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T Sathish Kumar
Research Scholar, Department
of Econometrics, School of
Economics, Madurai Kamaraj
University, Madurai, Tamil
Nadu, India

An analysis of regional divergence and the sectoral contributions to the India economy

T Sathish Kumar

Abstract

This study focuses on the divergence issue of select regional pockets, as it is chosen in the regional studies of India, in aggregate production, especially in services and production since the early liberalization period. For the analysis of subsectors in the services sector, the general classification provided in the GSDP is taken. Therefore, the study would be empirical in nature and would cover the major states empirical analysis of the regional distribution of GSDP data.

Keywords: Indian economy, sectoral contribution, GSDP, Divergence

Introduction

The neoclassical growth model predicts that the per capita income of regional economies converge towards their steady state levels, which implied a reduction in income inequality among regional economies over time. This proposition has been extensively tested in the literature using both cross-country data as well as data from regions within a single economy. In the cross-country studies, the results did not indicate convergence for developing countries though studies provided stronger support to the convergence hypothesis for developed countries. The issue of convergence / reduced inequality is of crucial importance for the political stability of nation states. The global trend of liberalization, privatization and globalization is cited as a main cause for divergence tendencies in developing countries. This phenomenon is associated with political and economic upheavals in many developing countries. Hence, the issue of divergence / convergence calls for a greater inquiry as it has an important bearing on the economic and political trajectory of many nations especially developing nations.

Objectives of the study

It is of great importance to see whether economic structure (share of agriculture, industry, services in GSDP) has an impact on the economic performance of States in India, and consequently, on regional divergence in its spatial context. Specifically, the objective of the study is

1. To study the overall regional divergence and the sectoral contributions to the economy.

Methodology

The Economy of India is the tenth largest in the world by nominal GDP and the fourth largest by purchasing power parity (PPP). Following strong economic reforms from the post-independence socialist economy, the country's economic growth progressed at a rapid pace, as free market principles were initiated in 1991 for international competition and foreign investment. During this period of reform India was witnessing a structural change and regional imbalances in the economy. This presents an interesting specter for study. Therefore, this study analyses the regional divergence in the context of structural changes with 17 major states viz., Andhra Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and, West Bengal.

Correspondence
T Sathish Kumar
Research Scholar, Department
of Econometrics, School of
Economics, Madurai Kamaraj
University, Madurai, Tamil
Nadu, India

Methodology of Structural Divergence Analysis

The literature on the convergence of regional economies has largely ignored the role played by various sectors in this process. Even though a few contributions have tried to throw some light on the role of the sectors, they have not quantified the contribution of each of the sectors in the trends in regional inequality. In order to quantify these roles, it is necessary to decompose these trends in regional inequality into their sectoral components. In this section, we shall describe a framework that can be used for this purpose. For the sake of convenience, we shall present the following analysis in terms of divergence, although it is also applicable for analysing convergence. Our starting point is to choose a measure for the rate of divergence of regions over time. Since the objective of this study is to decompose the total divergence into its sectoral components, we need a measure that is amenable to algebraic treatment. As we shall show in this section, the coefficient of variation can be used for this purpose.⁴

According to the coefficient of variation-based approach, any increase in inequality among the economies (measured by the coefficient of variation of the distribution of their output) over time indicates divergence. In order to estimate how much each of the sectors contribute to the aggregate divergence, the first step is to quantify the rate of divergence. In the regression-based approach, this is measured by the speed of divergence, and is determined from the estimation of the neoclassical growth model. However, there is no equivalent term in the coefficient of variation-based approach, although the degree of divergence is determined by the extent of the increase in the coefficient of variation. We formalize this idea by defining the rate of divergence as the growth rate of inequality, i.e., the growth rate of the coefficient of variation of output over time. Thus, denoting per capita regional output by X_i , its coefficient of variation by $C(X_i)$, and the rate of divergence by D , we have

$$D = \frac{C(X_i)}{C(X_i)}$$

Let there be n regions such that the output of each region is given by X_i , $i = 1 \dots n$. Let there be m sectors that contribute to each region's output X_i , such that the output of each sector in each region is given by X_{ij} , $i = 1 \dots n, j = 1 \dots m$.

Then,
$$X_i = \sum_j X_{ij}$$

Thus,
$$\bar{X} = \frac{1}{n} \sum_j X_i = \frac{1}{n} \sum_j \sum_i X_{ij} = \sum_j \frac{1}{n} \sum_i X_{ij} = \sum_j \bar{X}_j$$

The above equation indicates that the average output for the economy is equal to the sum of the average output of each of the sectors. Next, define P_j as the ratio between the average output of the j th sector and the average output of the economy.

Thus,
$$P_j = \frac{\bar{X}_j}{\bar{X}}$$

Let us also assume that $\sigma(X_i)$, $\text{Var}(X_i)$, $\text{Cov}(X_{ij}, X_{ik})$ and $r_{ij,ik}$ are the symbols for the standard deviation, variance, covariance and the correlation coefficient of the corresponding variables, respectively.

By definition,
$$\text{Var}(X_i) = \frac{1}{n} \sum_i (X_i - \bar{X})^2$$

$$\begin{aligned} &= \frac{1}{n} \sum_i (X_{ij} - \bar{X}_i)^2 \\ &= \frac{1}{n} \sum_i \left[\sum_j (X_{ij} - \bar{X}_j)^2 \right] \\ &= \sum_i \left[\frac{1}{n} \sum_i \left\{ (X_{ij} - \bar{X}_j) \left(\sum_k (X_{kj} - \bar{X}_k) \right) \right\} \right]_{k=1 \dots m} \\ &= \sum_j \left[\sum_k (\text{Cov}(X_{ij}, X_{ik}))^2 \right] \end{aligned}$$

$$\text{Var}(X_i) = \sum_j \text{Cov}(X_{ij}, X_i)$$

Now by definition, the coefficient of variation is given by,

$$C(X_i) = \frac{\sigma(X_i)}{\bar{X}} = \frac{\text{Var}(X_i)}{\sigma(X_i) \times \bar{X}}$$

Substituting this we get,

$$\begin{aligned} C(X_i) &= \frac{\sum_j \text{Cov}(X_{ij}, X_i)}{\sigma(X_i) \times \bar{X}} \\ &= \sum_j \frac{\sigma(X_{ij}) \times r_{ij,i}}{\bar{X}} \\ &= \sum_j \left(\frac{\sigma(X_{ij})}{\bar{X}} \times \frac{\bar{X}_j}{\bar{X}} \times r_{ij,j} \right) \end{aligned}$$

$$C(X_i) = \sum_j (C(X_{ij}) \times P_j \times r_{ij,i})$$

This indicates that the level of aggregate inequality (measured by the coefficient of variation of aggregate output) is equal to the sum of each sectors contribution. The contribution of each sector is equal to the product of: (i) the inequality in the sector, (ii) the average regional output of the sector as a proportion of the average regional output, and (iii) the correlation coefficient between the sector and the whole economy. This means that the inequality for the aggregate economy is affected not only by the sectoral inequalities, but also by the relative size of the sectors and their interlinkage with the economy. The size of the sectors add a scale effect to the sectoral inequality, i.e, a larger sector adds more to the economy's inequality compared to a smaller sector. The interlinkages of a sector with the whole economy - represented by the correlation coefficient between the two - also has an important role. This is due to the fact that a high correlation between any sector and the economy implies that a region that has a relatively high output from that sector also has a relatively high aggregate output, while a region that has a relatively low output from that sector also has a relatively low aggregate output. Thus, for a given level of inequality in the sector, an increase in the correlation coefficient increases the economy's inequality.

The expression breaks up the coefficient of variation of aggregate output into its sectoral components. However, in order to derive the rate of divergence, we need to derive the growth rate of coefficient of variation. Differentiating both

sides of the above equation with respect to time and dividing by $C(X_i)$ we get,

$$\frac{C(X_i)}{C(X_i)} = \sum_j \left[\left(\frac{C(X_{ij})}{C(X_{ij})} + \frac{P_j}{P_j} + \frac{r_{ij,i}}{r_{ij,i}} \right) \times \frac{C(X_{ij}) \times P_j \times r_{ij,i}}{C(X_i)} \right]$$

This implies that the aggregate divergence is equal to the weighted sum of growth rates of the three components in the previous equation. In each case, the weights are the sectors' contribution to the economy's initial levels of inequality, as a ratio of the economy's initial levels of inequality. It should be noted here that the later equation follows from earlier equation only in continuous time, when certain cross products arising out of an expansion of earlier take up negligible values and are assumed to be equal to zero. However, when we will use these equations to undertake some measurement in discrete time (in the next section), errors creep in due to non-negligible values of the cross products. In that case, the right hand side of later becomes approximately equal to the left hand side of the equation.

Results and Discussions

This section deals with the analysis of interrelationship between the aggregate divergence and the structural divergences of GSDP sectors, the role of services sector in aggregate divergence in India and the spatial interconnection and patterns in services sector output in the study period. The data described and the tool suggested in the methodology section is used to draw conclusion. The framework described in the methodology is used to derive the comparative contributions of the agricultural, industrial and the services sector in changing the regional inequalities in India during the post liberations era. Most studies dealing with the regional dimensions of the Indian economy consider the states as the appropriate unit of their analysis and base their study on the major states of India. In consonance with this approach, data from seventeen major

Indian states, i.e., Andhra Pradesh, Assam, Bihar, Gujarat, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Goa, Haryana and Himachal Pradesh. In order to generate data on the aggregate and sectoral output of the states, we use GSDP (Gross State Domestic Product) data classified by industry of origin. The agricultural output is derived by aggregating over agriculture, forestry and logging and fishing, while the industrial output is the aggregate of mining and quarrying, registered and unregistered manufacturing, construction and electricity, gas and water supply. The services sector comprises of transport, storage and communication, trade, hotels and restaurants, banking and insurance, real estate, ownership of dwellings and business services, public administration and other services.

The objective of this empirical exercise is to use the framework described in the methodology to measure: (a) the contribution of sectoral divergences, and (b) the total contribution by each sector in the divergence of aggregate output. It is shown in the preceding section that the aggregate divergence is equal to the weighted sum of the growth of three components which are, (i) the inequality in the sectors, (ii) the average regional output of the sectors as a proportion of average regional output and (iii) the correlation coefficient between the sectors and the aggregate economy. Table 1, 2 and 3 deals with each of these three components respectively. Table 1 presents the inequality at the aggregate and sectoral levels over the chosen time period. The upper part of the table presents the coefficient of variation of per capita output for the states covered by this study, for all the years under consideration. Column two gives the coefficient of variation for per capita output (GSDP), column three for the per capita agricultural output, column four for the per capita industrial output (S) and the fifth column for the per capita services output.

Table 1: Average Relative Size of the Sectors during 1980-81 to 2009-10.

Year	Primary Sector	Industry Sector	Services Sector
1980-81	0.381932	0.237772	0.380296
1981-82	0.384861	0.233096	0.382043
1982-83	0.365226	0.240644	0.39413
1983-84	0.376291	0.239334	0.384376
1984-85	0.366166	0.240279	0.393555
1985-86	0.348784	0.247563	0.403653
1986-87	0.334881	0.249811	0.415308
1987-88	0.319729	0.254807	0.425464
1988-89	0.334123	0.256244	0.409633
1989-90	0.324197	0.254609	0.421195
1990-91	0.313619	0.263734	0.422647
1991-92	0.307572	0.258518	0.43391
1992-93	0.305686	0.261197	0.432344
1993-94	0.298654	0.262952	0.438394
1994-95	0.295828	0.268983	0.435188
1995-96	0.276642	0.27917	0.444187
1996-97	0.281333	0.273879	0.444787
1997-98	0.258568	0.281393	0.460039
1998-99	0.257635	0.276164	0.46620
1999-00	0.243002	0.27665	0.480348
2000-01	0.237413	0.269709	0.492878
2001-02	0.237023	0.26126	0.501717
2002-03	0.215429	0.272767	0.511804
2003-04	0.220545	0.273479	0.505976
2004-05	0.207176	0.281594	0.51123

2005-06	0.198882	0.285364	0.515754
2006-07	0.186843	0.292917	0.52024
2007-08	0.180783	0.292025	0.527192
2008-09	0.169981	0.288958	0.541061
2009-10	0.160448	0.284172	0.55538
Pre reform period	-2.11563	1.049619	1.248598
Post reform period	-3.44685	0.506009	1.435494
Over all	-2.83221	0.700312	1.282937

Source: Author's calculation based on the methodology

The year wise average sectoral contribution of different sectors to GSDP in 17 major states from 1980-80 to 2009-10 is given in the Table-1. In the study period the agricultural and services sectors contributed about 38 percent each and manufacturing sector contributed about 23 percent to GSDP. A continuous fall in the proportional contribution of agriculture to GSDP is observed (-2.83 per cent per annum)

and for manufacturing and services sectors the same is found to increase steadily. The contribution services sector is found to be larger among the two (1.28 percent). The growth of relative size of manufacturing was 0.7 percent. The growth of relative size of services sector was higher (1.44 percent) in post liberalisation period and compared to pre liberalisation period.

Table 2: Changing Linkages between the Sectors and the Economy during (1980-81 to 2009-10)

Year	Primary Sector	Industry Sector	Services Sectors
1980-81	0.705265	0.921237	0.946642
1981-82	0.700042	0.914965	0.931786
1982-83	0.669912	0.919775	0.951596
1983-84	0.636402	0.924940	0.935265
1984-85	0.672607	0.927139	0.947585
1985-86	0.613898	0.915083	0.918436
1986-87	0.576004	0.917087	0.925282
1987-88	0.647901	0.907841	0.946917
1988-89	0.636969	0.943112	0.941014
1989-90	0.671533	0.946663	0.945515
1990-91	0.596901	0.952679	0.953849
1991-92	0.595795	0.950449	0.954680
1992-93	0.652370	0.960359	0.957703
1993-94	0.608780	0.962468	0.958095
1994-95	0.579666	0.965076	0.950291
1995-96	0.550403	0.961702	0.955476
1996-97	0.545886	0.965157	0.958778
1997-98	0.525998	0.970987	0.964289
1998-99	0.484633	0.979792	0.972205
1999-00	0.500907	0.969291	0.972615
2000-01	0.460069	0.960381	0.963473
2001-02	0.428744	0.960773	0.959509
2002-03	0.488047	0.960298	0.960072
2003-04	0.487610	0.964707	0.955389
2004-05	0.461669	0.966492	0.962025
2005-06	0.577962	0.967850	0.961134
2006-07	0.457477	0.963239	0.957511
2007-08	0.458115	0.958254	0.953095
2008-09	0.379370	0.960454	0.957797
2009-10	0.371048	0.958718	0.961748
pre reform period	-1.00075	0.214268	-0.01807
post reform period	-2.15357	0.016934	0.016735
over all	-1.80172	0.19811	0.10055

Source: Author's calculation based on the methodology

The year wise correlation between the sectors and aggregated economy from 1980-81 to 2009-10 is given the Table 2. In the start of the study period the services sector is found to be highly integrated with aggregated economy about (0.94 per cent) followed by manufacturing sector (0.92 per cent) and agriculture sector (0.70 per cent). Further

the link of agriculture sector with the rest of the economy is found to decline heavily, throughout the study period (-1.8 per cent) especially in the post reform period (-2.15 per cent). However, for the services and manufacturing sectors connect is found to increase at the same rate in post liberalization period at a very low rate (0.17 per cent).

Table 3: Aggregate and Sectoral Divergence Rates (1980-81 to 2009-10).

Year	GSDP	Agriculture	Manufacture	Services
1980-81	0.5462	0.4829	0.8805	0.5880
1981-82	0.5045	0.4793	0.7752	0.5549
1982-83	0.5433	0.4917	0.8983	0.5655
1983-84	0.5035	0.4459	0.8225	0.5615
1984-85	0.5211	0.4513	0.8220	0.5788
1985-86	0.5057	0.5059	0.7568	0.5702
1986-87	0.5138	0.5145	0.8227	0.5483
1987-88	0.5405	0.5193	0.7525	0.6126
1988-89	0.5594	0.4783	0.8329	0.6330
1989-90	0.5612	0.5293	0.8190	0.5948
1990-91	0.6066	0.5115	0.9295	0.6578
1991-92	0.5983	0.5521	0.9578	0.6012
1992-93	0.6399	0.5362	1.0761	0.6079
1993-94	0.6302	0.5224	1.0225	0.6332
1994-95	0.6218	0.4930	0.9424	0.6808
1995-96	0.6421	0.5009	0.9252	0.7223
1996-97	0.6870	0.4830	1.0196	0.7807
1997-98	0.6714	0.4772	0.9981	0.7296
1998-99	0.7720	0.4546	1.2683	0.7996
1999-00	0.7538	0.4906	1.2810	0.7303
2000-01	0.7285	0.5154	1.3521	0.6549
2001-02	0.7470	0.4941	1.4536	0.6645
2002-03	0.7875	0.5488	1.4592	0.6844
2003-04	0.7813	0.5328	1.4449	0.6847
2004-05	0.7969	0.5323	1.4103	0.7130
2005-06	0.7858	0.5333	1.3265	0.7033
2006-07	0.7699	0.4975	1.3123	0.6962
2007-08	0.7448	0.5062	1.2438	0.6860
2008-09	0.7467	0.5086	1.2423	0.6920
2009-10	0.7666	0.4905	1.2437	0.7277
Pre reform period	0.5904	0.9911	-0.6751	0.8148
Post reform period	1.4525	-0.0446	2.1066	0.4288
Over all	1.7734	0.1956	2.2545	0.9369

Source: Author's calculation

It is clear that the industrial and services sectors (0.88 and 0.59) had higher inequality than aggregate and agricultural sector (0.48 per cent) in the initial year of the study period. Further the Table 3 also points to inequality increasing for the aggregate economy throughout the study period. The rise is the lowest for the agriculture sector (0.2 per cent per annum) followed by services sector (0.94 per cent per

annum) and highest for manufacturing sector (2.25 per cent per annum) in the study period. But for the services sector the divergence is sustained in pre (0.18 per cent) and post (0.43 per cent) liberalisation periods however for the agriculture and manufacturing sectors showing a reverse trend in pre and post liberalisation period.

Table 4a: Components of the Pre-reform Period Divergence (1980-81 to 1990-91) (per cent)

	Agriculture	Manufacturing	Services	Total
Contribution from Sectoral Divergences	39.98	-40.38	53.49	53.09
Contribution from changes in Relative Size	-85.34	62.78	81.96	59.40
Contribution from Changing Linkages	-40.37	12.81	-1.18	-28.74
Total Sectoral Contribution	-85.73	35.21	134.27	83.76

Source: Author's calculation

Table 4b: Components of the Post-reform Period Divergence (1990-91 to 2009-10) (per cent).

	Agriculture	Manufacturing	Services	Total
Contribution from Sectoral Divergences	-0.48	55.84	11.52	66.88
Contribution from changes in Relative Size	-37.46	13.41n	38.58	14.53
Contribution from Changing Linkages	-23.40	0.44	0.44	-22.50
Total Sectoral Contribution	-61.34	69.70	50.56	58.91

Source: Author's calculation based on the methodology

Table 4c: Components of the Aggregate Divergence (1980-81 to 2009-10) (per cent).

	Agriculture	Manufacturing	Services	Total
Contribution from Sectoral Divergences	2.62	44.89	20.47	67.99
Contribution from changes in Relative Size	-38.03	13.94	28.03	3.94
Contribution from Changing Linkages	-24.19	35.76	1.72	13.29
Total Sectoral Contribution	-59.60	94.59	50.24	85.23

Source: Author's calculation based on the methodology

Table 4a to 4c highlights the total contribution of each sector in the study period. It is clear from the table that the services sector, despite having the lowest rate (20.47 per cent compound to 44.89 per cent of manufacturing sector) of divergence, has contributed significantly to GSDP divergence. Through this contribution of the services sector (50.24 per cent) was very high during the pre reform period (134.27 per cent), it is greatly moderated in the post-reform period (50.56 per cent).

Major Findings

- In the study period, on an average the agricultural and services sectors contributed about 38 percent each and manufacturing sector contributed about 23 percent to GSDP.
- A continuous fall in the proportional contribution of agriculture to GSDP is observed (-2.83 per cent per annum).
- The growth of relative size of manufacturing was 0.7 per cent and the services sector grows in relative size by 1.28 per cent.
- In the start of the study period the services sector is found to be highly integrated with aggregated economy about (0.94) followed by manufacturing sector (0.92) and agriculture sector (0.70).
- The link of agriculture sector with the rest of the economy is found to decline heavily, throughout the study period (-1.8 per cent) especially in the post reform period (-2.15 per cent).
- For the services and industry sectors connect is found to increase at the same rate in post liberalization period at a very low rate (0.17 per cent). But in the overall period it was vary thus, the industry sector has 0.19 per cent and the services sector has 0.10 per cent increases respectively.
- It is clear that throughout the period, the industrial and services sectors (0.88 and 0.59) had higher inequality than agricultural sector (0.48 per cent).
- The inequality was increasing for the aggregate economy throughout the study period. The rise was the lowest for the agriculture sector (0.2 per cent per annum) followed by services sector (0.94 per cent per annum) and highest for manufacturing sector (2.25 per cent per annum) in the study period.
- For the services sector the divergence momentum was sustained in pre (0.18 per cent) and post (0.43 per cent) liberalisation periods. For the agriculture and manufacturing sectors, a trend reversal was observed in pre and post liberalisation period. The regional agricultural output was diverging in the pre reform whole the post reform saw a convergence; but in services sector output was found to diverge at an accelerated pace in post reform period.
- The services sector, despite having the lower rate of divergence (20.47 per cent) compared to 44.89 per cent

of manufacturing sector, has contributed significantly to GSDP divergence.

- Among the three sectors the industry sector contributes very high (94.59 per cent) to overall divergence followed by the services sector (50.24 per cent) and the primary sector contributes in terms of negative.

Conclusion

The study has found that that the Indian economy experienced divergence, both at the aggregate level and in each of the three sectors (agricultural, industrial and services). However, the divergence rate was quite uneven across the sectors. Though the contribution of services sector to growth acceleration is significant, a main contributor to regional divergence in many studies, this study found that the highest contributor to rate of divergence is the industrial sector. Interestingly, the relative sectoral divergence for the manufacturing is observed to be much higher in the post liberalization period compared to services sector, especially in the new millennium, the structural shift in the economy in favour of the services sector is raising the relevance of that sector to overall divergence. Therefore, the results show that although the divergences within the three sectors are largely responsible for the aggregate divergence, there are other contributory factors as well. In fact, the other significant factor is the structural transformation of the economy, which is responsible for a significant part of the aggregate divergence, while the changing interlinkages play an insignificant role.

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