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INEQUALITY, INCOME DISTRIBUTION AND GROWTH IN MAHARASHTRA IN THE 2000s

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Abstract

The paper analyses the inter-district inequality of per capita incomes in Maharashtra for the period 2001-2009 and finds that inter-district inequality rose for the period 2001-05 and subsequently declined. Though it has been rising, it is at a lower level than that observed for 2001-05. This has been accompanied by shifts in the relative ranking of different districts across the income distribution. Data does not point to the convergence of per capita incomes across districts. The historical composition of incomes, in particular the share of the tertiary sector in GDP, is an important predictor of divergence in district per capita incomes.

Keywords: Inequality, Income Distribution, Convergence, Maharashtra

JEL Code(s): O47

Inequality, Income Distribution and Growth in Maharashtra in the 2000s

I Introduction

Maharashtra's economy has witnessed an annual average growth rate of 8.13% during the decade 2001-10. This is the third highest growth rate after Haryana and Gujarat which saw an annual average growth rate of 8.95% and 8.68% respectively among the non-special category States. Maharashtra also has the highest average per capita income of Rs. 45,575 (excluding Goa) among the non-special category States for the decade 2001-10. In spite of its affluence, the State historically has had a skewed distribution of income. This has resulted in regional inequalities within the State, causing much concern as well as political unrest among the so called backward regions like Vidarbha which lie in the eastern part of the State. Maharashtra has six administrative divisions and Table 1 depicts the districts in each division.

Table 1 Districts and Administrative Divisions of Maharashtra

Konkan Division	Nashik Division	Pune Division	Aurangabad Division	Amravati Division	Nagpur Division
Mumbai Thane Raigad Ratnagiri Sindhudurg	Nashik Dhule Nandurbar Jalgaon Ahmednagar	Pune Satara Sangli Solapur Kolhapur	Aurangabad Jalna Parbhani Hingoli Beed Nanded Osmanabad Latur	Buldhana Akola Washim Amravati Yavatmal	Wardha Nagpur Bhandara Gondia Chandrapur Gadchiroli
Western Maharashtra represents Pune and Nashik divisions Vidarbha represents Amravati and Nagpur divisions Marathwada represents the Aurangabad division					

The annual average growth rate of per capita Gross District Domestic Product (GDDPPC) for the districts of Maharashtra for the period 2001-09 are presented in Table 2. Over the period 2001-09, the districts of Maharashtra had an annual average growth rate of 8.67%. Districts like Sindhudurg, Nandurbar, Jalgaon, Ahmednagar, Satara, Sangli, Solapur, Jalna, Parbhani, Hingoli, Beed, Osmanabad, Latur, Buldhana, Washim , Amaravati, Yavatmal and Gondia grew faster than the State average. It is worth noting that the relatively faster growing districts are primarily concentrated in the Marathawada and Vidarbha regions of Maharashtra, which have been historically associated with low levels of economic development.

Table 2 Annual Average Growth Rate of Per Capita GDDP (1999-2000 prices)

District	GDDPPC	District	GDDPPC
Mumbai	4.79	Parbhani	11.86
Thane	5.85	Hingoli	14.29
Raigad	2.33	Beed	11.94
Ratnagiri	7.14	Nanded	8.23
Sindhudurg	10.77	Osmanabad	10.75
Nashik	8.31	Latur	9.28
Dhule	6.73	Buldhana	9.94
Nandurbar	13.50	Akola	8.22
Jalgaon	10.08	Washim	10.56
Ahmednagar	8.74	Amravati	8.91
Pune	6.14	Yavatmal	9.91
Satara	8.88	Wardha	8.02
Sangli	9.61	Nagpur	6.35
Solapur	9.74	Bhandara	8.59
Kolhapur	8.48	Gondia	9.02
Aurangabad	6.40	Chandrapur	5.81
Jalna	11.23	Gadchiroli	4.23
Mean Growth	8.67	Mean Growth	8.67

This indicates that substantial changes might be underway in the regional distribution of per capita incomes across districts in Maharashtra. The paper takes a look at the changes in inter-district inequality in per-capita incomes over the period 2001-09 and seeks answers to the following two questions a) What are the observed trends in inequality across the period and b) What could be a plausible explanation for the observed trends? The second question is particularly pertinent since it points to the extent to which policy interventions can redress the issue. Section II of the paper reviews, in brief, other studies on growth and inequality in Maharashtra while Section III discusses the data source and methodology adopted in the paper. Empirical evidence is presented in Section IV and Section V concludes the paper.

II Other Major Studies

The Dandekar Committee was appointed by the Government of Maharashtra in 1984 to examine regional imbalance in the State and suggest measures to achieve greater regional equality. The Committee studied the extent of the backlog but did not identify districts as developed or backward, making it difficult to have an idea of the levels of development of districts in the State. The State Planning Board appointed a Study Group in 1993 to identify backward areas and the Group identified 17 backward districts, of which six districts were in Marathwada region, eight districts in Vidarbha and three in the rest of the State. The Indicators and Backlog Committee appointed in 1995 found that regional imbalance between the three regions of the State viz. Marathwada, Vidarbha and rest of Maharashtra (comprising of Greater Mumbai, Konkan and Western Maharashtra) had increased fourfold (Kurulkar, 2003). Other studies like Prabhu and Sarkar (1992, 2003) examined levels of development across the districts in Maharashtra for 1985-86 using three different techniques, viz. ranking, indexing and principal components, noting that all the districts of western Maharashtra with the exception of Dhule, were classified as belonging to medium and high levels of development while all the districts in Marathwada, except Aurangabad, and six out of nine districts in Vidarbha were classified as belonging to the category of underdeveloped districts. Desarda (1996) pointed out that the backward regions of Vidarbha, Marathwada and parts of Konkan had not only suffered neglect but the growth model of western Maharashtra had been '*foisted*' on these districts which was not in sync with either their agro-climatic or socio-political features. The paper further noted that irrigation and power were crucial to this (western Maharashtra) growth model and hence over a long period of time '*more than half of the State's plan funds (were) spent on these two sectors*'(p.3233). Desarda opines that '*A peoples' movement to challenge the current growth processes which are parasitic and resource-squandering seems to be the only answer to balanced regional development, which should be firmly rooted in the specificities of factor endowment rather than copying the west or western Maharashtra*'(p.3234). Kurulkar (2003) discussed in detail the measures taken to examine and address regional disparity in Maharashtra and commented that during the period 1985-86 to 2000 the objective of reducing regional disparities had not been achieved and suggestions of various expert groups to allocate additional funds apart from the backlog funds had not been attained. Shaban (2006) econometrically analyzed the sectoral and aggregate per capita incomes over the period 1993-94 to 2002-03 and found a convergence in incomes across the regional economies in Maharashtra accompanied with significant differences in the rates of convergence across sectors and regions. The paper too finds Marathwada and Vidarbha to be the most underdeveloped regions of the State and finds evidence for 'spatial spillovers' on the regional patterns of economic development. Misra (2009) finds with the help of an updated human development index that districts in Western Maharashtra were relatively better placed than those is Marathwada or Vidarbha. Previous studies have been concerned with measuring regional disparities in various facets of economic backwardness. The focus of the current study is relatively limited in that we concentrate on inter-district inequalities in per capita incomes.

III Data and Methodology

Growth is measured in terms of Gross District Domestic Product per capita (GDDPPC) (at 1999-2000 prices) based on computations of district incomes by the Directorate of Economics and Statistics, Government of Maharashtra for the 34 districts of the State. The estimation of district incomes is a relatively recent development and the estimates are rightly regarded as tentative and are beset with several problems. In particular, even when the income accruing approach might be more relevant to the issues in this paper, because of the limitations on using this approach at the district level, district incomes are estimated using the income originating approach (CSO, 2008). The estimation of tertiary sector output at the district level is even more challenging, with State level estimates being allotted at the district level in proportion to the workforce at the district level. This implicitly assumes that labour productivities in the tertiary sector are identical across districts, when in reality, differential labour productivity across districts might be crucial to regional inequality. In spite of these limitations, district level estimates remain important for understanding living standards at the district level, simply because nothing else is available.

III.A Income Distribution

The paper initially examines the income distributions across districts for the period 2001-09 with the help of non-parametric kernel density functions for years 2001-02, 2004-05 and 2008-09.

A non-parametric kernel density estimate is given by

$$\phi_K(x) = \frac{1}{nh}\sum_{i=1}^{n} K(\frac{x - x_i}{h}) \qquad (1)$$

with K(x) usually chosen as a symmetric probability density function satisfying the condition

$$\int_{-\infty}^{\infty} K(x)dx = 1 \qquad K(x) = K(-x) \qquad (2)$$

Often K(x) is selected so that K(x) = 0 for |x| > 1. In this paper, we have used the Gaussian kernel (Cameron and Trivedi (2005). h is also known as the smoothing parameter or bandwidth. The choice of h, or the bandwidth is crucial. The optimal bandwidth here has been calculated using Silverman's plugin estimator

$$h^{\wedge}_{opt} = \frac{0.9\sigma^{\wedge}}{n^5} \qquad (3)$$

where, $\sigma^{\wedge} = \min(s, R/1.34)$, s is the sample estimate of the standard deviation and R is the interquartile range, n is the number of observations (Silverman, 1986).

Although kernel estimates are the most widely used density estimates they do suffer from some drawbacks, especially when applied to long-tailed distributions. The concentration of observations has an intrinsic variability with the value of Ø(x): the naturally low probability of acquiring data in regions where Ø is small results in a tendency for the density estimate to be noisy in the tails of the distribution. This effect can be mitigated by broadening the kernel (increasing h), but only at the expense of potential loss of resolution near the center of the distribution where the data are denser: the center of the distribution may appear too broad, and one runs the risk of missing details such as multiple modes that could reflect interesting physical properties inherent in the data. Also, when the support of the original random variable is bounded, the kernel density function has to be transformed to reflect this.

In this paper, we have developed a measure to quantify the relative inter-district and regional movements across various portions of the income distribution between an initial period t_o and a terminal period t_1. Suppose district A lies in the ith quartile of the distribution of district per capita incomes in t_o and in quartile j in t_1. A measure of the movement of district A across the income distribution in time is simply j-i , which we will refer to as $(j-i)_A$. The measure is bounded between 3 and -3. A district gains rank if it moves from the lower parts of the income distribution to the higher parts, while a district will lose rank if it moves from the higher quartiles to lower quartiles. If region G contains districts A, B, and C, and the per capita incomes in the three districts in time t_o were $pci_{At_o}, pci_{Bt_o}, pci_{Ct_o}$, then a measure of the movement of the region as a whole is

$$regionrank = (j-i)_A * (pci_{At_o} / \sum_{i=A}^{C} pci_i) + (j-i)_B * (pci_{Bt_o} / \sum_{i=A}^{C} pci_i) + (j-i)_C * (pci_{Ct_o} / \sum_{i=A}^{C} pci_i) \quad (4)$$

This gives us a measure for estimating the improvement of a region relative to other regions.

Recently, Generalised Entropy Measures , a class of measures to analyse inequality, have been widely used. The general formula is given by (World Bank 1999):

$$GE(\alpha) = \frac{1}{\alpha(\alpha-1)} \left[\frac{1}{N} \sum_{i=1}^{N} \left(\frac{y_i}{\bar{y}} \right)^{\alpha} - 1 \right]$$

Where $\bar{y}$ is the mean income across districts. The value of the GE measure varies between 0 and ∞, with zero representing an equal distribution, while higher values represent increasing inequality. The parameter α in the GE class represents the weight given to distances between incomes at different parts of the distribution, and can take any real value. For lower values of α, the GE is more sensitive to inequality in the lower tails. The common values of α are 0, 1,and 2.GE(1) gives the Theil's T index while GE(0) gives the log mean deviation. An attractive feature of the GE measures is that they can be decomposed as the sum of within group and between groups inequality. For GE(1), we have (representing total inequality by T)

$$\text{GE(1) = T = } \sum_j \left(\frac{y_j}{y} \right) T_j + \sum \left(\frac{y_j}{y} \right) \ln \left(\frac{y_j / y}{N_j / N} \right)$$

where , y_j is the income of a subgroup, N the total population, and N_j the population of the subgroup. The first term represents the within group inequality whereas the second term represents the between group inequality. Letting L represent GE (0), we have

$$L = \sum_j \left(\frac{N_j}{N} \right) L_j + \sum_j \frac{N_j}{N} \ln \left(\frac{N_j / N}{y_j / y} \right)$$

where, again, the first term represents within group and the second term represents between groups inequality.

III.B Spatial Regression Analysis

The paper, in addition also studies convergence in per capita incomes (sigma and beta) across districts in Maharashtra. Whilst studying regional variation in growth rates, it becomes imperative to account for spatial spillovers of economic activity. In particular, it is important to take into account the spatial structure of autocorrelation of residuals in order to obtain correct specifications. The standard OLS regression equation is written as follows,

$$y = \propto + \beta X + \varepsilon \qquad (5)$$

where, y is a vector of dependent variable, and X presents independent variables and ε denotes the vector of normally distributed, homoscedastic and uncorrelated errors. The standard OLS regression treats regions as independent economic entities or as '*isolated islands*'. Therefore, when the variables are spatial units e.g. cross–sectional observations on regional income, employment or observations on a group of neighbouring districts in a region, the results of the standard OLS regression may be biased and inconsistent due to the presence of spatial autocorrelation. Hence, these spatial spillovers need to be specifically modeled. Spatial analysis requires the creation of a spatial contiguity (weights) matrix which provides a unified approach to incorporating the spatial configuration information and reflects the intensity of the geographic relationship between observations in a neighborhood. The simplest is the binary contiguity matrix, where the element (i,j) of the spatial weight matrix, w_{ij} = 1 if region i and j share a border, and zero otherwise.

Spatial autocorrelation can be defined as the phenomenon that occurs when the spatial distribution of the variable of interest exhibits a systematic pattern (Cliff and Ord, 1981). Spatial correlation when positive implies that the value taken on by y at each location i tends to be similar to the values taken on by *y* at spatially contiguous locations while negative spatial autocorrelation would mean that the value taken by *y* at each location *i* tends to be different from the values taken on by *y* at spatially contiguous locations. In other words, significant positive spatial autocorrelation indicates the clustering of similar values across geographic space while significant negative spatial autocorrelation indicates that neighboring values are more dissimilar. There are several measures of spatial autocorrelation, namely, Moran's I, Geary's c and Getsi and Ord's G. This paper employs the widely used Moran's I statistic. For a row standardised (sum of each row equals 1) spatial weights matrix, Moran's I is computed as follows:

$$I = (n / s_0) \sum_{i=1}^{N} \sum_{j=1}^{N} w_{ij} x_i x_j / \sum_{i=1}^{n} x_i^2 \quad (6)$$

where, n is the number of observations, w_{ij} is the element in the spatial weight matrix w corresponding to the region (i,j), the observations x_i and x_j are deviations from mean values for region i and j, respectively, and s_0 is the normalising factor equal to the sum of the elements of the weight matrix, i e, $s_0 = \Sigma_i \Sigma_j w_{ij}$

With a null hypothesis of no global spatial autocorrelation, the expected value of I is given by

$$E(I) = -1/(N-1) \quad (7)$$

If the computed I is larger than the expected value, then the overall distribution of variable y can be seen as being characterized by positive spatial autocorrelation and if the computed I is smaller than the expected value, the overall distribution of y is characterized by negative spatial autocorrelation. Moran's I lies between -1 and +1. A negative value of Moran's I would indicate negative spatial autocorrelation and vice versa

The spatial regression analysis considers two kinds of spatial models – the spatial error model and the spatial lag model.

The spatial error model is as follows:

$$Y = \alpha + \beta X + \varepsilon \quad (8)$$

The spatial error models takes the form of a spatial autoregressive process in the error term ε where $\varepsilon = \lambda W \varepsilon + \mu$ and λ denotes the spatial autoregressive parameter and μ represents a vector of homoscedastic and uncorrelated errors. The final choice between the two models can be made based on an appropriate test statistic. The spatial lag model is a mixed regressive spatial autoregressive process and can be represented in the following form:

$$y = \rho Wy + \beta X + \mu \quad (9)$$

where, ρ - spatial autoregressive parameter, W_y – the spatially lagged dependent variable (Anselin, 1999; LeSage, 1997; Quah, 1996)

IV Empirical Evidence

The paper, at the outset, analyzed the distribution of per capita GDDP in 2001 across districts of Maharashtra so as to identify districts in the lowest and highest quartile. The results of the quartile distribution of per capita GDDP in 2001 are in Table 3.

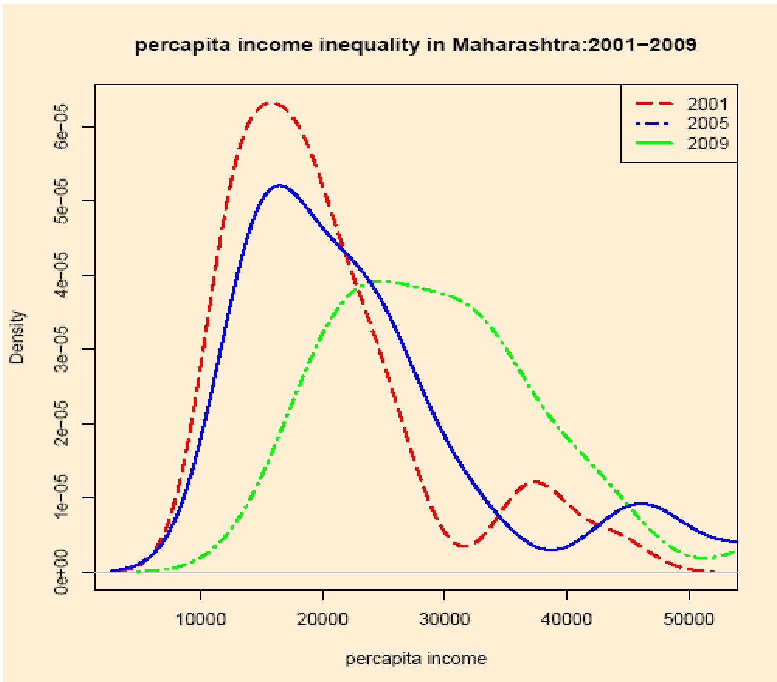
Table 3 Quartile Distribution of Per Capita GDDP in 2001

Districts in First Quartile	Districts in Second Quartile	Districts in Third Quartile	Districts in Fourth Quartile
Washim	Osmanabad	Ahmednagar	Aurangabad
Buldhana	Dhule	Jalgaon	Sangli
Hingoli	Yavatmal	Ratnagiri	Nashik
Nanded	Beed	Wardha	Kolhapur
Nandurbar	Gondia	Solapur	Nagpur
Jalna	Akola	Sindhudurg	Thane
Gadchiroli	Amravati	Satara	Pune
Latur	Bhandara	Chandrapur	Raigad
Parbhani			Mumbai

The districts which appear in the first two quartiles have a per capita GDDP lower than the median and represent the low income districts while districts in the third and fourth quartile have per capita GDDP higher than the median and are the high income districts in 2001. Table 3 highlights some interesting patterns – no district from the Konkan and Pune divisions fall in the first quartile while no district from the Amravati division lies in the fourth quartile. With the exception of Aurangabad none of the other districts from the Aurangabad/Marathwada division are in the fourth (highest per capita income) quartile. Of the nine districts that comprise the first quartile, 55% of the districts are from Aurangabad/Marathwada division, 20% from the Amravati division and almost 10% each from the Nashik and Nagpur divisions whereas a third of the nine districts that comprise the fourth quartile are dominated by the Konkan and Pune divisions and 10% of the districts are from the Nasik, Aurangabad and Nagpur divisions. There is, thus, a greater concentration of richer than average districts in Konkan and Western Maharashtra.

The non-parametric estimates of the distribution of per capita incomes across districts for three years, 2000-01, 2004-05 and 2009-09 are plotted in Figure 1. It is evident from the graph that that there has been an increase in mean incomes in 2009 as compared to 2001 and 2005. The period 2005-09 seems to have been associated with a significant expansion of average district incomes. But along with this expansion, the income distribution has also become more equal. The peak has become much more flat, and the right hand tail also has become fatter especially after 2005. On the other hand, the income distribution does not seem to have shifted a great deal between 2001 and 2005.

Figure 1



In view of the shift in inter-district distribution of incomes, we proceed to examine the shifts in the relative position of individual districts between 2005 and 2009. Such an analysis will enable us to identify those districts whose relative position has improved or deteriorated over the period. Table 4 displays the ranks of the various districts in Maharashtra according to their positions in various quartiles of the income distribution in 2005 and 2009 as also the change in ranks over the period.

Table 4 Ranking of Districts in Maharashtra (Income Distribution):2005 and 2009

District	Rank 2005	Rank 2009	Rank difference	District	Rank 2005	Rank 2009	Rank difference
Ahmednagar	3	2	-1	Nagpur	3	4	1
Akola	1	2	1	Nanded	3	4	1
Amravati	2	3	1	Nandurbar	2	1	-1
Aurangabad	4	4	0	Nashik	4	1	-3
Beed	3	2	-1	Osmanabad	4	1	-3
Bhandara	2	2	0	Parbhani	1	4	3
Buldhana	1	4	3	Pune	4	3	-1
Chandrapur	3	1	-2	Raigad	4	1	-3
Dhule	2	3	1	Ratnagiri	2	2	0
Gadchiroli	1	1	0	Sangli	4	3	-1
Gondia	1	3	2	Satara	3	1	-2
Hingoli	1	2	1	Sindhudurg	1	4	3
Jalgaon	3	3	0	Solapur	4	2	-2
Jalna	2	3	1	Thane	4	3	-1
Kolhapur	3	2	-1	Wardha	1	4	3
Latur	2	1	-1	Washim	2	1	-1
Mumbai	4	4	0	Yavatmal	1	4	3

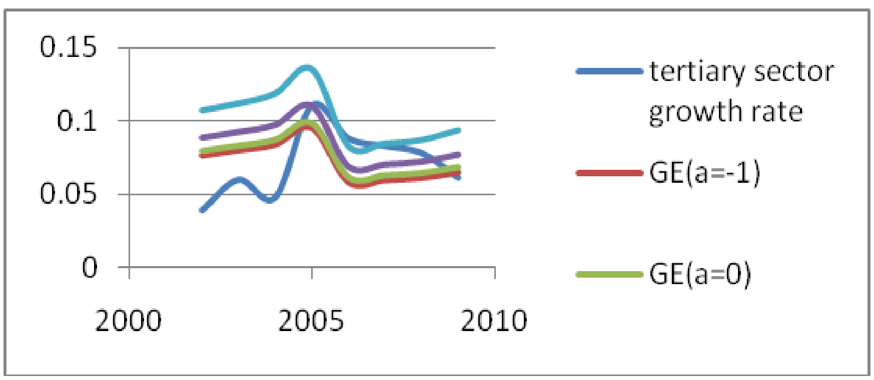
It can be noted from Table 4 that in terms of the ranks, Nasik, Osmanabad and Raigad have been the greatest losers in relative ranking, moving from the fourth quartile to the first quartile. On the other hand, Buldhana, Parbhani, Sindhudurg, Wardha and Yavatmal have gained by moving from the lowest quartile to the highest. Buldhana, Yavatmal and Wardha belong to the Amaravati and Nagpur divisions which constitute the Vidarbha region. Chandrapur, Satara and Solapur have moved from the third quartile to the first, and hence lost rank. On the other hand, Gondia has moved from the first quartile to the third quartile, improving its rank. Ahmadnagar, Beed, Kolhapur, Latur, Nandurbar, Pune, Sangli, Thane and Washim have all moved one quartile below their position in 2005, while Akola, Amaravati, Dhule, Hingoli, Jalna, Nagpur and Nanded have all improved their relative ranking by one quartile. The only static cases are Gadchiroli, which has continued to remain in the bottom quartile; Mumbai and Aurangabad have retained their positions in the top quartile and Ratnagiri continues in the second quartile.

The inter-quartile shifts have happened across the subdivisions. How does this translate into inter-division movements? We calculate the region ranks using the methodology outlined in

Section II. Konkan, Nasik and Pune divisions have lost rank, moving one quartile down, while Amaravati and Nagpur have moved one rank up. The rank of Aurangabad division has remained unchanged.

The generalized entropy inequality measures for different values of α (-1, 0, 1, 2) are plotted for the years 2002 to 2009 in Figure 2. Inter-district inequality as measured by all the four measures increased during 2002 -05 and then declined for the next year. There was a significant one time reduction in inequality in 2005 and inequality after 2005 has been consistently lower than the period prior to 2005. Further, the inequality measures mirror the growth rate of the tertiary sector thus emphasizing the association between differential growth rate of the tertiary sector across districts and inequality. The period of rapid growth in the tertiary sector (2002-2005) was also associated with rising inter-district inequality while the period of deceleration in tertiary sector growth is also associated with declining inequality. This supports the findings from the conditional regression equations (reported below) of the tertiary sector share being a significant driver of inequality.

Figure 2 Measures of Generalized Entropy and Tertiary Sector Growth



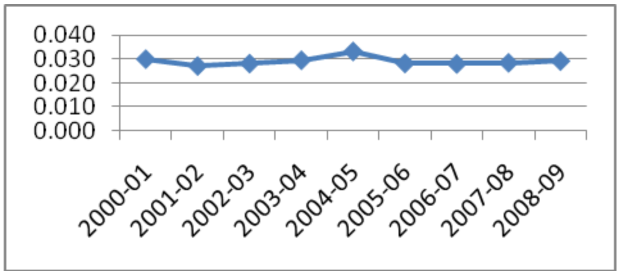
The generalized entropy is Theil's inequality index when α=1. It is possible to decompose total regional inequality as between districts and inequality among divisions (subgroups of districts). Our estimate of Theil's index shows that inequality between districts has declined from 0.18 in 2000-01 to 0.03 in 2008-09. During the same period inequality between divisions also declined from 0.01 in 2000-01 to 0.008 in 2008-09. In 2000-01, 94% of the total inequality could be explained by inter-district variations, while only 6% could be explained by inter-divisional variations. In 2008-09, even when total inequality declined, 78% of the total regional inequality was to be attributed to inter-district differences rather than inter-divisional variations. It is pertinent to note that the inequality between administrative divisions has always been of a much lower magnitude compared to inequality between districts that compose these subdivisions.

Given that the inequality in the distribution of per capita GDDP has declined across districts in Maharashtra especially over the period 2005-09, the paper also seeks to examine whether any convergence in GDDP has occurred over the time span 2001-09.

Convergence can be analyzed through sigma and beta convergence (Barro and Sala-i-Martin, 1995). Sigma convergence measures the cross-section dispersion of per capita income and is said to occur if the dispersion measured by the standard deviation/co-efficient of variation of the logarithm of per capita income/product declines over time. According to Sala-i-Martin (1994), sigma and beta convergence convey different information. While sigma convergence predicts whether the aggregate cross-sectional variance is falling or rising over time, beta convergence answers several questions such as whether poor districts/regions grow faster than the rich ones, the speed of convergence and whether the convergence process is conditional or unconditional and whether there is a different convergence process between groups of economies with different structures. Barro and Sala-i-Martin (1995, p.383) point out that *beta convergence tends to generate sigma convergence*. Put differently, beta convergence is a necessary but not a sufficient condition for sigma convergence and the two concepts can be considered complementary to each other.

Sigma convergence is analyzed by looking at the plot of the coefficient of variation (CV) of the log of per capita GDDP (at 1999-2000 prices) in Figure 3. It can be seen that the CV increased during 2001-05 and has been declining since then. In fact, the cross-section dispersion of per capita income in 2008-09 is at the same level as in 2000-01.

Figure 3 Sigma Convergence



Beta convergence, alternatively, can be inferred from a regression analysis wherein the growth of per capita income is regressed on the logarithm of the initial level of per capita income (unconditional convergence). The idea behind unconditional convergence is to simply examine whether districts that had a relatively higher per capita GDDP in 2001 grew relatively slowly over the period 2001-2009. This is captured by the negative coefficient on the initial GDDP ($GDDP_{2001}$) variable in the following regression equations:

Unconditional spatial lag model

$$\Delta GDDP_{(2001\text{-}2009)i} = \rho W \Delta GDDP + \beta GDDP_{(2001)_i} + \mu_i \quad (10)$$

where, ρ accounts for spatial autocorrelation

Unconditional spatial error model

$$\Delta GDDP_{(2001\text{-}2009)i} = \alpha + \beta GDDP_{(2001)i} + \varepsilon_i \text{ and } \varepsilon = \lambda W \varepsilon + \mu \quad (11)$$

However, there is a potential omitted variables bias in unconditional convergence. If initial district per capita incomes are correlated with initial composition of district incomes, which in turn are correlated with future growth, omission of the initial district composition of incomes will lead to an omitted variable bias. In that case, the OLS estimators are neither unbiased nor consistent. Hence, it is important to test if the convergence result is robust with the inclusion of the initial compositions of district income in the regression equation. On an average during 2001-09 in Maharashtra, the tertiary sector has accounted for 59.34% of GDP while the share of the primary and secondary sectors are 14.51% and 26.15% of GDP respectively. Hence conditional convergence is studied by testing for the negative coefficient on the initial GDDP in the following specifications:

Conditional spatial lag model

$$\Delta GDDP_{(2001\text{-}2009)i} = \rho W \Delta GDDP + \beta GDDP_{(2001)_i} + \eta_1 Primary_{(2001)i} + \eta_2 Tertiary_{(2001)i} + \mu_i \qquad (12)$$

Conditional spatial error model

$$\Delta GDDP_{(2001\text{-}2009)i} = \alpha + \beta GDDP_{(2001)i} +_1 Primary_{(2001)i} + \eta_2 Tertiary_{(2001)i} + \varepsilon_i$$

$$\varepsilon = \lambda W \varepsilon + \mu \qquad (13)$$

Prior to exploring beta convergence, the paper examined the overall degree of spatial autocorrelation in the growth rate of average per capita Gross District Domestic Product (GDDPPC) and log of the initial level of per capita GDDP (LGDDPPC01) using Moran's I (Table 5).

Table 5 Results of Moran's I

Variable	Moran's I Statistic
Average Growth of GDDPPC	$0.492^{\#}$
LGDDPPC01	$0.689^{\#}$
# indicates1% level of significance.	

The computed Moran's I statistic is statistically significant at 1% for both the average growth of GDDP per capita as well as for the logarithm of initial level of GDDP per capita (GDDP per capita in 2001 – LGDDPPC01).

The results of Table 6 indicate the emergence of significant unconditional convergence in per capita incomes across the districts of Maharashtra along with significant spatial effects as can be observed from the negative and statistically significant co-efficient of the log of initial GDDP in both the spatial error as well as the spatial lag model (Rows 1 and 2). The variance ratio and the squared correlation which represent the pseudo R^2 statistic tell us that initial per capita GDDP explains nearly 40% of the growth in average GDDP. The results of conditional convergence (Rows 3 and 4), however, convey that while the co-efficient of the log of initial GDDP continues to be negative it is not statistically significant in the presence of conditional variables like the initial share of the primary sector in total GDDP and the initial share of the tertiary sector in total GDDP. Further, the co-efficient of the initial share of the tertiary sector in GDDP is positive and statistically significant accompanied by marginally significant spatial effects. The results of conditional convergence, thus, seem to convey that the importance of the tertiary sector and its growth is crucial to the average growth rate of GDDP in Maharashtra during 2001-09.In particular, a high share of tertiary sector in district GDDP in the initial period leads to a higher growth rate for GDDP in the future. In other words, the initial shares of the tertiary sector can be significant determinants of future inequality.

Table 6 Results of Convergence (Unconditional and Conditional)

Dependent Variable: Growth of Gross District Domestic Product Per Capita

(1)	**Unconditional Convergence – Spatial Error Model**						
	Constant	Log Initial GDDPPC			Variance Ratio	Squared Correlation	LM Test of spatial effects
	53.55# (5.32)	-10.50# (-4.46)			0.406	0.422	4.520**
(2)	**Unconditional Convergence - Spatial Lag Model**						
	44.49# (3.17)	-8.84# (-3.05)			0.430	0.490	5.682#
(3)	**Conditional Convergence - Spatial Error Model**						
	Constant	Log Initial GDDPPC	Initial Primary GDDP	Initial Tertiary GDDP	Variance Ratio	Squared Correlation	LM Test of spatial effects
	16.91 (1.60)	-0.19 (-0.06)	2.60 (1.27)	28.78# (2.70)	0.277	0.276	3.530*
(4)	**Conditional Convergence - Spatial Lag Model**						
	17.26 (1.55)	-0.27 (-0.09)	2.58 (1.28)	28.62# (2.74)	0.276	0.272	2.658*
	Figures in parentheses indicate z-values # indicates 1% level of significance, ** - 5% level of significance and * 10% level of significance						

Table 6 describes the performance of the districts in Maharashtra in terms of the distribution of the average growth rate of per capita tertiary GDDP during 2002-09.

Table 6 Quartile Distribution of Average Growth of Per Capita Tertiary GDDP (2002-09)

Districts in First Quartile	Districts in Second Quartile	Districts in Third Quartile	Districts in Fourth Quartile
Raigad (2.70) Aurangabad (4.99) Akola (6.23) Pune (6.25) Gadchiroli (6.45) Nagpur (6.50) Dhule (6.52) Nashik (6.55) Mumbai (6.82)	Amravati(6.91) Wardha (6.99) Chandrapur (7.16) Thane (7.17) Buldhana (7.18) Nanded (7.21) Parbhani ((7.33) Jalgaon (7.53)	Satara (7.65) Washim (7.74) Sindhudurg (7.84) Yavatmal (7.86) Sangli (7.98) Ahmednagar (7.99)	Beed (8.00) Bhandara (8.02) Latur (8.09) Osmanabad (8.23) Kolhapur (8.35) Ratnagiri (8.40) Jalna (8.58) Solapur (8.63) Hingoli (8.83) Gondia (9.06) Nandurbar (9.70)
Figures in parentheses represent per capita growth of Tertiary GDDP			

Of the nine districts in the first quartile nearly 20% of the districts were from the Konkan, Nashik and Nagpur divisions while 10% of the districts were from the Aurangabad, Pune and Nashik divisions. However, of the total eleven districts in the fourth quartile, less than 10% of the districts were from the Konkan division while nearly 30% of the districts were from the Aurangabad and Nagpur divisions of the State. Further, no district from the Amravati division featured in the high growth fourth quartile and less than 20% of the 11 districts were from the Pune and Nashik divisions. Interestingly, Mumbai (comprising Mumbai City and Greater Mumbai) along with Pune, Nashik, Nagpur and Aurangabad districts in each of these divisions were in the first quartile which represents low growth for 2002-09.

This raises an important question: To what extent are the shares of tertiary income across districts diverging? Are the shares converging? In that case will the importance of initial shares of tertiary sector as determinants of future divergence of incomes diminish in time?

Some light can be shed on this by regressing tertiary sector growth over 2001-09 on the share of tertiary sector in GDDP in 2001.

Table 7 Results for Tertiary Sector Growth

Dependent Variable: Average Growth of Tertiary Sector Gross District Domestic Product Per Capita

(1)	**Spatial Lag Model**				
	Constant	Share of Initial Tertiary GDDP	Variance Ratio	Squared Correlation	LM Test of spatial effects
	7.42 (1.61)	-0.43 (-0.07)	0.005	0.227	4.71**
(2)	**Spatial Error Model**				
	8.25# (2.37)	0.10 (0.02)	0.000	0.002	4.55**

The results of the regressions estimates of tertiary sector growth point out that while there are significant spatial effects the initial share of the tertiary sector in GDDP is not significant District shares of tertiary sector do not show evidence of converging. The results also show that having a historically high share of the tertiary sector does not mean higher future tertiary sector growth for any district.

V Conclusion

The paper seeks to study the changes in income distribution/inter-district inequality in per-capita incomes in Maharashtra. The results point to a substantial reduction in inter-district inequality post 2005 as compared to 2001-05. It is pertinent to note that while inequality post 2005 is lower than during 2001-05, inter-district inequality has been very gradually rising, though it continues to be at a lower level than in the 2001-05. This has been accompanied by inter-quartile shifts across the divisions. While Konkan, Nasik and Pune divisions have lost rank, Amravati and Nagpur have moved one rank up and the rank of the Aurangabad division has remained unchanged.

The result of Theil's inequality index underscores the point that the inequality between administrative divisions has been of a much lower magnitude compared to inequality between districts that compose these subdivision. This becomes important since historically, inequality in

Maharashtra has always been analyzed at the level of administrative divisions and financial allocation decisions are made at the level of divisions. The major inequality in Maharashtra, however, seems to emerge across districts rather than across divisions.

In its analysis of convergence in per capita GDDP across districts, the paper estimates sigma as well as beta convergence and finds that the cross-section dispersion of per capita income (sigma convergence) rose for the period 2001-05 and subsequently declined. Significant spatial spillover effects are observed for both unconditional and conditional beta convergence. We do not find evidence in favour of convergence of per capita incomes. It is the initial share of the tertiary sector that emerges significant suggesting that the tertiary sector and its growth is crucial to the average growth rate of GDDP in Maharashtra during 2001-09. However, it is pertinent to note that a historically high share of the tertiary sector does not translate into higher future tertiary sector growth for any district in Maharashtra. Therefore, there do not seem to be substantial agglomeration economics for districts that have high historical share of the tertiary sector in their incomes. We would again like to reiterate that these findings are subject to the inherent limitations of estimating tertiary sector income at the district level. The finding on conditional convergence is a cause of concern since there is relatively little that explicit policy can do anything about district compositions of income which reflect a host of location specific advantages that are relatively impervious to policy.

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