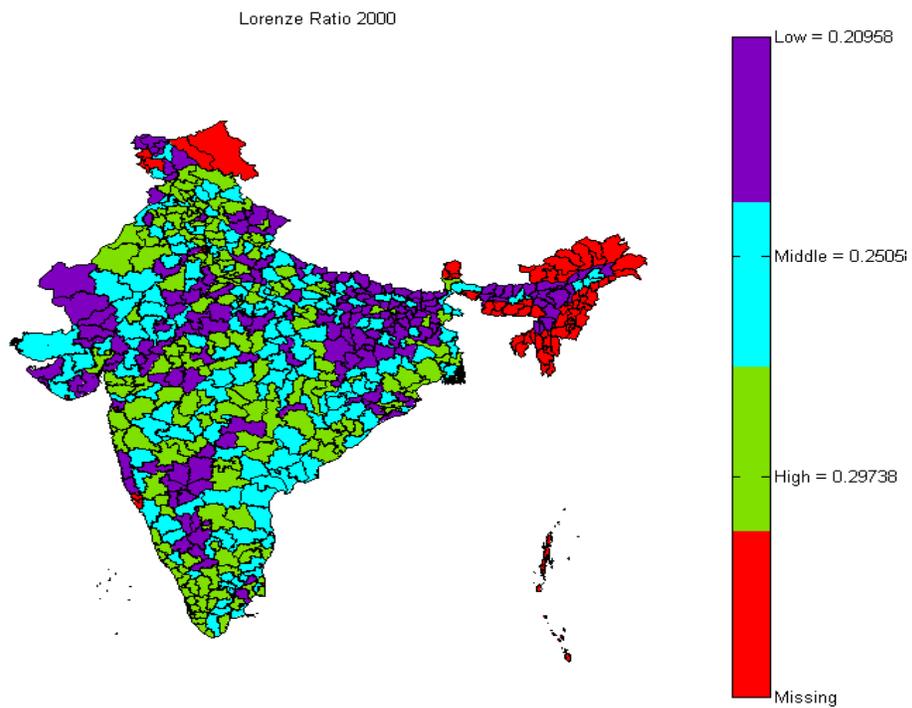
Figure 4a: Murder Total 2000/01

Murder Total
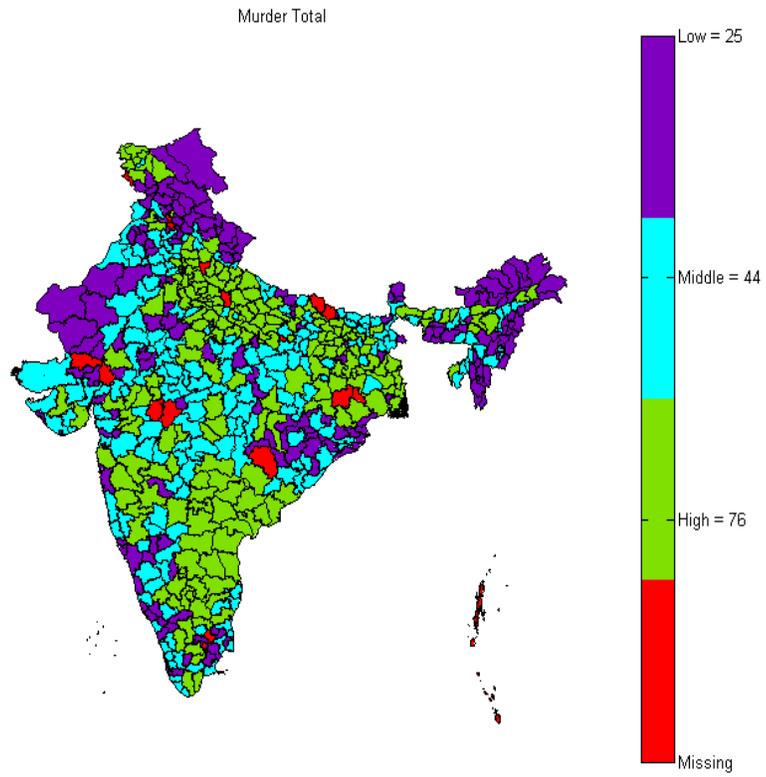
Figure 4b: Sex Ratio 2000/01

Dynamic Analysis

In the dynamic context we look at the Density of per-capita District GDP. Since, Gurgaon has consistently remained the richest District for the time period between 1999 and 2006, we assume per-capita income growth rate for Gurgaon as a proxy for the growth rate of technology frontier for India. Income of other District's per-capita GDP relative to Gurgaon per-capita GDP will give an indication about convergence (catching up), or divergence (lagging behind) of that particular District towards, or away from the national technological frontier. Ergo, density is drawn for per-capita District GDP relative to the richest District, which is, Gurgaon. The density estimates are computed using the Epanechnikov kernel with a bandwith chosen for optimizing normal densities.[8]

Figure 5 (a) capture the income density dynamics between 1999/00 and 2004/05. Contrary to the popular belief that: rich are becoming richer faster than the poor are becoming rich, our results indicate that there does not exist any noticeable evidence about divergence of District level per-capita income. Repeating this exercise for 2000/01 and 2004/05 (see, Figure 5b) yields similar result.

Figure 5(a): Kernel density for per-capita District GDP for 1999/2000 and 2004/05
(Scale adjusted by highest District's income).

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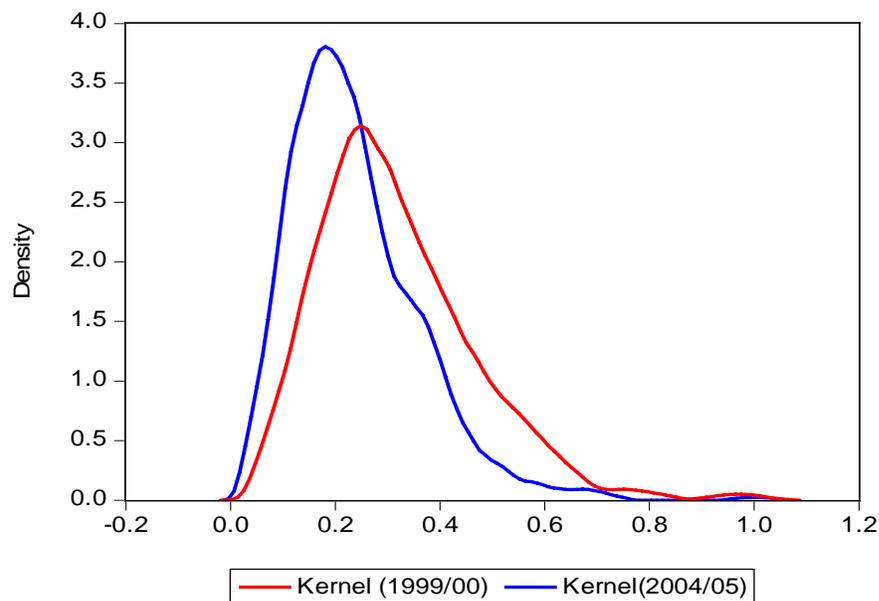
[8] Compared to other kernels (Gaussian, Uniform, Triangular, and Biwieght), Epanechnikov kernel minimizes the Asymptotic Mean Integrated Square Error, and hence is chosen for this analysis.

Figure 5(b): Kernel density for per-capita District GDP for 2000/01 and 2004/05
(Scale adjusted by highest District's income).
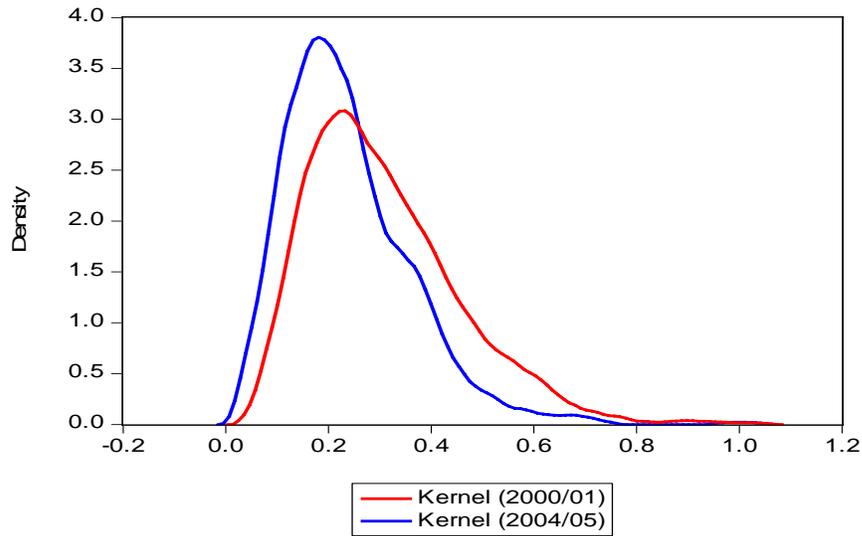
To examine the robustness of our results (as to whether actually per-capita income density has changed) we drew median adjusted Kernel density. So instead of taking Gurgaon as the base District, this time we took the median income of the District. For any particular year we adjusted any District's income with the median District income for that year. The results are reported in Figure 6 and Table 3. The results support the earlier findings. The increase in standard deviation between 1999/00 and 2004/05 is not statistically significant. The other moments: Kurtosis and Skewness, also do not indicate any significant change in per-capita income density.

Figure 6: Kernel density for per-capita District GDP for 1999/2000 and 2004/05
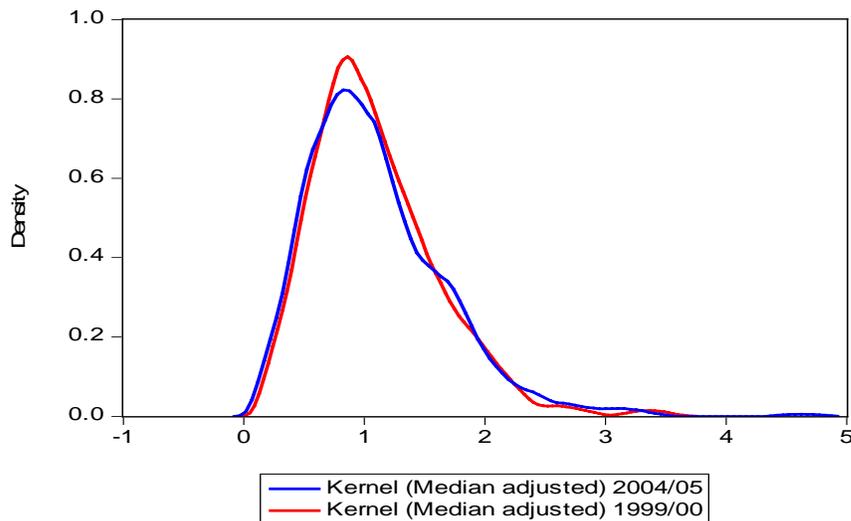(Scale adjusted by Median)

TABLE 3
Summary Statistics

	1999/00 Income (Scale adjusted by Median)	2004/05 Income (Scale adjusted by Median)
Mean	1.091178	1.098093
Median	1.000000	1.000000
Maximum	3.456400	4.622433
Minimum	0.242157	0.219618
Standard Deviation	0.510955	0.566695
Skewness	1.077775	1.346547
Kurtosis	4.886474	6.570408
Observations	508	508

In short, there has been no evidence about change in income density. This means there has not been a significant divergence happening at a per-capita District level income. What about the growth rates of income? Figure 7 depict Kernel density for the growth rate of per-capita District income between 1999/2000 and 2004/05. Remarkably, we find that relative to the fiscal 1999/2000, for the fiscal 2004/05 the difference in income growth rate has reduced across Districts.

Figure 7: Kernel density for the growth rate of per-capita
District GDP between 1999/2000 and 2004/05.
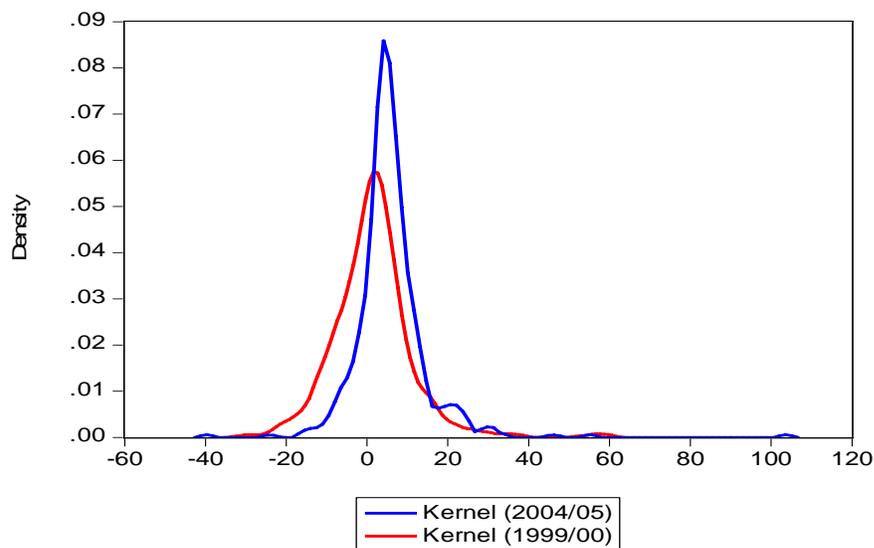
In summary, examination of dynamic analysis suggested lack of evidence against divergence of District level per-capita income.

Alternatively, as depicted in Figure 8, there is no clear evidence about emergence of spatial divergence in income. What this figure suggests, that Districts which are above 45 degree line has done relatively well, and the one below 45 degree lines are falling behind.

Going by this figure, one cannot clearly demarcate emergence of spatial (east, west, south, central, and north) divergence of income across India.

Figure 8: Relative District per-capita income 2000/01 versus 2004/05.
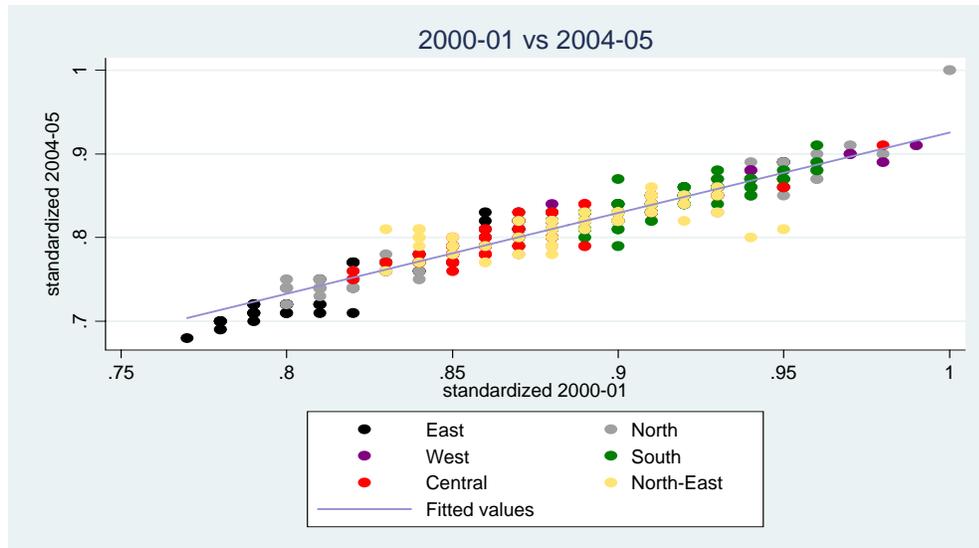
The above results suggest that not only India has grown fast but also the effect of growth has percolated towards providing better development indicators.

Spatial Analysis of Income and Development Indicators: Finally, we want to examine whether our income and development indictors are regional, or India specific. Emergence, or clustering of growth and development centers would yield a low or even negative spatial-correlations among regions, but if all regions are on average similar then there will be positive spatial correlations among regions. We form idea about spatial correlation using Moran's Index.

The Moran's index introduced in 1950 the first measure of spatial autocorrelation in order to study stochastic phenomena, which are distributed in space in two or more dimensions. Imagine India as a network, with each district a node in the network. Moran's correlation of a variable *y* defined on a spatial network (*W*) with *n*–nodes (districts) is:

$$I\left(y \,:\, W\right) = \frac{\sum_{i,j=1}^{n} w_{ij}\left(y_i - \overline{y}\right)\left(y_j - \overline{y}\right)}{trace(W'W) * \sigma\left(y\right)}$$

where $\sigma(y)$ is the standard deviation of the variable. w_{ij} ∎1 if the District *i* is adjacent to District *j* , and zero otherwise if the Districts are not adjacent. In that case, the diagonal elements will be zero (w_{ii} ∎0.) Like a correlation coefficient the values of Moran's I range from +1 - meaning strong positive spatial autocorrelation, to 0 - meaning a random pattern, to -1 indicating strong negative spatial autocorrelation.

In our study the variable *y* can be either income (growth, inequality), or development indicator variables, like IMR, LEB, sex ratio, literacy rate, etc. The results are reported in Table 4.

TABLE 4

All India Moran Indices

Variable	Moran Index	Expected Value	Variance
'Lorenz Ratio 2000 '	0.39	0.00	1.07
'PCI Growth 2000-2004 '	0.45	0.00	1.07
'Projected PCI 2020 '	0.16	0.00	1.07
'PCI (Rs) 1999-2000'	0.60	0.00	1.07
'PCI (Rs) 2004-05'	0.58	0.00	1.07
'IMR'	0.42	0.00	1.07
'LEB'	0.44	0.00	1.07
'Sex ratio'	0.67	0.00	1.08
'Literacy'	0.68	0.00	1.08
'Household with Electric Connection'	0.79	0.00	1.08

Our results indicate 'Literacy Rate' has a highly positive Moran Index implying literacy/illiteracy is more or less uniform all over India. Same with infrastructure development as indicated by 'Households with Electric Connection'. Low positive correlation among IMR and LEB shows health infrastructure in India is geographically patchy or there are pockets of excellence in health care provision.

'Lorenz ratio' and 'Per capita Income (PCI)' shows lower but significant positive spatial correlation. There is no significant change in the PCI Moran Index between 1999-2000 and 2004-2005 implying geographic distribution of PCI remains the same. There does not seem to be any evidence of increase of geographic clusters of deprivation and/or prosperity.

5. CONCLUSION

This paper finds that during post reforms period (specifically post 1999), not only India has grown fast but also the effect of growth has percolated towards providing better development indicators. We also find evidence about distribution of income becoming more equal at a District level. In general, there is no strong evidence about emergence of cluster at all India level. For the time period between 1999 and 2005, the Districts in the State of Rajasthan and Orissa have done particularly well, whereas, there were evidence about pockets of deprivation in the Districts of Uttar Pradesh and Bihar.

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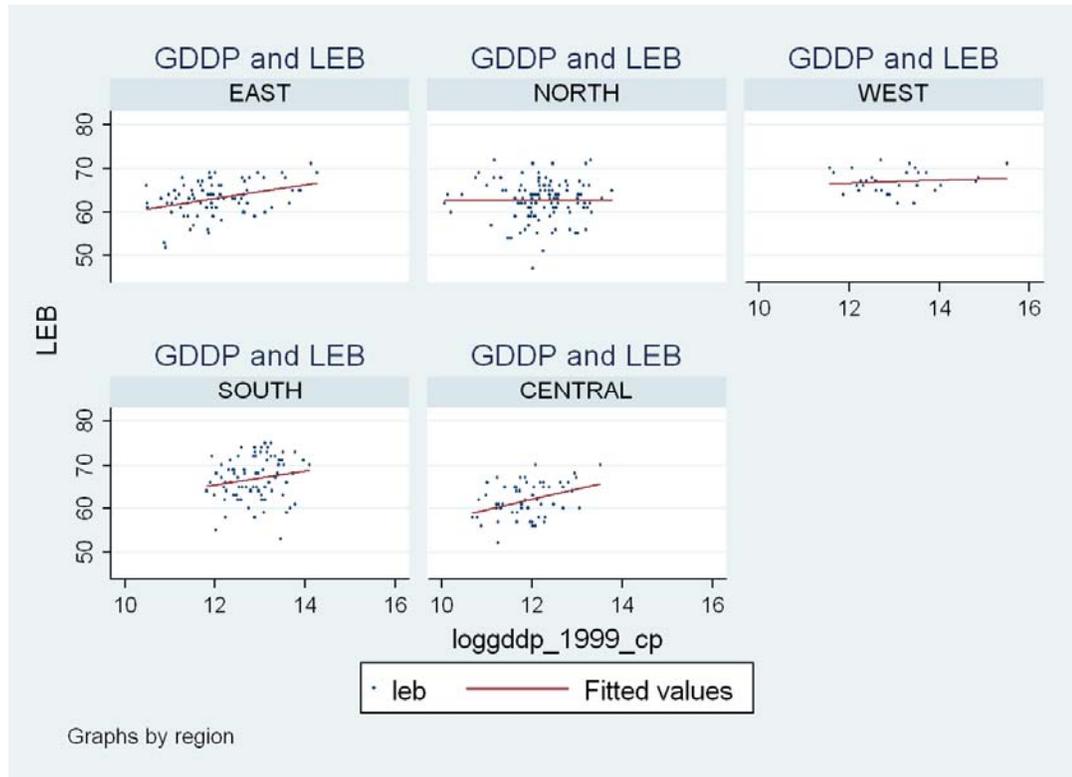
APPENDIX

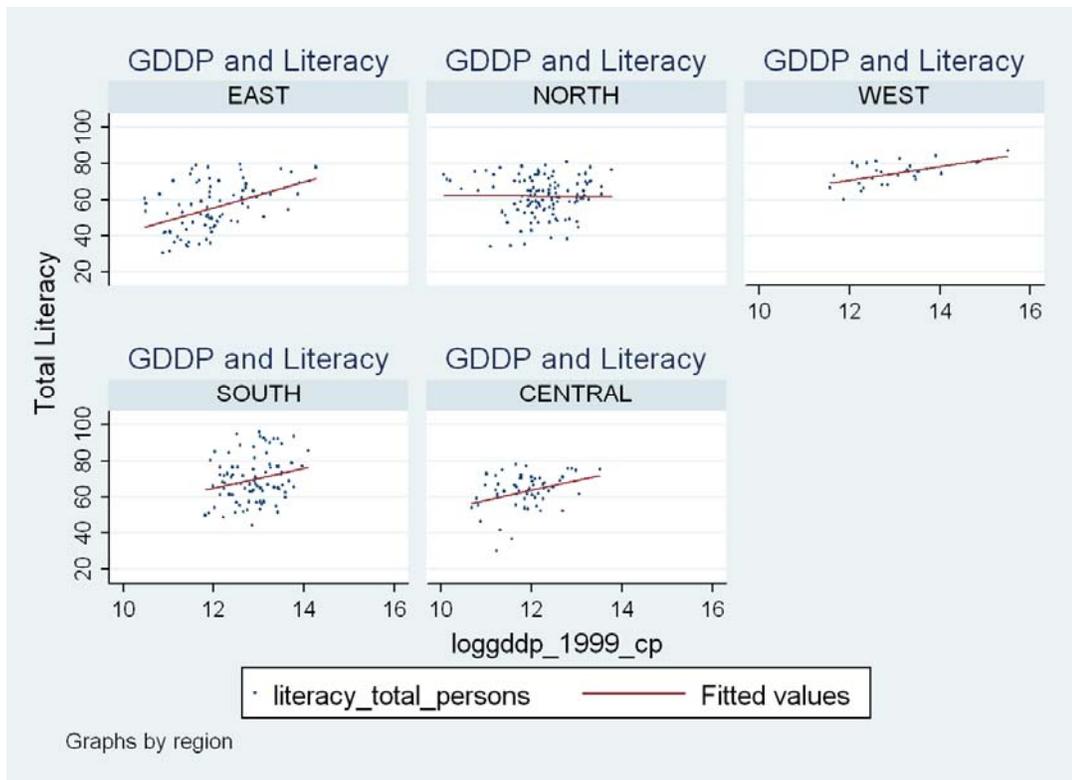**Scatter Plot 1:** Per-capita District GDP and Infant Mortality Rate
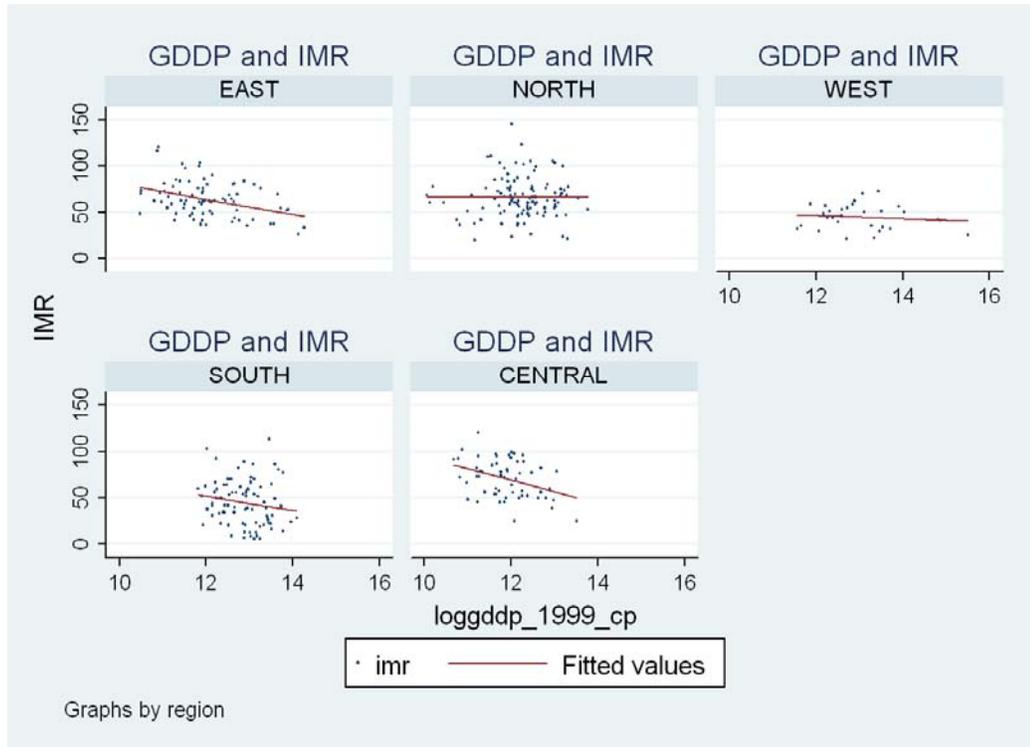
Scatter Plot 2: Per-capita District GDP and numbers of Murder Committed
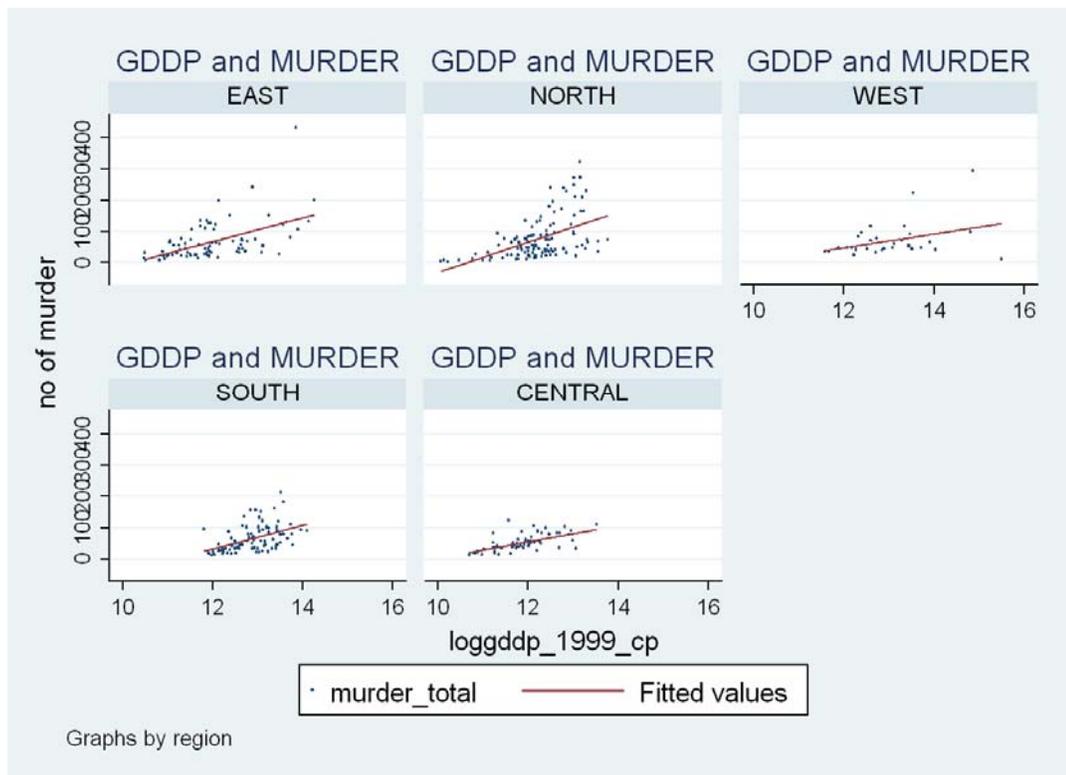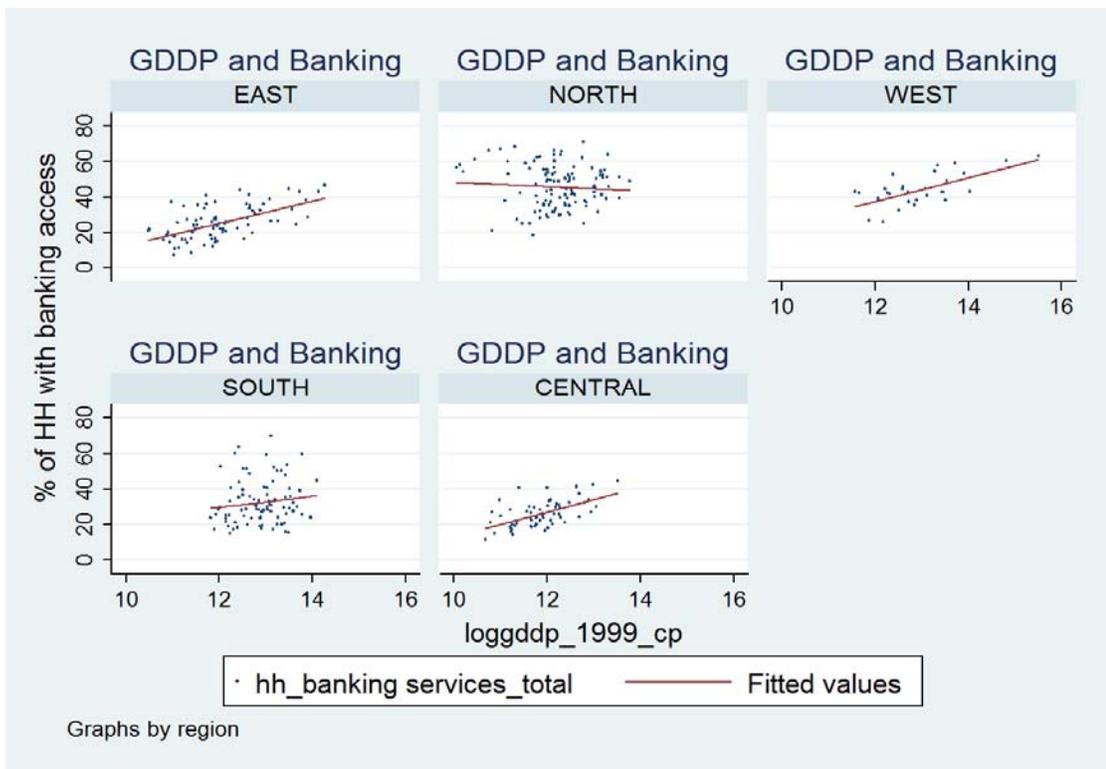
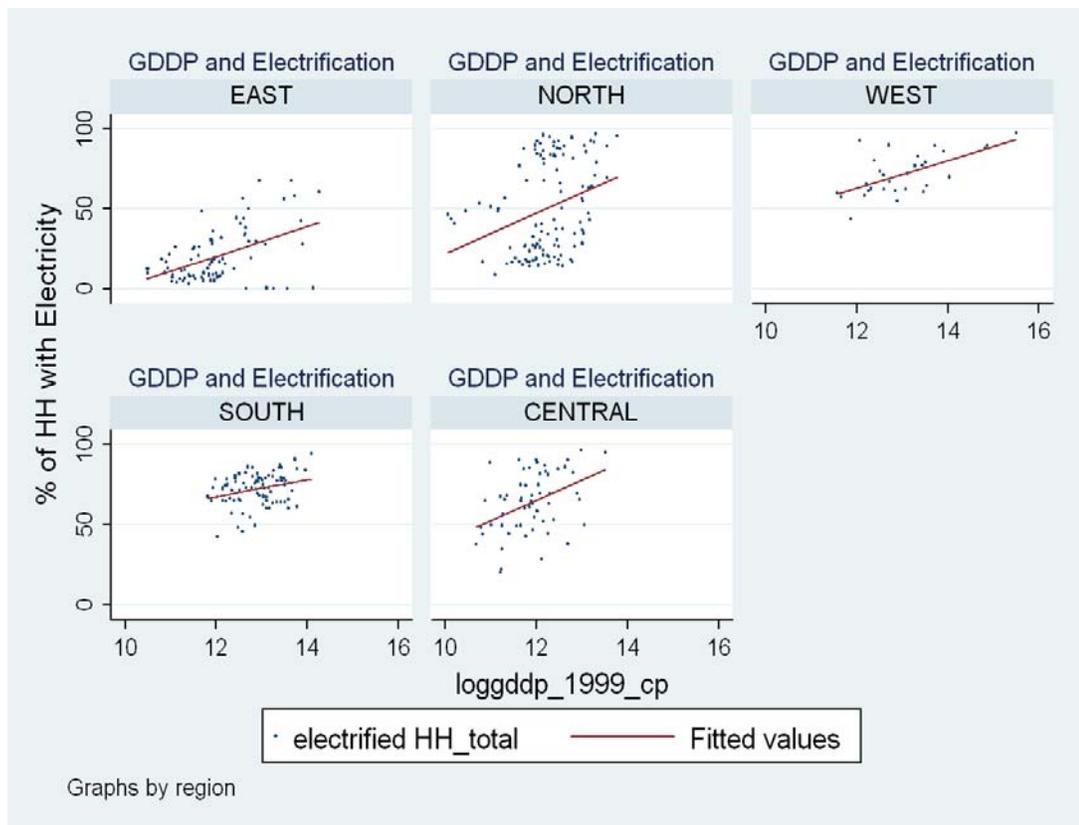**Scatter Plot 3:** Per-capita District GDP and Life Expectancy at Birth

Scatter Plot 4: Per-capita District GDP and Literacy Rate

Scatter Plot 5: Per-capita District GDP and number of Banks

Scatter Plot 6: Per-capita District GDP and Electrification