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An Empirical Study of Inter-Sectoral Linkages and Economic Growth in India

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Abstract The objective of the present paper is to examine casual relationship between GDP, agricultural, industrial and service sector output in India using time series data from 1950-51 to 2011-12.The study conducts an econometric investigation by applying methodologies, viz., Stationary tests, and Johansen's Cointegration test, Johansen's Vector Error Correction Model (VECM) in VAR and Impulse Response Function and Variance Decomposition Analysis. With all the variables in log terms being I(1), Johansen's co-integration test confirms two long run relationships among the variables at 5% significance level. It reveals that there exists bidirectional causality among the agriculture, industry, service sector and GDP and agriculture and industrial sector with services sector, while there is a unidirectional causality between agriculture and industry sector. However, results based on vector error correction model indicate a weak association between the sectors in the short run. Dynamic causality results show that contribution GDP forecast error by the services sector is the highest, followed by agriculture and industry sectors, while the contribution to the agriculture sector forecast error by GDP is the highest, followed by the service sector and industry. In the case of the industry sector, the explanatory power of one standard deviation innovation in the agriculture sector and the services sector to forecast error variance is quite high (33.38% and 5.38%). Further, results of decomposition variance analysis and impulse response suggest that the agriculture sector plays the main role in determining the overall growth rate of the economy through its linkages to other sector. The analysis of inter – sectoral linkages identify agriculture as the main economic activity that controls most economic activities in India.

Keywords: *GDP, agriculture, industry, services sector, Cointegration and Vector Error Correction Model, Impulse Response Function and Variance decomposition analysis*

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1. Introduction

The process of economic development in an economy results in distinct structural changes. As a country progresses and the gross domestic product (GDP) basket enlarges, a shift in the economy occurs away from agriculture towards services and industrial sectors, owing to higher elasticity of the latter two sectors than that of the former sector (Fisher, 1939, Clark, 1940). The process in turn leads to structural shifts, and consequent diminishing significance of agricultural activities and growing dominance of industrial and service sector activities. As per the standard literature on the subject, services sector experiences an accelerated growth only after a certain level of development has taken place in agriculture and industry. Experiences of the economies over-time, in this regard, have been varied. For instance, in most of developed economies, economic development followed a sequence wherein sectors via, agriculture, industry and services sector developed in that order. On the contrary, the experience of some countries such as India bears out that sequence where territory sector developed without a successful transition to an industrialized economy.

From a traditional agro-economy till the 1970s, the Indian economy has transformed into a predominantly service-oriented economy, especially since the mid 1980s. Economic reforms initiated in the mid 1980s. The economic reforms executed from early nineties have seen the share of services sector in GDP rising continuously. Figure 1, shows that though the contribution of the services sector to GDP was highest in 1980 also but its growth was remarkable in the last three decades, it rose approximately eleven times from 300614 Rs. Cr. (37.65%) in 1980-81 to 3263196 Rs. Cr. (59.29%) in 2012-13, while industry sector recorded only seven times growth from 204861Rs. Cr. (25.66%) in 1980-81 to 1487533 Rs. Cr. (27.03%) in 2012-13 and agriculture and allied sector grown by 2.65 times in this period from 285015 Rs. Cr. (35.35%) to 752746 Rs. Cr. (13.68%). The high growth rate recorded by Indian economy is in the first decade of this century comes mainly from service sector followed by industry sector. The growth in the agriculture sector continues to be highly volatile due mainly to adverse impacts of natural shock such as droughts and floods.

The shift in the composition of GDP has brought about substantial changes in inter-sectoral production and demand linkages. Thus, investigation of structural transformation among sectors becomes an important from a policy perspective. It helps one to understand not only the evolution and progression of such relationships, but also inter - sectoral adjustments over time. A clear perspective on inter - sectoral dynamics could be useful in devising a conductive and appropriate development strategy. Further, sharp divergences in growth rates of different sectors are found to have serious implications for income distribution of an economy. A proper comprehension of the characteristics and trend of sectoral linkages also assumes importance in designing socially-just policies. The studies of sectoral inter - linkages are all the more important for a developing country like India so that positive growth stimuli among sectors could be identified and fostered to sustain the economic growth momentum. This would go a long way in redressing various socioeconomic problems such as poverty, unemployment and inequality.

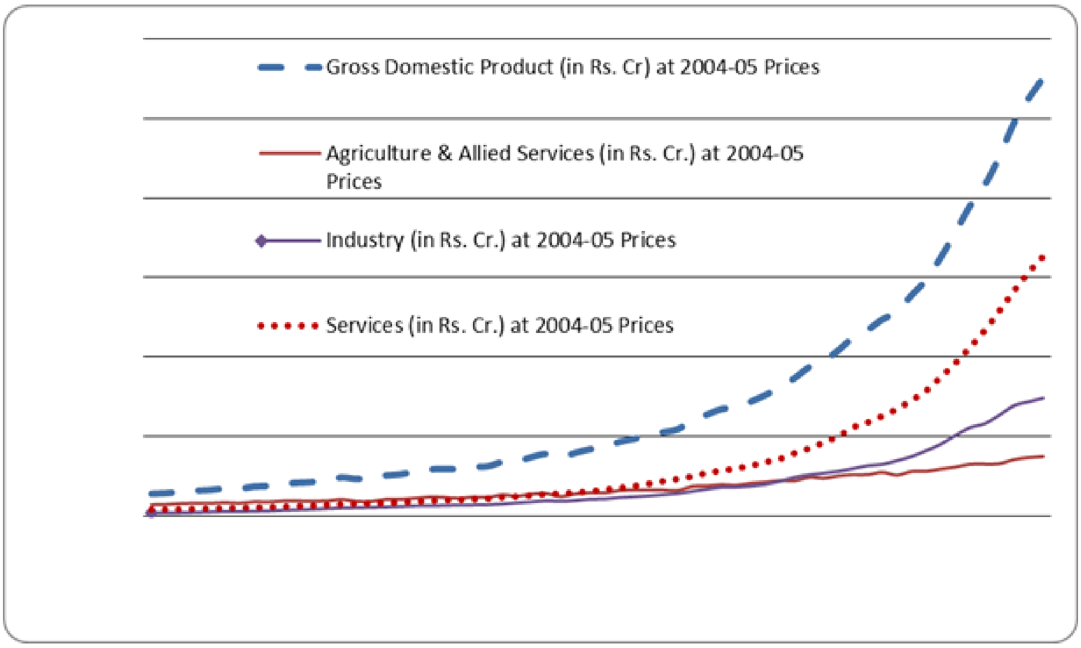

Figure 1. Trends of GDP and Sectoral Value added growth in India, 1951-2012 (Source: Central Statistical Organization, India)

In this backdrop, the present paper focuses on examining the sectoral links with GDP and inter-linkages among the sectors of the economy. Scheme of paper is as follows: Section 1 documents survey of the literature on inter-linkages among GDP and various sectors of GDP. Section II highlights some of growth attributes of the Indian Economy. Section III analyses the data, data sources and methodology used in the paper. Section IV examines the existence of long run equilibrium and short run dynamic relationship amongst selected variables using co-integration and error correction mechanism. Finally, section V marks some concluding observations.

2. Survey of Literature

The interaction between agriculture growth and sectoral growth extensively studies in developing countries on the theoretical and empirical. For example Lewis model (1954), provides pioneer theoretical literature on the interaction between agricultural and industrial in the economy. He states that agriculture sector provides input raw material, surplus labour and savings for the other sectors of the economy in order to enhance the overall economic growth or output.

Katircioglu (2004) examined the link between economic growth and sectoral growth in a case study of north Cyprus. He has found a long run relationship between economic growth and sectoral growth in the country. The causality result of his study indicates unidirectional causality from GDP growth to agricultural sector growth and also concludes that GDP growth gives unidirectional causation to industry and services sector growth. In another study, Katircioglu (2006) investigated the impact of agricultural sector growth on the overall economic growth; using time series data of 1975-2002. He has found a bidirectional relationship between agricultural output growth and economic growth in the case of North Cyprus.

Chebbi (2010) examines the link between agriculture growth and other sector growth of the economy (i.e., Manufacturing, transportation, tourism and telecommunication, commerce and service sector); using the J.J. Co-integration and Granger causality in the case of Tunisia. The author concluded the existence of a long run relationship between agricultural growth and other sectors of the economy. In addition, he rejected the weak exogeneity for the agricultural sector and suggests possible long run linkages between agriculture and other sectors of the economy. The main objective of the research is to investigate the same issue in India, since it has not yet been discussed at extent.

A number of studies have been made to analyze the sectoral linkages in the context of India. Like Rangarajan [13] who found a strong degree of association between the agricultural and industrial sectors. He claimed that the consumption linkages are much more powerful than the production linkages between sectors. In particular, it has been observed that an addition of 1% growth in the agriculture sector stimulates the industrial sector output to the extent of 0.5%. Kanwar [10] found that the process of income growth in manufacturing and construction gets significantly affected not only by agriculture but also by infrastructure and services. Bhattacharya and Mitra [4] provided empirical evidence in support of a positive linkage among the broad sectors. It established that many service activities are significantly associated with the agricultural and industrial sectors and this helps in overall employment generation. Hansda [8], in his study, found that services and agriculture do not seem to share much interdependence; industry is observed to be the most services-intensive. Sustained services growth requires a growing industry too.

Sastry et al [16] maintained that due to the modernization of agriculture the dependence of agriculture on the industry for inputs has grown. As for the services sector, they found a movement of production linkages from the late1960s to the early 1990s moderately in favour of agriculture, and sharply in favour of the services sector. On demand linkages, the study asserts that a fall in agriculture income reduces the demand for agricultural machinery and other industrial products, resulting in a fall of aggregate demand and vice versa. Further, a fall in aggregate demand either in agriculture or services sector is likely to cause serious production constraints in the industrial sector, thereby affecting both demand and production linkages.

Bathla [2] carried out a comprehensive econometric analysis of inter-sectoral linkages in the Indian economy for the period 1950-51 to 2000-01. This study does not find any significant relationship between the primary and secondary sectors, while the primary sector was found to have a unidirectional causation with “trade, hotels, restaurants, communication” and “financing-insurance-real estate and business” services. Under the co-integration framework, strong evidence of the existence of long-run equilibrium relationship was found among the primary, secondary and the specialized service sector.

Kaur et al (2009) explored that primary, secondary and tertiary (excluding community, social and personal services) sector display strong long run equilibrium relationship amongst each other. At sub-sectoral level, the existence of long-term equilibrium was found between ‘trade, hotels, transport & communication’ and ‘manufacturing’ sectors. Further, the financial sector activity in the ‘banking & insurance’ sector was found to be co-integrated with the ‘manufacturing’ and ‘primary’ sectors.

Debnath and Roy [6] analyzed the trend in sectoral shares in state domestic product and inter-sectoral linkages in northeast India for the period 1981 to 2007 in his paper. They show that there exists bidirectional causality among the sectoral output of north-eastern states, at least in the short run. In the long run, there exists a unidirectional causality running from the agricultural sector and the industrial sector to the services sector. From the above discussion, it has seen that the importance of sectoral linkages is useful to understand the association between different sectors in the economy.

3. Methodology and Data Sources

The objective of this paper is to examine the causal relationships between GDP, agricultural, industrial and service sector output in India using time series data from 1952 to 2012. For the purpose, we first perform the stationary tests with the variables involved namely GDP in level, and GDP from the agriculture sector , GDP from the mining and industry sector and GDP from the service sector.

Next step is the estimate the relationship between the variables with the specification given below:

$$\ln GDP = \beta_0 + \beta_1 \ln AAS + \beta_2 \ln MIS + \beta_3 \ln SER.$$

After the estimation of the above relationship we proceed to see if it is spurious for that co- integration test is conducted to determine whether groups of non-stationary series are co- integrated or not, we applied following methodologies:

1. Johansen’s co- integration Test;
2. Johansen’s Vector Error Correction Model (VECM) in VAR; and
3. Dynamic Analysis in a Co integrated VAR Framework: Impulse Response Function and Variance Decomposition Analysis.

To examine the stationary property of all the variables, we have carried out the ADF and DF (GLS) unit root tests. All the tests have been conducted with, intercept alone. If the data generating process is following a unit root and therefore non-stationary, then the data has to be transformed into first differences and unit root test have to be repeated. If the data in first differences follow a stationary process, or if data in different forms is stationary, then the variables in levels form have to be tested for any co-integrating relationships [7] and Johansen and Juselius (1990).

If in the level form, there is co-integration, the vector Error Correction Model is to be run, and the Granger Casualty can be tested for both long run and short run, Further, in order to analyse the dynamic interaction among the variables, we have used Variance Decomposition analysis and the impulse response function. These are generally used to overcome the shortcoming of VAR approach; the coefficients obtained from the VAR Model cannot be interpreted directly [17]. The VAR Approach consists of a set of regression equations in which all the variables are considered endogenous.

Data used in this paper are collected from the Data Book for PC by Central Statistical Organization of India [5]. All data are annual figures; covering the period 1950-51 to 2012-13 and variables that are measured is at a constant 2004-05 prices. The GDP data have been classified into three parts: GDP from agriculture and Allied sector (AAS), mining and industrial GDP (MIS) and GDP originates from the services sector (SER). The agricultural sector consists of agriculture and allied activities, fishery and forestry. The industrial sector includes mining and quarrying, manufacturing, construction, and electricity, gas and water supply. The services sector comprises the rest of all sub-sectors like banking, communication etc.

4. India’s Growth Story: Some Stylized Facts

Before we analyse the trend in the GDP and interlinking among the major sectors, let us have a broad idea about the growth pattern of GDP components of the

Indian Economy. The summary statistics of the variables in level form is given below in Table 1.

Table 1. Summary statistics, using the observations (in Rs. Crores), 1951– 2012

	GDP	AAS	MIS	SER
Mean	14,50,500	3,55,560	3,88,140	7,01,210
Minimum	8,55,760	2,97,710	2,22,830	3,27,500
Maximum	2,86,150	14,72,200	4,77,390	8,47,990
Std. Dev.	5.503500	7.52750	1.487500	3.263200
C.V.	1.350600	1.71800	3.855700	8.045800
Skewness	0.93115	0.48319	0.99338	1.1474
Ex. Kurtosis	1.5043	0.72191	1.4517	1.6902
Jarque-Bea Test	28.44*	6.449**	25.24*	39.79*

Notes:*significant at 1% level, ** significant at 5% level and *** significant at 10% level.

Next we calculate the decade-wise growth of GDP and its components, using the simple one period growth formula during the period 1951-2012.Considerable variation in the decade-wise performance of the Indian economy in respect to sectoral output and GDP growth is observed. Decade-wise analysis reveals that the growth rate of GDP declined from 3.70 % during the fifties to 2.08 % during the seventies thereafter it started picking up and increased remarkably to 9.2% during the first decade of the twenty first century (Table 2). At the disaggregated level, growth rate of agriculture sector, first increased from 2.55% during the eighties to 3.13 % during 1991-2000 thereafter there was a decline and it plummeted to 2.65 % during the first decade of this century. On the other hand, the growth trend of industrial sector remained stagnant till 2000 and thereafter it increased from 6.2% to 9.9% in the first decade of twenty first century but service sectors increased substantially from just after to the liberalisation of an economy and continued in second decade also.

Table 2. Growth Rates by sectors - Average per Year (percent)

Period	GDP	AAS	MIS	SER
1951-1960	3.70273	2.62630	6.36173	4.19428
1961-1970	2.69485	1.47959	4.04061	3.37264
1971-1980	2.08428	0.26838	2.84271	3.17353
1981-1990	3.76278	2.55075	4.09497	4.48600
1991-2000	6.72943	3.13651	6.21095	9.67890
2001-2010	9.22975	2.64430	9.95052	11.7441

Source: Authors ‘calculations.

Performance of services sector in the Indian economy has been exemplary after the decade 1981-1990 as a result of some economic reforms introduced in the late eighties. First, in contrast with agricultural and industrial sectors, except for the 1970s and 1980s, the growth in the services sector has trended upwards, accelerating from 4.2 percent to 11.7 percent in the first decade of the twenties. On the contrary, while the growth in agricultural and allied sector remained volatile with no clear trend, growth in industrial sector in the 1970s to 1990s remained even lower than 6.4% growth of the 1960s. Notwithstanding the highest growth, the volatility as measured by the coefficient of variation is highest in the services sector in comparison to agriculture and secondary sectors (Table 3). Consistent and high growth of the services sector has added a dimension of stability of India’s growth process through a decline in volatility of output [14].

Table 3. Volatility in GDP and various Sectors as measured by Coefficient of Variation

Period	GDP	AAS	MIS	SER
1951-1960	0.11621	0.087093	0.18979	0.12918
1961-1970	0.11035	0.091861	0.15017	0.12987
1971-1980	0.11221	0.082315	0.14016	0.13952
1981-1990	0.16082	0.10114	0.18298	0.20321
1991-2000	0.18619	0.099298	0.18767	0.23781
2001-2010	0.24150	0.099983	0.25691	0.27989

Source: Authors ‘calculations

5. Estimation Equation and Result Interpretation

At the outset, before undertaking any time series econometric analysis of the data, it would be useful to see the broad trends and behaviour of the variables, which may help in interpreting the model results later. For this purpose, time series plot is drawn for all the variables. In the next step, we have computed the descriptive statistics of all the selected variables. The summary statistics are presented in the Table 1. It can be seen from the table that the measures of Skewness indicate that all the variables have right skewed distribution, which means that most values are concentrated on the left of the mean with extreme values to the right. Distributions with negative or positive excess kurtosis are called platykurtic distributions or leptokurtic distributions respectively. The Jarque-Bera normality test rejects normality of all series at any level of statistical significance.

To examine the stationary property of the variables used in our study, we have carried out the ADF and Dickey Fuller (GLS) tests. The null hypothesis is that there exists a unit root or the underlying process is non stationary. The results of the unit root test are given in Table 4. The results indicate that gross domestic product (GDP), Agriculture Sector (AS), Industrial Sector (IS), and Services Sector (SS) value added are integrated order one I (1).

Table 4. Unit Root Tests of the Variables

Tests	ADF Test		Dickey-Fuller (GLS) test		KPSS Test	
Variables	Level	First Diff.	Level	First Diff.	Level	First Diff.
LNGDP	3.59	-7.68*	6.38	-6.96*	1.61*	0.967
LNAAS	-0.09	-12.5*	1.905	-12.59*	1.64*	0.081
LNMIS	1.11	-6.06*	5.363	-3.73*	1.62*	0.222
LNSER	9.31	-3.33*	7.72	-2.55*	1.62*	1.28

The next step is to examine the interaction among the variables in the system using the error-correction model. The VECM involves selection of appropriate lag length. An appropriate lag selection may give rise to problems of over-parameterizations or under parameterization. According to AIC, BIC and HQC criteria, the appropriate lag length is 1. Mathematically, two or more variables are said to be co-integrated if they are individually integrated of the same order, say (p), and a linear combination of the variables exists such that their linear combination is stationary, i.e. I (0). Generally, existence of co-integration is examined by two alternative approaches, viz., The Engle-Granger two step method proposed by Engel and Granger [7] and Johansen-Juselius method proposed by Johansen [9] and later extended by Johansen and Juselius (1990).

Table 5. Empirical Results of the Co-integration Tests based on Johansen-Juselius method

Variables in the system	Rank	Eigenvalue	Trace Test [p-value}	Lmax test [p-value]	Conclusion
1	2	3	4	5	6
LAAS, LIS	0	0.27403	20.656 [0.0066]	19.535 [0.0055]	One co-integrating relationship exist
	1	0.01820	1.1209 [0.2897]	1.1209 [0.2897]	
LAAS, LSS	0	0.63524	79.608 [0.0000]	61.519 [0.0000]	Two co-integrating relationship exist
	1	0.25662	18.089 [0.0000]	18.089 [0.0000]	
LIS, LSS	0	0.64781	68.649 [0.0000]	63.659 [0.0000]	Two co-integrating relationship exist
	1	0.07854	4.9901 [0.0255]	4.9901 [0.0255]	
LAAS, LIS, LSS	0	0.68187	95.700 [0.0000]	69.862 [0.0000]	At most Three co-integrating relationship exist
	1	0.28953	25.837 [0.0007]	20.852 [0.0031]	
	2	0.07848	4.9858 [0.0256]	4.9858 [0.0256]	
LGDP, LASS, LIS, LSS	0	0.72499	128.07 [0.0000]	78.747 [0.0000]	At most Two co-integrating relationship exist
	1	0.49619	49.326 [0.0001]	41.819 [0.0000]	
	2	0.11513	7.5069 [0.5265]	7.4614 [0.4449]	
	3	0.000745	0.045 [0.8311]	0.0455 [0.8311]	

The Engle – Granger method is basically a test for unique co-integrating relationship, while the Johansen-Juselius method can be applied to test for the existence of more than one co – integrating relationship. The number of co-integrating vectors based on the Johansen - Juselius method is determined by two test statistics, viz., The Trace Statistics and the Maximal Eigen values Statistic. The trace Statistic examines the null hypothesis that the number of distinct co-integrating vectors is less than or equal to ‘r’ against a general alternative. The Maximal Eigen value Statistic tests the null hypothesis that the number of co-integrating vectors is ‘r’ against the alternative of ‘r+1’ co-integrating vectors. Since there are more than two variables, there may be more than one Co integrating relationships. Thus, it is appropriate to examine the issue of Co integration within the Johansen VAR framework. All the variables are tested under Johansen’s technique and results have been presented in Table 5. The trace test indicates that the null hypothesis of at most 1 Co integrating vector is rejected and the Max-eigenvalue test also confirms this result.

6. Long-run Equilibrium: Co Integration

The next step is to determine the interaction among the variables in the system using the error-correction model. Using standard notation, the long run equilibrium condition is finally stated:

$$\ln GDP = 0.065059 + 0.5869 * \ln AAS$$
$$- 0.1707 \ln LIS - 0.779 * \ln LSS.$$

The signs of the coefficients of the co-integrated equation suggest that a one percent increase in the agriculture output leads to a 0.58 percent increase in the GDP of India and it is statistically significant. Similarly, a one percent increase in the share of industry and services sectors cause a decline of 0.17 and 0.77 percent growth, respectively, in GDP of India but the coefficient of industry is not significant whereas that of service is significant.

7. Short Run Dynamics: Vector Error Correction Model

Based on the results of Cointegration test above, the VEC model has been presented. Since, in this paper, we focus on how the GDP is influenced by various sectors and vice a versa, we presented four equations in Table 6.

The estimated coefficient of the EC1 has the correct negative sign for the only industry sector and is significant confirming further that the variables in the system are co integrated. Also, it indicates that while the contribution of industry sector may temporarily deviate from its long run equilibrium, the deviations adjusting towards the equilibrium level in the long run. The estimated coefficient of EC1 is -0.089 implying that about 8.9 percent of the short run deviations of industry sector would be adjusted each year towards the long run equilibrium level of industry sectors.

Table 6. Estimation of Vector Error Correction Model

Dependent	DLGDP	DLAAS	DLIS	DLSS
Independent Variables	*Coefficient (t-ratio)*	*Coefficient (t-ratio)*	*Coefficient (t-ratio)*	*Coefficient (t-ratio)*
const	-0.17 (-0.45)	0.468 (0.68)	0.665* (1.73)	-0.638*** (-3.51)
DLGDP	0.256 (0.37)	1.344 (1.06)	-0.248 (-0.35)	0.0072 (0.02)
DLAAS	-0.269 (-1.02)	-0.95* (-1.96)	0.075 (0.27)	-0.019 (-0.14)
DLIS	-0.060 (-0.29)	-0.33 (-0.88)	0.152 (0.708)	0.09 (0.93)
DLSS	0.260 (0.55)	-0.42 (-0.50)	0.95* (1.98)	0.147 (0.65)
EC1	0.027 (0.52)	-0.058 (-0.61)	-0.089* (-1.67)	0.092*** (3.63)
Adjusted R-squared	0.143	0.157	0.08	0.57
Durbin-Watson	2.16	2.29	1.82	1.959

8. Dynamic Analysis in a Co Integrated VAR Framework: Variance Decomposition Analysis and Impulse Response

After investigating the long-run relationship and short-run adjustment dynamics of GDP and its major sectors in India, the study has made use of the VAR model and reported the impulse response functions and variance decomposition results in order to analyse the dynamic interaction among the variables.

9. Variance Decomposition Analysis

The magnitude of variance explained at the 10th time horizon by different components is presented in Table 7. It is observed that 1.41 percent variance in GDP explained at the 10thtime horizon is explained by agriculture, whereas GDP explains 84.96 percent variance in agriculture at the same time horizon. Hence, the GDP affects agriculture strongly in the long run, and, thus causality seems to run from GDP to agriculture. Similarly, between the industry and agriculture sector, it is observed that 0.85 percent variance in agriculture is explained by industry sector, whereas agriculture explains 33.38 percent variance in industry at the same time horizon. Hence, agriculture affects industry strongly in the long run and, thus causality seems to run from agriculture to industry. In consistence with the above finding, the present study argues that shocks originated from agriculture sector spill over to industry sector.

Similarly, it follows that causality runs from agriculture to services sector because the agriculture sector explains 6.07 percent variance in the service sector, while the latter explains only 0.18 percent variance in the agriculture sector. The agriculture sector is likely to generate demand for traditional services. Traditional services dominate over modern services in gross value of service sector's output; this means that agriculture sector derives the service sector. Agriculture provides factors such as labour to the service sector, particularly traditional services like transport, storage etc. Between the service and industrial sectors, only 0.06 percent variance in service is explained by industry while industry explains 5.38 percent variance in the service sector. Thus, causality runs from service sector to the industry sector. All this suggests that agriculture is the main economic activity that controls most of economic activities in India. Among three main causalities two runs from agriculture to industry and agriculture to services sector, while another causality run from service sector to industry sector.

Table 7. Magnitude of Variance explained at the 10th Time Horizon by Different Components

Variance in GDP explained by Agriculture	1.41	Variance in Agriculture explained by GDP	**84.96**
Variance in GDP explained by Industry	0.02	Variance in Industry explained by GDP	**42.25**
Variance in GDP explained by the Service	0.17	**Variance in Service explained by GDP**	**87.51**
Variance in Agriculture explained by Industry	0.85	Variance in Industry explained by Agriculture	**33.38**
Variance in Service explained by Industry	0.06	Variance in Industry explained by the Service	**5.38**
Variance in Agriculture explained by the Service	0.18	Variance in Service explained by Agriculture	**6.07**

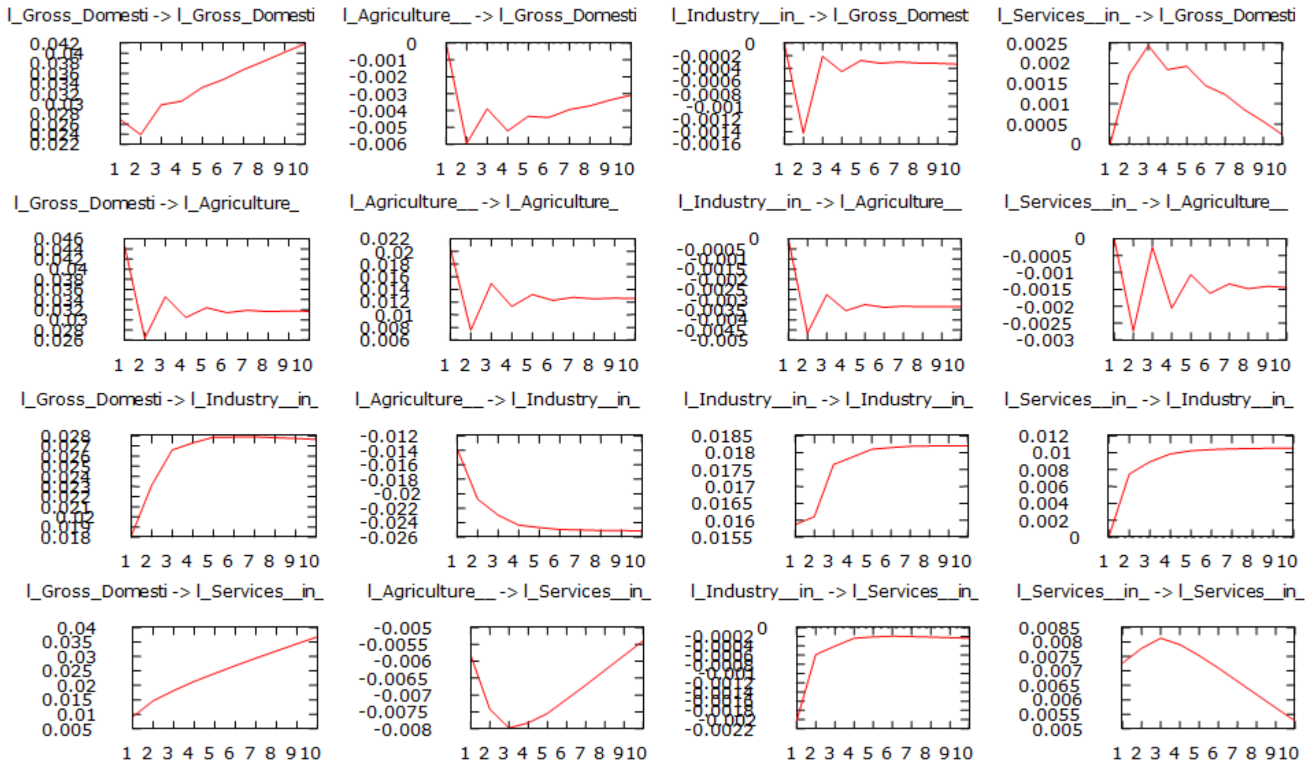

Figure 2. Impulse Response of GDP to its Components to Various Shocks (Note: Y axis measures the impact and the X axis denotes the time trend)

10. Impulse Responses

The impulse response function analyzes the responsiveness of dependent variables to shocks of each of variables in a co integrated VAR framework. The finding presented in Table 7 is compatible with the findings of the impulse response function. As depicted in the Figure 2 that innovations in GDP have a positive impact in Industry and the services sector, while for the agriculture and allied sector, it shows a heavy decline in the second year and then moves onwards. Agriculture sector initially reduces its own growth as well as the growth rate of industry sector and the services sector in the second year and after that it increases the growth rate of the industry and the services sector in the medium and long run.

11. Conclusion

We have analysed the causality and co-integration relationship between sectoral GDPs of agriculture, industry, service and the total GDP of India during the period 1950-51 – 2012-13. Since the ADF test results indicate a first order integration, 1 (I) of the variables under consideration, we have employed the Johansen and Juselius (1990) Cointegration test, VECM, Impulse response and Variance decomposition analysis to examine the static and dynamic relationships between the variables. Johnson and Juselius (1990) Cointegration test reveals that there exists bidirectional causality among the agriculture, industry, service sector and GDP and agriculture and industrial sector with services sector, while there is a unidirectional causality between agriculture and industry sector. To devise an appropriate strategy for accelerating the growth rate, the present paper examines inter-sectoral linkages to identify the lead sector in the economy using a VAR framework.

Results of Variance decomposition analysis (VDA) suggest that GDP explains 84.96 percent variance in agriculture; it means that the GDP affects agriculture strongly in the long run. Between the industry and agriculture sector, it is observed that 0.85 percent variance in agriculture is explained by industry sector, whereas agriculture explains 33.38 percent variance in industry at the same time horizon. Hence, agriculture affects industry strongly in the long run and, thus causality seems to run from agriculture to industry. In consistence with the above finding, the present study argues that shocks originated from agriculture sector spill over to industry sector. Similarly, it follows that causality runs from agriculture to services sector because the agriculture sector explains 6.07 percent variance in the service sector, while the latter explains only 0.18 percent variance in the agriculture sector. The agriculture sector is likely to generate demand for traditional services. Traditional services dominate over modern services in gross value of service sector's output; this means that agriculture sector derives the service sector. Agriculture provides factors such as labour to the service sector, particularly traditional services like transport, storage etc.

Results of impulse response (IR) is very much supportive to variance decomposition analysis shows, agriculture sector reduces its own growth as well as the growth rates of industry sector and the services sector in the second year. But it increases the growth rates of the industry and the services sector in the medium and long run. Thus results of both techniques suggest that the agriculture sector plays the main role in determining the overall growth rate of the economy through its linkages to other sector. The analysis of inter – sectoral linkages identify agriculture as the main economic activity that controls most economic activities in India.

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