

An Analysis of Convergence and Cointegration of Sectoral Shares and Growth in India

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Abstract- The paper studied that India's agricultural share in GDP has been steadily declining at the rate of 1.69% per year, the industrial share in GDP in India has been catapulting at the rate of 0.93% per year and the service sector share in GDP in India has been increasing at the rate of 0.747% per year from 1950-51 to 2013-14 which are statistically significant. The sectoral shares have weak cointegration but the shares showed the bidirectional causality with growth rate. The VAR model is stable showing significant relation with previous period but impulse response functions are diverging and the residuals are not normal which was tested by Doornik-Hansen normality test. VECM showed that errors have been correcting speedily and the model is stable since AR polynomial roots lie inside the unit root circle. The sectoral shares and GDP growth rate have significant Beta convergence but insignificant sigma convergence in India during 1950-51-2013-14 which is not suited for sustainable development in India.

Index Terms- Sectoral shares, Economic growth, Convergence, Cointegration, VAR, VEC

I. INTRODUCTION

In developed countries, the shares of services and industrial sector has increased in the past few decades and at the same time the share of agriculture sector went down considerably. In the literature, there exists a debate about structural change in the developed countries. Neoclassical economists believe that structural change is an unimportant side effect of the economic development. On the contrary, economists associated with the World Bank and some others posit that growth is brought about by the changes in sectoral composition. The importance of sectoral shares in the development process in India is under nourished since it ignored basic theory of stages of development as well as under estimated the key features of Indian agriculture due to wide scope of globalization and liberalization. Service sector led growth becomes questionable unless sustained growth in agriculture and industry are achievable because industrial recession and subsistence agriculture cannot keep pace with service sector led growth.

In this paper we endeavour to scrutinize the convergence and cointegration of sectoral shares and growth rates in context of Indian economy during the period of 1950-51-2013-14.

II. METHODOLOGY AND DATA

To verify convergence hypothesis among the sectoral shares and growth rate of GDP in India during 1951-52-2013-14, we

take Salai-i-Martin model (1996) for analysis. We used Johansen (1988) model for cointegration and Johansen (1991,1996) model for VAR Analysis. We have done Granger Causality test by using Granger Model(1969). We have taken data on GDP growth rate and the shares in agriculture, manufacture and service sector in GDP in during 1950-51-2013-14 from the Planning Commission of India. Assume, x_1 = agricultural share in GDP, x_2 = Manufacturing sector share in GDP, x_3 =share of service sector in GDP, y = GDP growth rate.

III. LITERATURE REVIEW

Kuznets (1966) examined these three categories in more detail and added the analysis of sectoral shares of GDP and was able to empirically demonstrate that growth is brought about by changes in sectoral composition. He provided the historical empires and conceptual framework for the structural transformation, although he used no econometric techniques.

Singariya and Sinha(2015) examined causal relationship among per capita GDP, agriculture and manufacturing sector output in India using time series data collected from CSO for the period 1970 to 2013. It reveals that there exists bidirectional causality between agriculture sector and per GDP, while the unidirectional causality between the manufacturing sector and per capita GDP and between the agriculture and manufacturing sector. The results based on vector error correction model indicate a weak association between the sectors in the short run. Dynamic causality results show that the agriculture sector affects Per Capita GDP and manufacturing sector, while Per Capita GDP affects manufacturing sector strongly in the long run, thus causality seems to run from agriculture to PCGDP and manufacturing and from PCGDP to Manufacturing sector. It is also evident from impulse response function that any innovation in agriculture sector increases its own growth as well as growth of manufacturing sector in India. The paper argues that shocks originated from agriculture sector spill over to Per Capita GDP and Manufacturing sector in long run in India.

The study of Singariya (2014) indicates that the growth pattern of different sectors of the economy shows an emergence of the service sector as the major contributor, decline in the share of agriculture sector and industry sector has seen a steep decline during this period. It indicates that some states were able to shift their labour force from low – productivity agriculture to higher productivity industry and service sectors, and to increase productivity within those sectors, despite the rapid growth of populations. The growth pattern of different sectors of the economy shows an emergence of the service sector as the major contributor, decline in the share of agriculture sector and industry

sector has seen a steep decline during this period. It indicates that some states were able to shift their labour force from low – productivity agriculture to higher productivity industry and service sectors, and to increase productivity within those sectors. Ghate, Glomm and Liu (2012) studied the sectoral allocation of public infrastructure investments in the agriculture and manufacturing sectors in India. In addition to the changing employment and output shares of these two sectors, the capital output ratio in agriculture in India has fallen, while it has risen in manufacturing. To match these observations they construct a two sector OLG model with Cobb-Douglas technologies in both sectors. The preferences are semi-linear. They later extend the analysis to allow for a CES production function in the manufacturing sector. They conduct several policy experiments on the sectoral allocation of infrastructure across agriculture and manufacturing. They found: 1. The growth maximizing share of public capital going to agricultural is small with about 10%. This fraction stays constant even in the face of the relative decline of the agricultural sector. 2. The optimal funding level for public infrastructure is far bigger than the one suggested by one sector growth models. 3. Growth rates are decreasing in manufacturing tax rates and increasing in agricultural tax rate.

This study of Pais (2014) attempts to understand the growth and structure of the services sector in India through the analysis of the sub-sectors within the services sector at a level of disaggregation that has so far not been adequately analysed in the literature. It identifies sub-sectors within services that have contributed mainly to GDP growth.

The study of Hussain and Yik (2012) examines the contribution of economic sectors to economic growth in India and China by using time series data from 1978 to 2007. Three economic sectors were analyzed: agricultural sector, manufacturing sector and services sector. Augmented Dickey-Fuller (ADF) unit-root test shows that the time series data are stationary at first difference. Then, correlation analysis indicates that each economic sector has strong, positive and significant linear relationship with economic growth in China and India. In addition, the results of multiple regression analysis show that agriculture, manufacturing and services sectors have positive relationship with GDP per capita in China and India.

Gordon and Gupta (2012) analyzed the factors behind the growth of the services sector in India because growth acceleration of the services in the 1990s was mostly due to fast growth in communication services, financial services, business services (IT) and community services. While factors such as a high income elasticity of demand for services, increased input usage of services by other sectors, and rising exports were important in boosting services growth in the 1990s, supply side factors including reforms and technological advances also played a significant role. The large growth potential of Indian services exports is well known, but the paper finds that there is also considerable scope for future rapid growth in the Indian service economy provided that deregulation of the services sector continues. The paper shows that employment growth in the Indian services sector has been quite modest, thus underscoring the importance of industry and agriculture also growing rapidly.

Tregenna (2007) analyses the role of manufacturing in South African economic development and concludes that manufacturing has been especially important through its strong

backward linkages to the service sector and other sectors of the economy.

For India recent papers reach contradictory conclusions. Katuria and Raj (2009) examined the engine of growth hypothesis at regional level for the recent period and conclude that more industrialised regions grow more rapidly. On the other hand, Thomas (2009) concluded that services have been the prime mover of growth resurgence in India since the 1990s. Chakravarty and Mitra (2009) find that manufacturing is clearly one of the determinants of overall growth, but construction and services also turn out to be important, especially for manufacturing growth.

The paper of Mukherjee (2012) shows that services is the fastest growing sector in India, contributing significantly to GDP, GDP growth, employment, trade and investment. Labour productivity in services is the highest and it has increased overtime. India is a major proponent of liberalizing services both in the WTO and in its bilateral trade agreements. Economic growth has slowed down. Growth in employment in services has not been commensurate with the share of the sector in GDP. Although India is portrayed as a major exporter of services, its rank among WTO member countries in services exports is lower than that of China's and its export competitiveness concentrate in few sectors and a few markets. The paper identifies a number of barriers faced by the services sectors and suggests policy measures, which, if implemented, will lead to inclusive growth, increased productivity, generate quality employment, increase trade and investment, and enhance India's global competitiveness in services.

Bharati Singh (2012) stated that till the decade of 1990s many studies raised doubts about the sustainability of service-led growth in India. Most often it was stated that growth in manufacturing is required to give a boost to services, employment growth, income generation, and trade balance. It is now increasingly being realized that the resilience of the Indian economy is due to the resilience of the services sector. Numerous studies since 2000s have shown that services induced growth of GDP of India is feasible. The service-led growth model is sustainable not only from the economic perspective but from social and environmental perspectives as well. To realize the maximum potential from high growth of services India should make investment in education, entrepreneurship, technology, modern means of communication and transportation, and social development. Policy reforms should be initiated to liberalise the service sub-sectors like trade (retail and wholesale), financial services, and software services that will help in faster growth through attraction of FDI. So also, labour reforms are desirable to take advantage of the demographic dividend.

The paper of Behera (2012) analyses the trends in sectoral shares in state domestic product and inter-sectoral linkages in Odisha for the period 1980-81 to 2011-12. Results drawn from Granger causality test suggest that there is a weak linkage between primary and secondary sectors in the growth process. In the case of primary and tertiary sector services, though the primary sector does not show linkages with the tertiary sector as a whole, it does have linkages with some important sub-services like trade, hotel and restaurant services. Between secondary and sub-sector of tertiary sectors, there is an independent relationship of industry with trade, hotel and restaurant, and community,

social and personal services. However, there is a unidirectional causality between secondary to finance, insurance, real estate and business services on one hand and transport, storage and communication to secondary sector on the other. The long-run cointegration results show a strong relationship between secondary and TSC services in the economy on one hand and independent long run relationship within FIRB on the other. However, results based on error correction model indicate a weak association between the sectors in the short run. Though the linkage is significant between the sectors, but it is not linked with three sector analysis where primary sector is completely missing for a relatively faster adjustment towards long run equilibrium rate of growth.

Vijay Subramaniam and Michael Reed (2009) estimated an econometric model that incorporates the linkages among the sectors (agriculture, manufacturing, and service) using a Vector Error Correction Model (VECM). This procedure is employed to identify the existence of long-run and short-run relationships among different sectors in the economies of Poland and Romania. The empirical findings from the analysis confirm that the different sectors in the Romanian and Poland economies moved together over the sample period, and for this reason their growth was interdependent. This implies that once the sectors deviate from the stable, long-run path the sectors have the tendency to return to the long-run equilibrium.

Kularatne and Sivrajasingham(2015) studied that the Sri Lankan economy has been undergoing structural changes for the last few decades. The existence of dynamic linkages among the three major sectors- agriculture, industry and services of the Sri Lankan economy are examined in this paper for the period of 1960-2011. They employed graphical analysis including scatter plot, line graph, Confidence Ellipse and Nearest Neighbor fit to identify the basic features and the relationship between selected variables. The dynamic sectoral growth linkage results suggested the existence of inter-linkages across different sectors of the economy. ADF test and PP test were used to test the unit root characteristics of the time series variables. Inter temporal correlation results show that there exists a high positive statistically significant correlation between all sectors. Engel-Granger (EG) co-integration test provides further evidence for this. Error correction model estimates indicate that short run changes in Industry GDP have a positive impact on short run changes in Agriculture and services GDP. The results of Granger-causality test suggested that services growth causes agricultural and industrial growth significantly. The findings implied that by developing the services sectors, agricultural and industrial growth can be simulated.

Srikantha and Satyanarayan (2011) studied that there is a strong positive correlation between GDP and Agriculture Sector. Johnson's co-integration test indicates that there is an existence of cointegration between GDP and Agriculture Sector. Hence, it can be inferred that the agriculture sector and GDP have long-run equilibrium relationship between them. When Granger causality test is conducted with 2 years of lags and 3 years of lags, there is an existence of causal relationship in both the directions between GDP and agriculture sector at 10% level of significance. It indicates that GDP granger cause agriculture sector and at the same time agriculture sector granger cause GDP.

Hamid and Hye(2012) verified that the structural changes of an economy entail that in the long run, the dynamics of sector shares (industrial, agricultural and services) are related to each other and to economic growth as well. In this study, the hypothesis that there is a long-term relationship between agricultural growth and other economic sectors growth is tested for the case of Iran, using autoregressive distributed lag model (ARDL) and variance decomposition analysis also. The time series data consists of data for the period 1959-2010. The results indicate that the long run relationship exists when the variables gross domestic product (Y), industrial value added (IN), agricultural value added (AG), services value added (SS) and oil and gas value added (O and S) remain to be dependent variables. The long run elasticity also shows that one percent increase in value added of IN, AG, SS and Oil and Gas, will cause the gross domestic product to increase by 0.216, 0.091, 0.431 and 0.156 percent respectively.

The study of Ahmed,Amjad and Amber(2013) empirically tested the relationship between sectoral shares and economic growth by using the panel data for 20 developed countries. The results of the granger causality suggest that both services and agriculture sectors do granger cause economic growth, whereas industrial sector does not granger cause growth. Reverse causality does not hold for any of the three sectors. The results of Barro and Non-Barro regressions along with the set of control variables have suggested that services sector is negatively affecting growth, whereas both industrial and agriculture shares are positively affect economic growth.

IV. OBSERVATIONS FROM THE ECONOMETRIC MODELS

[A] General Econometric relations

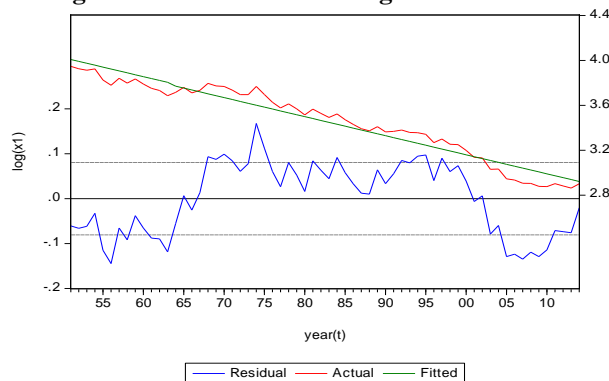
According to semi log linear model, India's agricultural share in GDP has been steadily declining at the rate of 1.69% per year from 1950-51 to 2013-14 which is statistically significant. The estimated regression equations are given below. The actual agricultural share and its linear downward trend line are shown in the Fig-1.

$$\text{Log}(x_1)=4.025345-0.016972t$$

$$(195.88)^* \quad (-31.562)^*$$

$$R^2=0.9414, F=996.1778^*, DW=0.2517, x_1= \text{agricultural share in GDP}, * =\text{significant at}5\%$$

Fig-1: Trend line of India's agricultural share



Source-Computed by author

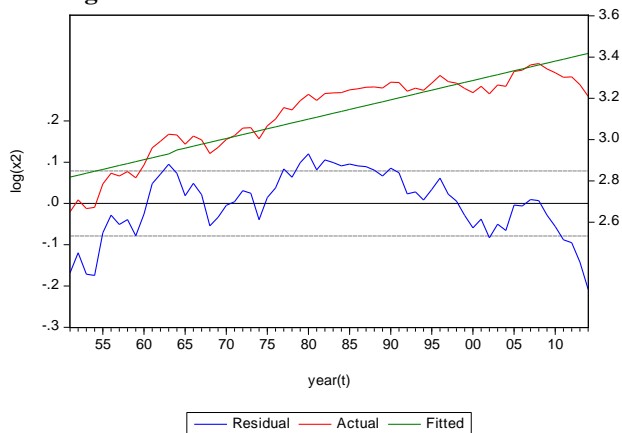
The industrial share in GDP in India has been catapulting at the rate of 0.93% per year from 1950-51 to 2013-14 which is significant. The estimated semi log linear equation is given below. The upward linear trend line is shown in Fig-2.

$$\text{Log}(x_2) = 2.8090 + 0.009364t$$

$$(140.2039) * (17.86)^*$$

$R^2 = 0.8372$, $F = 319.04$, $DW = 0.2152$, $x_2 =$ industrial share in GDP, $*$ = significant at 5% level

Fig-2: Trend line of Industrial share in GDP



Source- Computed by author

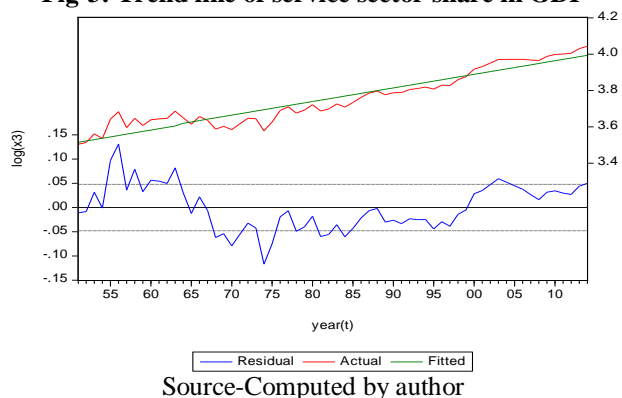
Similarly, the service sector share in GDP in India has been increasing at the rate of 0.747% per year during 1950-51-2013-14. The estimated line is significant and is given below. The upward trend line is also shown in the Fig-3.

$$\text{Log}(x_3) = 3.5075 + 0.007478t$$

$$(287.39) * (23.4149)^*$$

$R^2 = 0.898$, $F = 548.256$, $DW = 0.429$, $x_3 =$ service sector share in GDP, $*$ = significant at 5%

Fig-3: Trend line of service sector share in GDP



Source-Computed by author

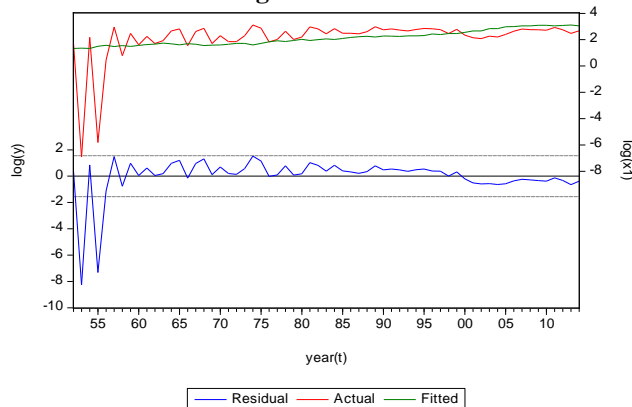
The sectoral shares have great influence on the GDP growth rate in India. According to the double log model, it was estimated that one percent increase in agricultural share led to 1.678% decrease in GDP growth rate from 1951-52 to 2013-14 which is statistically significant. The estimated trend line is given in Fig-4.

$$\text{Log}(y) = 7.95247 - 1.67866 \log(x_1)$$

$$(3.7997) * (-2.7908)^*$$

$R^2 = 0.1132$, $F = 7.788^*$, $DW = 1.98$, $Y =$ GDP growth rate, $X_1 =$ agricultural share in GDP, $*$ = significant at 5% level

Fig-4: Estimated line between agricultural share and GDP growth rate



Source-Computed by author

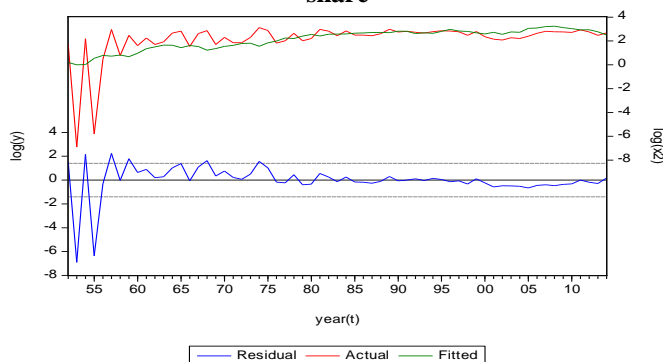
Again, according to the double log model, it was estimated that one percent increase in industrial share per year led to 4.6147% increase in GDP growth rate per year from 1951-52 to 2013-14 which is statistically significant. The estimated trend line is given in Fig-5.

$$\text{Log}(y) = -12.30655 + 4.6147 \log(x_2)$$

$$(-4.0891) * (4.80517)^*$$

$R^2 = 0.2745$, $F = 23.089$, $DW = 2.4405$, $y =$ GDP growth rate, $x_2 =$ industrial share in GDP, $*$ = significant at 5% level

Fig-5: Estimated line between growth rate and industrial share



Source-Computed by author

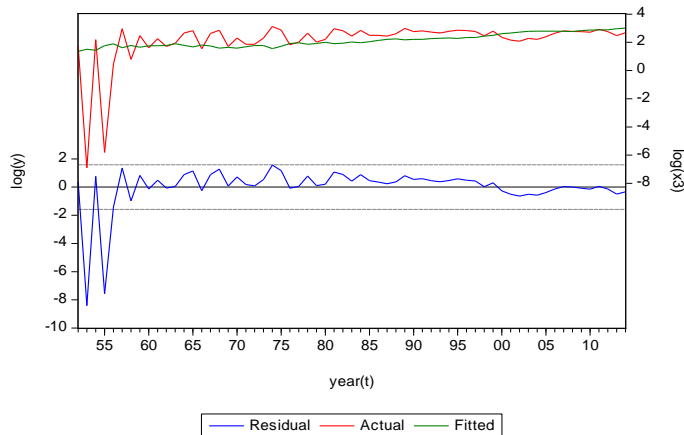
And one percent increase in service sector share per year led to 3.116% increase in GDP growth rate per year during 1951-52-2013-14 which is statistically significant and the estimated equation is given below. In Fig-6, it is shown clearly.

$$\text{Log}(y) = -9.58838 + 3.11609 \log(x_3)$$

$$(-1.863) * (2.278)^*$$

$R^2 = 0.078$, $F = 5.192^*$, $DW = 1.96$, $y =$ GDP growth rate, $x_3 =$ service sector share in GDP, $*$ = significant at 5% level

Fig-6:Estimated line between GDP growth rate and service sector share



Source-Computed by author

Now, if we estimate growth rate of GDP with all the sectoral shares in GDP in India during 1951-52-2013-14 through multiple double log regression model, we found that one percent increase in agricultural share, manufacturing share and service sector share per year which might lead to decrease in GDP growth rate by -4.478% per year (insignificant) increase by 3.475% per year (significant) and decrease by -13.400% per year (insignificant) respectively.

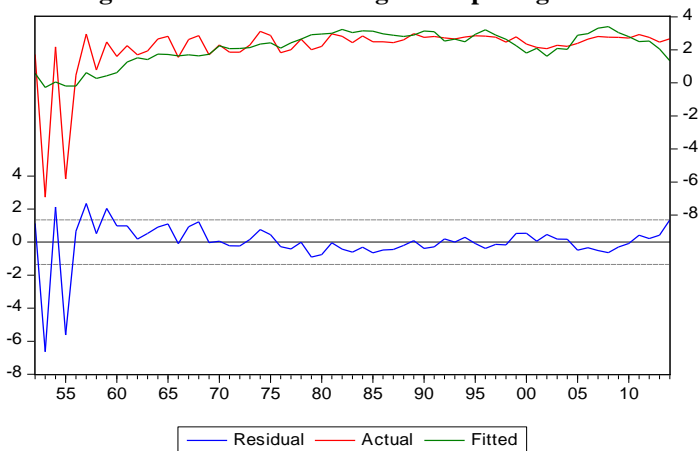
$$\text{Log}(y) = 47.6717 - 4.4787\text{log}(x_1) + 6.49394\text{log}(x_2) - 13.4007\text{log}(x_3)$$

(1.0665) (-1.162) (3.4752)* (-1.7357)

$$R^2 = 0.351, F = 10.64*, DW = 2.408, * = \text{significant at 5\% level}$$

The estimated model is shown in Fig-7. This estimation is insignificant but the model is stable.

Fig-7. Estimated line through multiple regression



Source-Computed by author.

In the Table-1, it is shown that the residuals of this regression have autocorrelation and Partial Autocorrelation problems and the Q-stat are significant up to lag 8.

Table-1: Autocorrelation and Partial autocorrelation

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
█	█	1 -0.21...	-0.21...	3.1629	0.075
█	█	2 0.375	0.343	12.585	0.002
█	█	3 0.014	0.170	12.598	0.006
█	█	4 -0.16...	-0.32...	14.513	0.006
█	█	5 0.023	-0.16...	14.550	0.012
█	█	6 -0.10...	0.101	15.398	0.017
█	█	7 0.021	0.137	15.429	0.031
█	█	8 -0.01...	-0.06...	15.455	0.051
█	█	9 -0.01...	-0.13...	15.469	0.079
█	█	1... -0.03...	-0.06...	15.545	0.113
█	█	1... 0.011	0.104	15.555	0.158
█	█	1... -0.12...	-0.08...	16.720	0.160
█	█	1... -0.03...	-0.19...	16.831	0.207
█	█	1... -0.03...	0.003	16.943	0.259
█	█	1... -0.08...	0.062	17.599	0.284
█	█	1... 0.006	-0.05...	17.602	0.348
█	█	1... -0.01...	-0.07...	17.615	0.414
█	█	1... -0.02...	-0.03...	17.674	0.477
█	█	1... -0.06...	-0.09...	18.017	0.521
█	█	2... -0.07...	-0.14...	18.520	0.553
█	█	2... -0.06...	-0.04...	18.886	0.592
█	█	2... -0.05...	0.032	19.148	0.636
█	█	2... -0.04...	-0.07...	19.372	0.679
█	█	2... 0.037	-0.08...	19.519	0.724
█	█	2... -0.00...	-0.01...	19.520	0.772
█	█	2... 0.009	-0.00...	19.529	0.813
█	█	2... 0.029	-0.06...	19.621	0.846
█	█	2... -0.01...	-0.09...	19.647	0.877

Source-Computed by author

Moreover, it has serial correlation problems which was verified by residuals test of Breusch-Godfrey Serial Correlation LM test where $nR^2 = 3.105985$ which is insignificant in F statistic.

[B] Convergence test

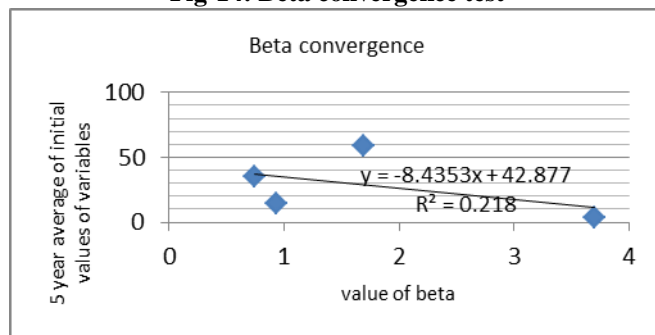
All the sectoral shares in GDP and the GDP growth rates of India during 1951-52-2013-14 satisfied the Salai-i-Martin (1996) convergence criteria because the estimated regression line of the slopes of growth rate of all sectoral shares (Beta) and GDP growth rates and their 5 year average of initial values showed declining which is shown in Fig-14.

$$\beta = 42.87 - 8.43x$$

(1.79) (-0.746)

$$R^2 = 0.218, x = 5 \text{ year averages of initial values of variables}$$

Fig-14: Beta convergence test



Source-Computed by author

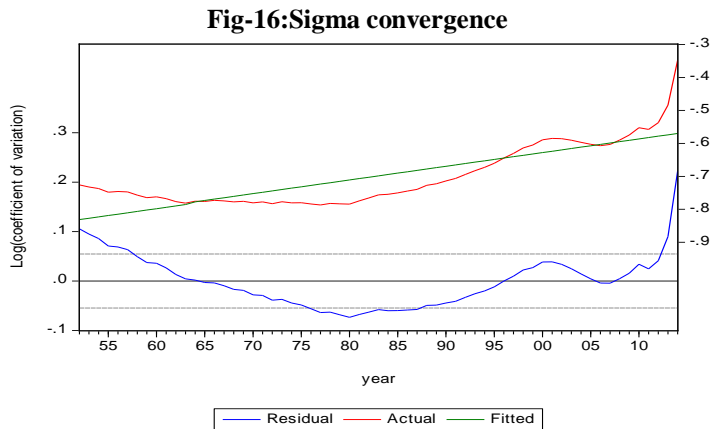
But the sectoral shares and GDP growth rates of India during 1951-52-2013-14 did not satisfy the Sigma convergence hypothesis of Salai-i-Martin (1996) because the trend line of the coefficient of variations of the said variables (sigma) during the above period showed upward rising which confirmed that there is no sigma convergence. It is shown in Fig-16.

$$\text{Log}(z) = -0.8395 + 0.00415t$$

(-58.36)* (11.112)*

$R^2=0.669, F=123.49^*$, where z = coefficient of variation (δ , ie, sigma), *=significant at 5% level

Source-Computed by author



Thus the convergence of shares of agriculture, manufacture and service sector and GDP growth rate is weak and not strong.

[C] Cointegration, Causality and VAR

Johansen Cointegration Test suggests that Trace Statistic showed one cointegrating equation and Max Eigen Statistics showed two cointegrating equations which are significant. Therefore, the sectoral shares are cointegrated with GDP growth rate during 1951-52-2013-14. It is shown in Table-2.

Table-2: Cointegration Test (1)

Hypothesized no of CE(s)	Eigen value	Trace Statistic	0.05 critical value	Prob.
None*	0.452800	65.47375	47.85613	0.0005
At most 1	0.311187	28.69433	29.79707	0.0666
At most 2	0.092438	5.954414	15.49471	0.7009
At most 3	0.000620	0.037846	3.841466	0.8457
Max Eigen Statistic				
None*	0.452800	36.77942	27.58434	0.0025
At most 1*	0.311187	22.73992	21.13162	0.0295
At most 2	0.092438	5.916568	14.26460	0.6239
At most 3	0.000620	0.037846	3.841466	0.8457

Source-computed by author, *=rejection of hypothesis at 0.05 level. H0=no cointegration

The variables are not cointegrated which was tested by cointegrating equation deterministic constant where tau-statistics and z-statistic are significant in the H0: series are not cointegrated which is given in the Table-3.

Table-3: Cointegration Test(2)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
X ₁	-4.740661	0.0169	-28.33463	0.0444
X ₂	-4.839077	0.0131	-29.09931	0.0374
X ₃	-4.727325	0.0174	-28.19563	0.0458
Y	-6.937898	0.0000	-54.20277	0.0000

Source-Computed by EViews-8, *=significant at 5% level.

Granger Causality Test concludes that there are two-way causality among x₁, x₂, x₃ and x₁, x₃ and y but there is no causality between x₂ and y which were supported by F statistic using lag 1 and is shown in Table-4.

Table-4: Granger causality Test among sectoral shares and growth rate

Null Hypothesis	Obs	F statistic	Prob.
X ₂ does not Granger Cause x ₁	63	0.05003	0.8238
X ₁ does not Granger Cause x ₂		0.32318	0.5718
X ₃ does not Granger Cause x ₁	63	0.09515	0.7588
X ₁ does not Granger Cause x ₃		0.17783	0.6748

Y does not Granger Cause x_1	62	4.88366	0.0310
X_1 does not Granger Cause y		11.9058	0.0010
X_3 does not Granger Cause X_2	63	0.44898	0.5054
X_2 does not Granger Cause X_3		0.00103	0.9745
X_2 does not Granger Cause X_3		0.00103	0.9745
Y does not Granger Cause X_2	62	0.73860	0.3936
X_2 does not Granger Cause Y		20.4909	3.E-05
Y does not Granger Cause X_3	62	6.73126	0.0119
X_3 does not Granger Cause Y		7.53619	0.0080

Source-Computed by author

The estimated VAR model is given below.

$$\begin{aligned}
 X_{1t} &= -260.9326 + 3.6091X_{1t-1} + 2.8005X_{2t-1} + 2.5198X_{3t-1} - 0.0534Y_{t-1} \\
 &\quad (-3.070)^* \quad (4.231)^* \quad (3.21)^* \quad (3.027)^* \quad (-1.22) \\
 R^2 &= 0.982, F=812.51^*, AIC=3.49, SC=3.66 \\
 X_{2t} &= 63.0254 - 0.6273X_{1t-1} - 0.315X_{2t-1} - 0.623X_{3t-1} + 0.00245Y_{t-1} \\
 &\quad (1.32) \quad (-1.295) \quad (0.636) \quad (-1.31) \quad (0.098) \\
 R^2 &= 0.96, F=382.78^*, AIC=2.351, SC=2.53 \\
 X_{3t} &= 263.8704 - 2.653X_{1t-1} - 2.8237X_{2t-1} - 1.5445X_{3t-1} + 0.05209Y_{t-1} \\
 &\quad (4.11)^* \quad (-4.008)^* \quad (-4.008)^* \quad (-2.39)^* \quad (1.53) \\
 R^2 &= 0.97, F=585.109^*, AIC=2.98, SC=3.154 \\
 Y_t &= -743.237 + 7.4534X_{1t-1} + 8.6411X_{2t-1} + 7.0426X_{3t-1} + 0.1151Y_{t-1} \\
 &\quad (-2.89)^* \quad (2.88)^* \quad (3.265)^* \quad (2.789)^* \quad (0.866) \\
 R^2 &= 0.431, F=10.809, AIC=5.71, SC=5.88, *=significant at 5% level.
 \end{aligned}$$

Thus agricultural and service sector shares are significantly related with previous period of all sectoral shares as well as GDP growth rate is significantly related with previous period's sectoral shares. The estimated equations have high R^2 and F.

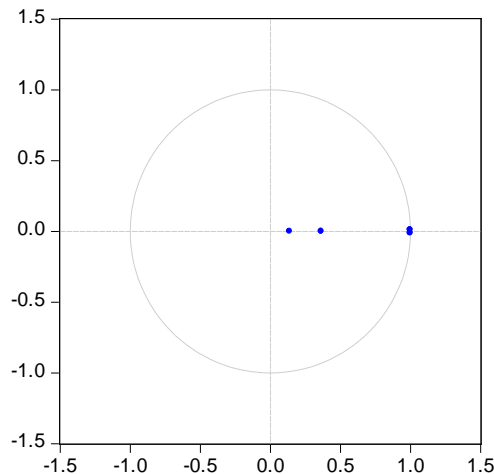
This VAR model satisfies the stability condition because all inverse roots in AR characteristic polynomial lie inside the unit root circle (values of roots are given below in Table-5). The unit root circle is shown in Fig-8.

Table-5: Value of roots

Root	0.997248 - 0.010405i	0.997248 + 0.010405i	0.363549	0.136930
Modulus	0.997302	0.997302	0.363549	0.136930

Source-Computed by author

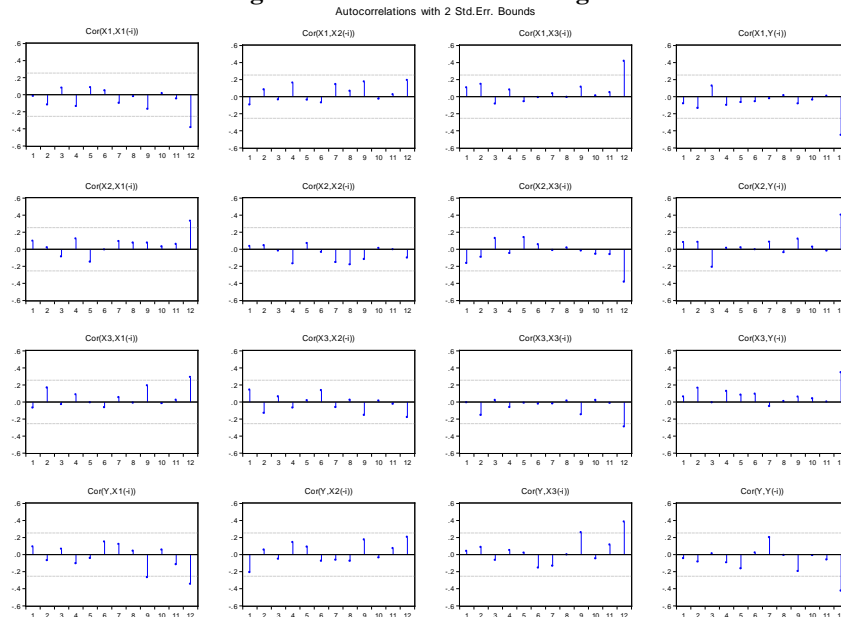
Fig-8: Inverse root of AR characteristic polynomial
 Inverse Roots of AR Characteristic Polynomial



Source-Computed by author

Residual test for correlogram confirms that the VAR model has Autocorrelation problem which is shown in Fig-9 below.

Fig-9: Residual test for correlogram



Source-Computed by author

VAR residual serial correlation LM test suggests that it has serial correlation which is shown in the Table-6.

Table-6. VAR serial correlation LM test

Lag	1	2	3	4	5	6	7	8	9	10	11	12
LM stat	21.09	12.37	12.64	12.32	16.74	17.94	11.55	17.76	24.44	5.90	6.25	31.72
Prob	0.17	0.71	0.69	0.72	0.40	0.32	0.77	0.33	0.08	0.98	0.98	0.01

Source-Computed by author

Doornik-Hansen VAR residual normality test showed that the residuals are not multivariate normal because Chi-square distribution of skewness and kurtosis components are not significant. In Table-7, this is given.

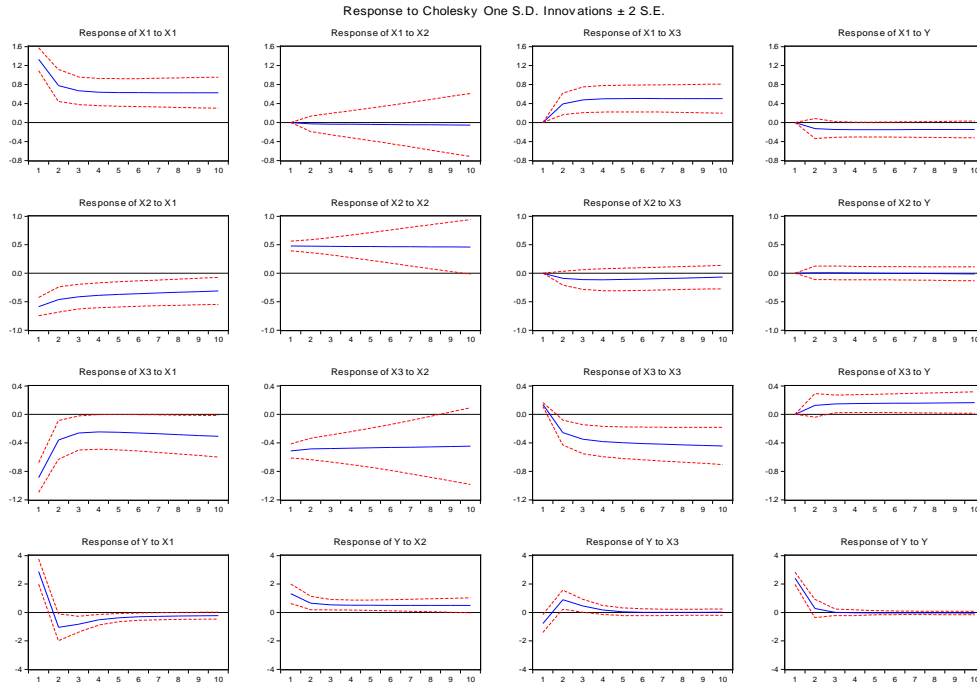
Table-7: Normality test

Component	Skewness	Chi-sq	df	Prob.
1	0.160140	0.315740	1	0.5742
2	0.271047	0.889638	1	0.3456
3	0.439009	2.244647	1	0.1341
4	0.539668	3.292022	1	0.0696
joint		6.742047	4	0.1502
Component	Kurtosis	Chi-sq	df	Prob.
1	5.112755	14.64254	1	0.0001
2	3.116093	0.341283	1	0.5591
3	3.763536	1.618767	1	0.2033
4	4.161352	2.398429	1	0.1215
Component	Jarque-Bera	Df	Prob.	
1	14.95828	2	0.0006	
2	1.230921	2	0.5404	
3	3.863414	2	0.1449	
4	5.690451	2	0.0581	
Joint	25.74306	8	0.0012	

Source-Computed by author

Since most of the impulse response functions approach away from zero then the VAR is not stable.

Fig-10: Impulse Response Functions



Source-Computed by author

The estimates of the VECM are given below.

$$\Delta X_{1t} = -0.5246 - 0.486\Delta X_{1t-1} - 0.785\Delta X_{2t-1} - 0.3328\Delta X_{3t-1} + 0.0581\Delta Y_{t-1} + 0.7708EC_1$$

(-2.329)* (-0.3356) (-0.549) (-0.259) (1.17) (2.76)*

$$R^2=0.178, F=2.38, AIC=3.169, SC=3.827$$

$$\Delta X_{2t} = 0.2437 + 0.689\Delta X_{1t-1} + 0.8069\Delta X_{2t-1} + 0.4179\Delta X_{3t-1} - 0.0234\Delta Y_{t-1} - 0.1058EC_2$$

(1.94) (0.852) (1.01) (0.583) (-0.848) (-0.681)

$$R^2=0.062, F=0.727, AIC=2.45, SC=2.658$$

$$\Delta X_{3t} = 0.252 - 0.542\Delta X_{1t-1} - 0.281\Delta X_{2t-1} - 0.3603\Delta X_{3t-1} - 0.0465\Delta Y_{t-1} - 0.810EC_3$$

(1.451) (-0.483) (-0.254) (-0.362) (-1.214) (-3.75)*

$$R^2=0.267, F=1.09, AIC=3.10, SC=3.13$$

$$\Delta Y_t = 0.444 + 1.211\Delta X_{1t-1} - 0.460\Delta X_{2t-1} + 1.407\Delta X_{3t-1} + 0.134\Delta Y_{t-1} + 4.931EC_4$$

(0.696) (0.295) (-0.1136) (0.386) (0.959) (6.24)*

$$R^2=0.61, F=17.36*, AIC=5.70, SC=5.90$$

The VECM states that the errors have been correcting speedily which are significant except EC_2 and the first difference variables are not related significantly with previous periods.

The residuals of VECM has three unit roots and other roots are less than one and all lie in the unit circle which state that the VECM is stable. It is shown in the Table-8.

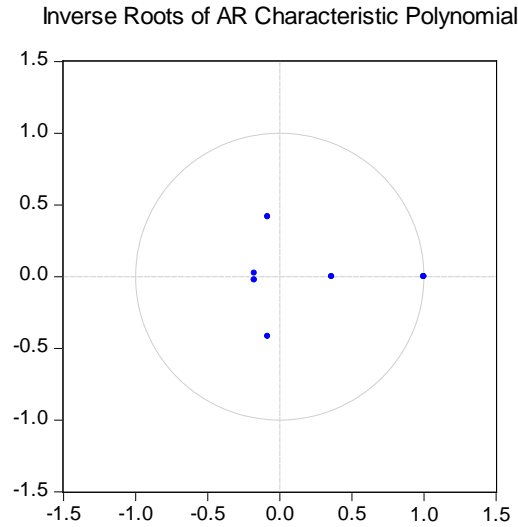
Table-8: Value of roots

Root	Modulus
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
-0.082326 - 0.418084i	0.426112
-0.082326 + 0.418084i	0.426112
0.360754	0.360754
-0.176347 - 0.023885i	0.177957
-0.176347 + 0.023885i	0.177957

Source-Computed by author

The unit root circle is shown in Fig-11 where all roots lie inside the circle which proves stability.

Fig-11:Unit root circle

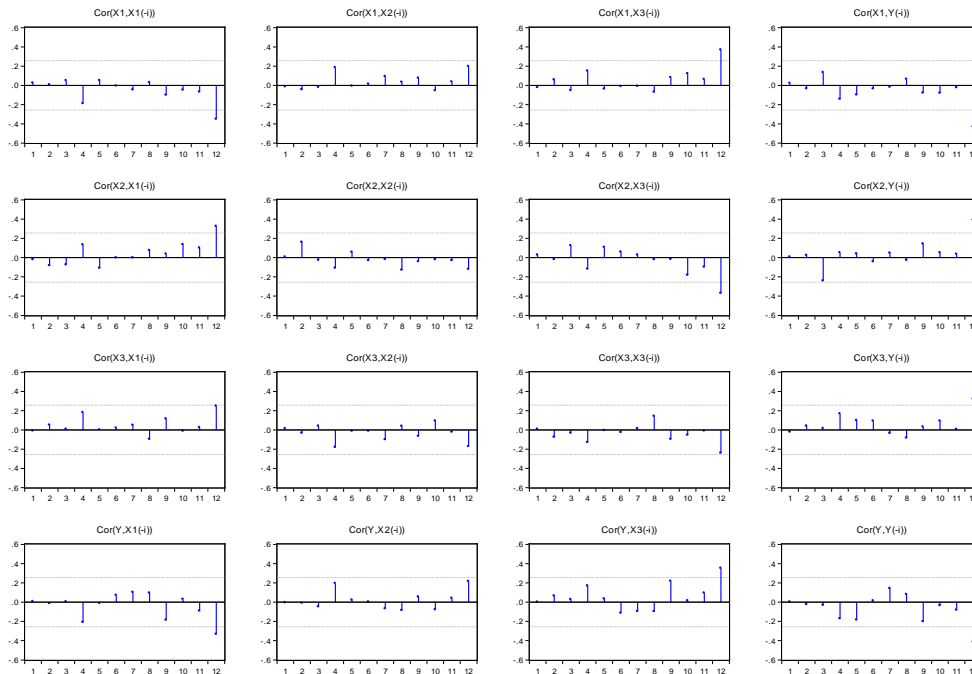


Source-Computed by author.

Residual test for correlogram of VECM showed autocorrelation problem which is found from the Fig-12.

Fig-12:Correlogram

Autocorrelations with 2 Std.Err. Bounds



Source-Computed by author

Doornik-Hansen VEC residual normality test confirm that Chi-square distribution of components of skewness and kurtosis are not significant although Chi-square distribution of first and third component of Jarque-Bera are significant. It signifies that residuals are not multivariate normal which is shown in Table-9.

Table-9:Doornik-Hansen Normality test

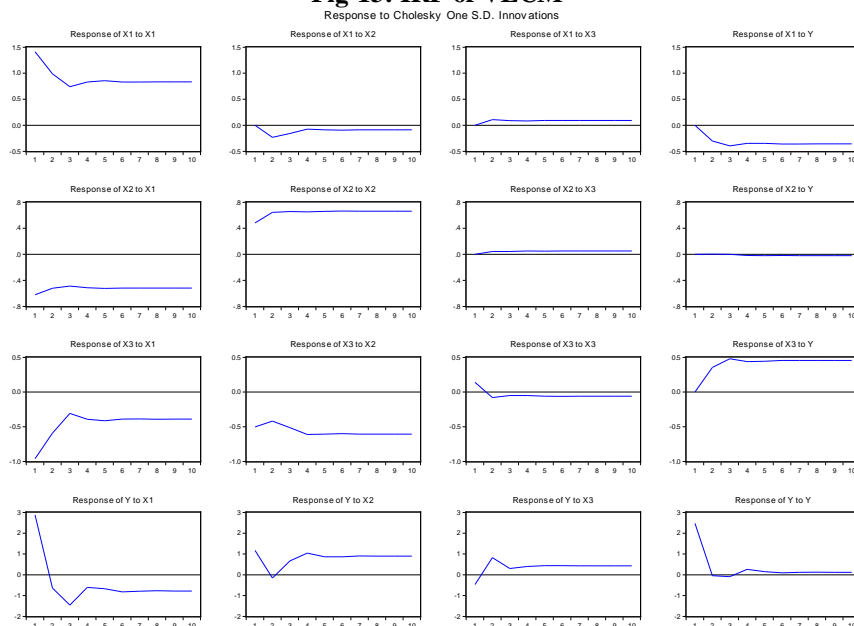
Component	Skewness	Chi-sq	Df	Prob.
1	0.049859	0.030435	1	0.8615
2	0.110068	0.147813	1	0.7006
3	0.781692	6.254873	1	0.0124
4	0.460347	2.420372	1	0.1198

		8.853494	4	0.0649
Component	Kurtosis	Chi-sq	Df	Prob.
1	4.543969	10.00600	1	0.0016
2	2.943809	0.269511	1	0.6037
3	4.401776	0.561409	1	0.4537
4	3.971826	2.399823	1	0.1213
joint		13.23674	4	0.0102
Component	Jarque-Bera	Df	Prob.	
1	10.03643	2	0.0066	
2	0.417325	2	0.8117	
3	6.816282	2	0.0331	
4	4.820195	2	0.0898	
Joint	22.09023	8	0.0048	

Source-Computed by author

Some of all the impulse response functions are not converging towards zero which implies that the VECM model is not converging. It is visible in Fig-13.

Fig-13: IRF of VECM



Source-Computed by author.

V. POLICY IMPLICATIONS

More investment ,credits, irrigation facility, infrastructure, floriculture, fishery, forestry are needed to increase agriculture productivity so as to catapult employment rate and share in GDP of the agricultural sector that can be helpful for convergence. It is required to increase industrial share in GDP, convergence of industrial expansion in states and increase in growth rates are urgent which need new industrial policy. The acceleration of service sector due to globalization and liberalization is leading GDP growth in India although it is uneven in the states that should be included in the inclusive growth process. For significant cointegration in the sectoral shares the importance of agriculture and technological shift of industry are to be emphasized in the planning framework.

VI. CONCLUSION

The paper concludes that India’s agricultural share in GDP has been steadily declining at the rate of 1.69% per year , the industrial share in GDP in India has been catapulting at the rate of 0.93% per year and the service sector share in GDP in India has been increasing at the rate of 0.747% per year from 1950-51 to 2013-14 which are statistically significant. The sectoral shares have weak cointegration but the shares showed the bidirectional causality. The VAR model is stable showing significant relation with previous period but impulse response functions are diverging and the residuals are not normal which was tested by Doornik-Hansen normality test.VECM showed that errors have been correcting speedily and the model is stable since AR polynomial roots lie inside the unit root circle. The sectoral shares and growth rate have significant Beta convergence but

insignificant sigma convergence in India during 1950-51-2013-14 which are not suited for sustainable development in India.

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