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Tilling the Soil, Fueling the Factory: Exploring the Agriculture-Industry Nexus in India Before and After Liberalization

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Abstract: ***The present paper reconsiders the issue of nexus between agriculture and industry in India, and, in its states and Union Territories. The country-level study covers the period from 1950-51 to 2022-23. Further, the study is done separately for the periods before and after liberalization. For the state-level analysis the period from 1993-94 to 2022-23 is considered. We also examine whether such relationship has any impact on the average rate of economic growth of states measured by the annual growth rate of net state domestic product during the study period. The results of the cointegration tests and the relevant error correction models and vector autoregressive models indicate that during the period 1950-51 - 2022-23 the gross value added by agriculture and that by industry for India were significantly and positively related in the long-run. However, the nature of relationship was found to change in the post-liberalization period. A positive long-run relationship was noted before liberalization; but after liberalization, the relationship was significant in the short-run only, where GVA by industry was expected to have positive influence on GVA by agriculture. The state-level analysis indicated a significant positive relationship in the long-run in 14 out of 33 states. Out of the nine states where short-run relationship was significant, in six of them the industrial state value added Granger-caused the agricultural state value added. Moreover, during the study period, the average rate of economic growth of the states was not found to be affected by the existence or non-existence of the agriculture-industry relationship.***

Keywords: Agriculture-industry relationship, States of India, Sectoral linkages

JEL: C22, O53, O49, E0

1. Introduction

There are no two opinions about the crucial roles played by agriculture and industry in fostering economic development of countries. The contribution of agricultural, industrial and service sectors is assessed at various stages of development. It is observed that economic growth leads to structural changes in the economy and usually the share of agriculture in overall growth decreases whereas those for industry and service sectors increase in the process of development. This transition from agriculture-based economy to modern industry-based one is thus a phenomenon observed in the course of economic development.

The interlinkages among various sectors in an economy and their implications for economic development is another important issue. Overall economic development of a country is dependent upon sectoral development and in presence of inter-related sectors, development or non-development of one sector affects the other sectors, and through that the overall development is naturally affected. The study the nature of relationship among sectors is thus important both from the points of views of academicians and policymakers.

We confine ourselves to the linkages between the agricultural and the industrial sectors as a whole which are the two integral parts of any economy. Agriculture and industry are interrelated through several ways. Agriculture is needed for the survival of a country whereas industry is needed for generating employment. In order to meet people’s demand for food and non-food items each sector depends on the output of both sectors. Clearly, expansion of one sector, through consequent increase in employment, leads to more demand for output of both sectors; thus, expansion of one sector should be accompanied by expansion of the other. Again, for the agro-based industries raw materials are supplied by agricultural sector; these industries cannot grow unless there is availability of necessary agricultural inputs. In the agricultural sector, modern technology-based production uses various industrial products like fertilizers, pesticides, equipment etc. as inputs. There is thus a literature on macroeconomic inter-linkages between industrial sector and agricultural sector of countries.[1] Some studies construct theoretical models to incorporate such interlinkages whereas the issue is examined empirically for a number of countries. Studies on Indian economy mostly address the issue for the country as a whole.[2]Our paper attempts to analyse this relationship for the states of India also.

The purpose of the current study is to reconsider the issue of interlinkages between agriculture and industry in India covering a period from 1950-51 to 2022-23. Further, the study is done separately for the periods before and after economic liberalization in the 1990s. The analysis is also done for each of 33 states and Union Territories (henceforth states only) for the period from 1993-94 to 2022-23. Further,

[1]See for example, Alagh (2011), Nag and Ghosh (2003), Rangarajan (1982), Rattso and Torvik (2003), Saikia (2009), Saikia (2011a) etc.
[2] Kalirajan and Sankar (2001) conducted a state-level analysis to examine the relationship between agricultural and industrial growth rates.

we examine if such relationship had any impact on the average economic growth rate of states during the study period.

The paper is organised as follows. A brief review of the literature on the issue of agriculture-industry relationship is presented in Section 2. Section 3 explains the methodology of research. In Section 4 the relationships are studied for the Indian economy (4.1) and for the states (4.2). Sub-section 4.3 examines the impact of such relationship on the average economic growth of the states. In Section 5 some concluding remarks are made with a note on limitations of the current study and the suggestions of further studies in this area of research.

2. A Brief Survey of the Existing Literature

The historical development of the issue of the agriculture-industry nexus was theoretically analysed by Bharadwaj (1987) considering the classical as well as neo-classical approaches. Various methodologies viz., input-output models, social accounting matrix, econometric analysis etc. were used by the authors to study the issue for many countries in the world. Some of them are mentioned below. Mureithi and Sharma (1984) studied the interlinkages between agriculture and industry in Kenya in 1976 by ranking the degree of effects in one sector on the other sectors using input-output model. Syed (1986) analysed input-output tables for studying the inter-industry dependence in the Pakistan. Vogel (1994) used social accounting matrix framework to explain the role of agricultural development on the development of rest of the economy during the 1970s and early 1980s by classifying the countries into six groups on the basis of levels of economic development. The study suggested ‘agricultural demand led industrialization’ as a significant strategy for the low- and middle-income developing countries. Koo and Lou (1997) used panel data of 30 provinces of China during 1988-1992 and noted that agricultural growth was not significant factor in determining industrial growth whereas industrial growth was a significant factor for agricultural growth. Francks (2002) emphasized on the roles of various kinds of linkages among the agricultural and other sectors in the villages of the nineteenth century Japan. Matahir (2012) noted significant impact of industrial value added on agricultural value added in Malaysia during 1970-2009.

It is believed that agriculture is more important in developing countries compared to that in developed countries. Using the data on two developing countries viz., China and Indonesia, and two developed countries viz., Netherlands and the US, Arendonk (2015) focused on the role of the determinants of the contribution of agriculture sector in GDP to analyse this issue for these countries. A panel data analysis, comprising 136 countries with sub-samples of high performing East Asian and Sub-Saharan African countries, conducted by Shifa (2015) indicated significant positive effect of agricultural growth on industrial growth. The econometric study based on a simultaneous equations model conducted by Biswas (2016), indicated a mutually interdependent significant relationship between agricultural and industrial output in Bhutan during 1981-2000.The econometric study conducted by Gani and Scrimgeour (2019) revealed statistically insignificant impact of agricultural output on industrial output in Fiji; however, the impact was found to be significant for food industry.

Some of the studies examined the same issue for the Indian economy. Rangarajan (1982) constructed a macroeconomic model incorporating the linkages between the agricultural sector and the rest of the economy. The empirical study noted significant influence of agricultural output on the rest of the economy of India during 1961-72. Bhardwaj and Chadha (1991) focused on the relationship among industries in India during 1973-74 – 1984-85 using input-output tables. Ghosh, Sinha, Chakraborty and Bhattacharyya (1991) studied the impact of agricultural income and its distribution on the demand for industrial products in India. Satyasai and Viswanathan (1999) emphasized on the contribution of various factors, viz., the share of commercial crops, the share of industrial items used as inputs in agriculture, the size of the urban market for agro-based consumer goods etc. on the agriculture-industry linkages. In a simultaneous equations framework Sastry, Singh, Bhattacharya and Unnikrishnan (2003) analysed interlinkages among the various sectors using input-output table and it was suggested that the growing contribution of the service sector should be accompanied by the growth of the agricultural and the industrial sectors, otherwise, the service sector would face a demand constraint. Jha (2010) theoretically and empirically explained the various links through which agriculture and industry in India were interlinked covering the period since 1950s. Tiwari and Kg (2010) found that during 1950-51-2008-09 in India, service sector growth Granger-caused industrial growth, and agricultural growth Granger-caused service sector growth. Saikia (2011b) used sectoral shares and growth rates, terms of trade and relative price between agriculture and industry for his study, and noted that the direction of causation was from industry to agriculture during the pre-reform period, which changed to the opposite direction in the post-reform period. Sahoo and Sethi (2012) noted a significant and positive impact of agricultural and industrial output on the economic growth rate in India during 1950-51 – 2009-10.

The state-level studies on Indian economy mainly focused on describing the growth patterns of the states over time and on assessing the roles of various determinants in explaining the economic disparities among the states. Some of the authors attempted to examine whether these disparities decreased over time supporting the convergence hypothesis of growth theory. An extensive review of the literature on growth patterns of Indian states during 1960-2000 is available in Krishna (2004). Chatterjee and Mani (2013), Ghosh (2006), Gopalakrishna and Rao (2012), Kalirajan, Bhide and Singh (2009), Kumar and Baliyan (2013), Lall (1999), Mathur (1987), Nayyar (2008), Panda and Sahay (2020), Purfield, (2006), Sanyal and Arora (2024) were the other papers to mention a few in this area. The papers varied in the periods of study and in methodologies. However, one common observation was the existence of economic disparity among the states and its continuous increase over time.

Sarkar and Das (2011), in a state-level analysis, found that during the period after liberalisation industrial growth performance was better for the richer states compared to that for the poorer ones. Kumar and Kumar (2013) conducted a state-level analysis to evaluate the effectiveness of various reforms in the Indian industrial sector. In their study Saksena and Deb (2016) noted strong interdependence between economic growth and human development during 1991-2011. There was evidence of decreasing disparity between the poorer and wealthier states as far as the indicators of human development were concerned, whereas disparity increased in terms of economic growth.

The issue of agriculture-industry nexus at the state level was analysed in a few papers. A cross-section study by Bhattacharya and Mitra (1989) showed evidence of significant positive impacts of difference between income and employment in the non-agricultural sectors on the disparity between industry and agriculture in income in Indian States. The study made by Kalirajan and Sankar (2001), based on fourteen Indian states during 1960-89, indicated presence of one-way causation, from agricultural to industrial growth rates in one of the states, and, from industry to agriculture in five states; for all other states bi-directional causation was revealed. Saikia (2011b), pointed out that the contribution of agriculture in the national product was found to decline drastically since the 1990s, and this structural change would have significant impact on the agriculture-industry interdependence. The present paper tries to explore this issue for the states of India during the post-liberalisation period.

3. Methodology of Research

To examine relationship between agriculture and industry we conduct time series regression between the following pairs of variables:

(a) Gross value added by agriculture (GVA_AGR) and gross value added by industry (GVA_IND) for the Indian economy during the periods (i) 1951-52 – 2022-23, (ii) 1951-52 – 1991-92 and (iii) 1992-93 – 2022-23

(b) State value added by agriculture (SVA_AGR) and state value added by industry (SVA_IND) for each of 33 states of India during the period 1993-94 to 2022-23.[3]

The data on gross value added by economic activities are collected from Economic Survey 2023-24, Statistical Appendix, the data on state value added by economic activities and net state domestic products are collected respectively from the Handbook of Statistics on Indian States and the Handbook of Statistics on the Indian Economy published by the Reserve Bank of India.

First, the data with various base years were converted into a common base at 2011-12 prices.

The model considered for the Indian economy in Sub-section 4.1 is as follows:

$$log\_GVA\_AGR_t = \alpha + \beta log\_GVA\_IND_t + error_t \quad (1)$$

We thus compute the logarithms of GVA_AGR and GVA_IND, which are denoted by gva_agr and gva_ind respectively. Then the Augmented Dickey Fuller (ADF), Phillips- Perron (PP)and Dickey-Fuller Generalised Least Squares (DF-GLS) tests are conducted for each variable to determine the order of integration where the Akaike Information Criterion (AIC) is used to determine the optimum lag. For each pair of variables, we then apply the following procedure.[4] When both variables are found to be non-stationary at level and stationary at first difference, Johansen methodology is used to examine whether the variables are co-integrated i.e., whether there exists a long run relationship between the variables.

An error correction model is estimated to analyse relationship in the short run, if the variables are found to be co-integrated. The error correction model can be expressed as

$$Dlog\_GVA\_AGR_t = a_0 + a_1 log\_GVA\_AGR_{t-1} + a_2 log\_GVA\_IND_{t-1} + a_3 ECT_{t-1} \quad (2)$$

$$Dlog\_GVA\_IND_t = b_0 + b_1 log\_GVA\_AGR_{t-1} + b_2 log\_GVA\_IND_{t-1} + b_3 ECT_{t-1} \quad (3)$$

where ECT_{t-1} is the lagged error correction term, and a_3 and b_3 are the adjustment parameters.

When the variables are not found to be co-integrated, a vector autoregressive model in first difference is used and Granger causality test is conducted.

In Sub-section 4.2 the analysis for the states is done applying same methodology where state value added (SVA) is used in place of gross value added (GVA).

In Section 4.3 in order to analyse the impact of relationship (if any) between the agricultural and industrial sva on the average growth rate (R) of net state domestic product in a period (0,T), we compute the annual average growth rate using the formula:

$$R = (logY_T - logY_0)/T$$

where Y_0 and Y_T are the net state domestic products of a state in the initial and ending periods respectively.

Depending upon the results of Sub-section 4.2 we divide the states into two groups – in one group, all the states, for which there exists a significant short and/or long run relationship, are included; in the other group, all the states with no relationship, are included. Now, for studying the impact of such relationship on the annual average growth rate of NSDP, growth rate is regressed on the dummy variable, created on the basis of the groups of States. For this cross-section study, the technique of ordinary least squares is used and Breusch-Pagan test is used for detection of heteroscedasticity.

4. Study of the Agriculture-Industry Relationship

4.1 Relationship in India

We first examine the relationship between agricultural and industrial output in India.

[3] The starting years are 1999-2000 and 2004-05 for Mizoram and Telangana respectively. The ending year is 2021-22 for some states. The period of study is determined by the availability of data.

[4] See Enders (2018).

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In Table 1 we find that the optimum lags according to AIC criterion are 3 and 2 respectively for levels and first differences of the variables.

Table 1: Optimum lag using AIC

Lag	Variables	
	gva_agr & gva_ind	Dgva_agr & Dgva_ind
0	.305	-7.17
1	-7.31	17.35
2	-7.39	-7.38*
3	-7.41*	-7.30
4	-7.35	-7.29

Source: The Author

Table 2 shows that gva_agr and gva_ind are non-stationary at level and stationary at first difference, where gva_agr and gva_ind denote the logarithms of the variables.

Table 2: Results of Unit Root Test for gva_agr and gva_ind

	Test statistic (5% critical value)		
Variable	ADF	PP	DFGLS
gva_agr	1.376 (-2.915)	0.889 (-2.912)	-1.600 (-3.034)
gva_ind	0.185 (-2.915)	0.562 (-2.912)	- 1.357 (-3.034)
Dgva_agr	-6.400 (-2.915)	-14.706 (-2.913)	- 6.735 (-3.062)
Dgva_ind	-4.751 (-2.915)	-6.680 (-2.913)	- 4.679 (-3.062)

Source: The Author

For lag length 3 the results of co-integration test are presented in Table 3. The results show that the null hypothesis of no co-integration (r=0) between the variables is not rejected at 5 per cent level for trend (constant) specification; for trend (restricted constant) specification, however, the null hypothesis of no co-integration (r=0) between the variables is rejected and we fail to reject the null hypothesis of r=1. Thus, the two variables are co-integrated, i.e., there may be a long run relationship between the two variables for restricted constant specification.

Table 3: Results of Johansen tests for co-integration between gva_agr and gva_ind

	Specification: Trend (constant)		Specification: Trend (restricted constant)	
Maximum rank	Trace statistic	5% critical value	Trace statistic	5% critical value
0	7.54*	15.41	41.99	19.96
1	1.25	3.76	5.68*	9.42

Source: The Author

Estimating the ECM, we analyze the long run and short run relationship between the variables where the figures within parentheses are p-values.

Long run relationship:

$ECT_{t-1} = gva\_agr_{t-1} – .487gva\_ind_{t-1} – 6.48$
(0.000) (0.000)

Short run relationships:

$Dgva\_agr_t = 0.085ECT_{t-1} – 0.665gva\_agr_{t-1} – 0.283gva\_agr_{t-2} + 0.144gva\_ind_{t-1} – 0.259gva\_ind_{t-2}$
(0.000) (0.000) (0.023) (0.384) (0.117)

$Dgva\_ind_t = 0.077ECT_{t-1} – 0.101gva\_agr_{t-1} – 0.025gva\_agr_{t-2} + 0.233gva\_ind_{t-1} – 0.163gva\_ind_{t-2}$
(0.000) (0.316) (0.796) (0.069) (0.203)

The estimated coefficient of gva_ind_{t-1} (–0.487) is statistically significant at 5% level of significance which indicates that in the long run GVA by industry andGVA by agriculture are positively related. The estimated adjustment parameters are significant but for the agricultural sector it does not have correct sign. This indicates that previous year's error or any deviation from long run equilibrium is not corrected for within the current year. In the short run, past values of gva by agriculture have impact on gva of this sector. Other estimated coefficients are statistically insignificant. Thus, there is no evidence of any short run impact of gva of one sector on the gva of the other sector, whereas, in the long run, the relationship is significant.

Further, the results of diagnostic tests detect no autocorrelation in residuals.

Saikia (2011b) pointed out that the declining trend in the contribution of agriculture in the national output of India led to a fall in the strength of agriculture-industry relationship. In order to study this opinion, we divide our period of study into two parts, viz., (i) before liberalization: 1950-51 – 1991-92 and (ii) after liberalization: 1992-93 – 2022-23, and examined the relationship separately for the two periods.

The results of the Johansen tests show that for all specifications except trend (constant) gva_agr and gva_ind are cointegrated before liberalization whereas for all specifications except trend (none) they are not cointegrated after liberalization. This shows evidence of long run relationship between gva by agriculture and gva by industry before liberalization; however, such existence of long run relationship is not found after liberalization. Further, the results of relevant ECM and VAR models show that before liberalization gva by agriculture and gva by industry have significant positive relationship in the long run only, whereas after liberalization, gva by industry Granger-causes gva by agriculture in the short run only. Our results are different from the findings of Saikia, (2011b), who observed a direction of causation from agriculture to industry after liberalization. However, that study was based on sectoral shares, terms of trade, relative prices etc. whereas in the present one GVA by the sectors have been used.

4.2 Relationships in the States

The interdependence between agriculture and industry in each State is examined in this sub-section. It is observed that except for Nagaland, logarithms of SVA by agriculture (sva_agr) and SVA by industry (svs_ind) are integrated of order one according to the results of Phillips-Perron test. The results of the Johansen's cointegration test are presented in Table 4.

Table 4: Results of Johansen's Cointegration Tests for the States

State/UT	Model	Rank	Trace Statistic	Critical Value	Result
Andaman & Nicobar Islands	Trend (constant)	0 1	9.7844* 0.8295	15.41 3.76	Not cointegrated
Andhra Pradesh	Trend (None)	0 1	15.7422 2.3902*	12.53 3.84	Cointegrated
Arunachal Pradesh	Trend (constant)	0 1	9.4588* 1.3502	15.41 3.76	Not cointegrated
Assam	Trend (constant)	0 1	8.0543* 2.9808	15.41 3.76	Not cointegrated
Bihar	Trend (rconstant)	0 1	22.0602 7.2869*	19.96 9.42	Cointegrated
Chandigarh	Trend (None)	0 1	15.7928 0.4284*	12.53 3.84	Cointegrated
Chhattisgarh	Trend (constant)	0 1	10.9487* .3421	15.41 3.76	Not cointegrated
Delhi	Trend (constant)	0 1	6.6365* .5864	15.41 3.76	Not cointegrated
Goa	Trend (constant)	0 1	16.8620* 4.0420	15.41 3.76	Not cointegrated
Gujarat	Trend (rconstant)	0 1	22.8122 6.2989*	19.96 9.42	Cointegrated
Haryana	Trend (None)	0 1	48.2306 0.2122*	12.53 3.84	Cointegrated
Himachal Pradesh	Trend (rconstant)	0 1	29.6655 6.9132*	19.96 9.42	Cointegrated
Jammu & Kashmir	Trend (constant)	0 1	18.2260 0.0726*	15.41 3.76	Cointegrated
Jharkhand	Trend (constant)	0 1	11.5222* 0.3439	15.41 3.76	Not cointegrated
Karnataka	Trend (rconstant)	0 1	37.4159 5.5731*	19.96 9.42	Cointegrated
Kerala	Trend (rconstant)	0 1	40.9561 8.1911*	19.96 9.42	Cointegrated
Madhya Pradesh	Trend (rconstant)	0 1	23.5781 6.0159*	19.96 9.42	Cointegrated
Maharashtra	Trend (constant)	0 1	13.0192* 1.0119	15.41 3.76	Not cointegrated
Manipur	Trend (rconstant)	0 1	21.8728 6.1816*	19.96 9.42	Cointegrated
Meghalaya	Trend (constant)	0 1	19.6527 2.4253*	15.41 3.76	Cointegrated
Mizoram	Trend (rconstant)	0 1	26.4232 3.5252*	19.96 9.42	Cointegrated
Nagaland	Variables are not integrated in the same order				Not cointegrated
Odisha	Trend (constant)	0 1	16.1071 0.0174*	15.41 3.76	Cointegrated
Puducherry	Trend (constant)	0 1	12.3089* 4.1321	15.41 3.76	Not cointegrated
Punjab	Trend (constant)	0 1	9.0658* 1.67	15.41 3.76	Not cointegrated
Rajasthan	Trend (rconstant)	0 1	23.5650 7.1504*	19.96 9.42	Cointegrated
Sikkim	Trend (rconstant)	0 1	21.4942 4.7717*	19.96 9.42	Cointegrated
Tamil Nadu	Trend (constant)	0 1	12.5050* 0.0055	15.41 3.76	Not cointegrated
Telangana	Trend (constant)	0 1	8.6235* 2.4842	15.41 3.76	Not cointegrated
Tripura	Trend (rconstant)	0 1	31.7206 5.6366*	19.96 9.42	Cointegrated
Uttar Pradesh	Trend (rconstant)	0 1	26.6591 4.4926*	19.96 9.42	Cointegrated
Uttarakhand	Trend (constant)	0 1	19.5086 1.5372*	15.41 3.76	Cointegrated
West Bengal	Trend (constant)	0 1	18.6824 1.0909*	15.41 3.76	Cointegrated

Source: The Author

It is observed that out of 33 States/UTs, in 20 states SVA_agr and SVA_ind are cointegrated. The results of the error correction models for the cointegrated variables and VAR model for the others are shown in Table 5.

Table 5: Results of Error Correction Model / VAR Model

State	Long Run (if exists) and Short Run Relationships	Remark
Andaman & Nicobar Islands	$D\_sva\_agr_t = -.082D\_sva\_agr_{t-1} - .148D\_sva\_ind_{t-1} + .016$ (.66) (.193) (.462) $D\_sva\_ind_t = -.318D\_sva\_agr_{t-1} - .158D\_sva\_ind_{t-1} + .067$ (.285) (.382) (.051)	No significant long run or short run relationship
Andhra Pradesh	$ECT_{t-1} = sva\_agr_{t-1} - .62sva\_ind_{t-1}$ (0.000) $D\_sva\_agr_t = .009ECT_{t-1} - .529sva\_agr_{t-1} + .062sva\_ind_{t-1}$ (.046) (.002) (.825) $D\_sva\_ind_t = .0104ECT_{t-1} - .044sva\_agr_{t-1} + .057sva\_ind_{t-1}$ (.001) (.707) (.768)	Significant positive relationship in long run only
Arunachal Pradesh	$D\_sva\_agr_t = -.193D\_sva\_agr_{t-1} - .149D\_sva\_ind_{t-1} + .033$ (.286) (.167) (.144) $D\_sva\_ind_t = -.295D\_sva\_agr_{t-1} - .343D\_sva\_ind_{t-1} + .10008$ (.322) (.054) (.007)	No significant long run or short run relationship
Assam	$D\_sva\_agr_t = -.093D\_sva\_agr_{t-1} + .059D\_sva\_ind_{t-1} + .024$ (.659) (.640) (.058) $D\_sva\_ind_t = .342D\_sva\_agr_{t-1} + .268D\_sva\_ind_{t-1} + .032$ (.258) (.032) (.069)	No significant long run or short run relationship
Bihar	$ECT_{t-1} = sva\_agr_{t-1} - .268sva\_ind_{t-1} - 10.931$ (0.0) (0.000) $D\_sva\_agr_t = -.659ECT_{t-1} - .061sva\_agr_{t-1} + .441sva\_agr_{t-2}$ (.006) (.810) (.017) $+ .286sva\_ind_{t-1} + .295ind_{t-2}$ (.045) (.055) $D\_sva\_ind_t = .8634ECT_{t-1} - .591sva\_agr_{t-1} - .289sva\_agr_{t-2}$ (.004) (.063) (.211) $+ .023sva\_ind_{t-1} + .184sva\_ind_{t-2}$ (.896) (.337)	Significant positive relationship in long run; sva_ind has significant positive impact on sva_agr in short run
Chandigarh	$ECT_{t-1} = sva\_agr_{t-1} - .536sva\_ind_{t-1}$ (0.000) $D\_sva\_agr_t = -.034ECT_{t-1} + .1529sva\_agr_{t-1} + .252sva\_ind_{t-1}$ (.004) (.382) (.002) $D\_sva\_ind_t = .098ECT_{t-1} + .534sva\_agr_{t-1} - .186sva\_ind_{t-1}$ (.000) (.180) (.319)	Significant positive relationship in long run; sva_ind has significant positive impact on sva_agr in short run
Chhattisgarh	$D\_sva\_agr_t = -.639D\_sva\_agr_{t-1} + .186D\_sva\_ind_{t-1} + .025$ (.000) (.592) (.469) $D\_sva\_ind_t = .141D\_sva\_agr_{t-1} - .089D\_sva\_ind_{t-1} + .071$ (.056) (.611) (.000)	No significant long run or short run relationship
Delhi	$D\_sva\_agr_t = .428D\_sva\_agr_{t-1} - .147D\_sva\_agr_{t-2}$ (.026) (.354) $- .338D\_sva\_ind_{t-1} - .653D\_sva\_ind_{t-2} + .022$ (.400) (.080) (.583) $D\_sva\_ind_t = -.208D\_sva\_agr_{t-1} + .038D\_sva\_agr_{t-2}$ (.006) (.545) $- .108D\_sva\_ind_{t-1} - .085D\_sva\_ind_{t-2} + .054$ (.494) (.559) (.001)	No significant long-run relationship; sva_agr has significant negative impact on sva_ind in short run (which is unexpected)
Goa	$D\_sva\_agr_t = -.367D\_sva\_agr_{t-1} + .034D\_sva\_ind_{t-1} + .0009$ (.040) (.778) (.965) $D\_sva\_ind_t = .013D\_sva\_agr_{t-1} + .113\_sva\_ind_{t-1} + .053$ (.964) (.555) (.075)	No significant long run or short run relationship
Gujarat	$ECT_{t-1} = sva\_agr_{t-1} - .42003sva\_ind_{t-1} - 8.271$ (0.0) (0.000) $D\_sva\_agr_t = -.657ECT_{t-1} + .024sva\_agr_{t-1} + .228sva\_agr_{t-2}$ (.004) (.922) (.242) $+ .731sva\_ind_{t-1} + 1.51ind_{t-2}$ (.116) (.003) $D\_sva\_ind_t = .2684ECT_{t-1} + .030sva\_agr_{t-1} + .132sva\_agr_{t-2}$ (.004) (.761) (.092) $+ .002sva\_ind_{t-1} - .108sva\_ind_{t-2}$ (.992) (.594)	Significant positive relationship in long run; sva_ind has significant positive impact on sva_agr in short run
Haryana	$ECT_{t-1} = sva\_agr_{t-1} - .762sva\_ind_{t-1}$ (0.000) $D\_sva\_agr_t = .001ECT_{t-1} - .418sva\_agr_{t-1} + .356sva\_ind_{t-1}$ (.860) (.019) (.181)	Significant positive relationship in long run only

	$D\_sva\_ind_t = .025ECT_{t-1} - .057sva\_agr_{t-1} - .081sva\_ind_{t-1}$ (.000) (.664) (.679)	
Himachal Pradesh	$ECT_{t-1} = sva\_agr_{t-1} - .473sva\_ind_{t-1} – 6.034$ (0.0) (0.000) $D\_sva\_agr_t = .171ECT_{t-1} - .657sva\_agr_{t-1} - .263sva\_agr_{t-2}$ (.510) (.164) (.464) $- .102sva\_ind_{t-1} -.158ind_{t-2}$ (.928) (.759) $D\_sva\_ind_t = .2114ECT_{t-1} - .199sva\_agr_{t-1} -.063sva\_agr_{t-2}$ (.000) (.059) (.436) $-.683sva\_ind_{t-1} +.046sva\_ind_{t-2}$ (.787) (.691)	Significant positive relationship in long run only
ammu & Kashmir	$ECT_{t-1} = sva\_agr_{t-1} - .48862sva\_ind_{t-1} – 6.40$ (0.000) $D\_sva\_agr_t = - .518ECT_{t-1} -.428sva\_agr_{t-1} +.101sva\_ind_{t-1} + .001$ (.015) (.018) (.703) (.957) $D\_sva\_ind_t = .013ECT_{t-1} -.260sva\_agr_{t-1} - .076sva\_ind_{t-1} +.047$ (.940) (.077) (.724) (.007)	Significant positive relationship in long run only
Jharkhand	$D\_sva\_agr_t = -.470\_sva\_agr_{t-1} - .248D\_sva\_agr_{t-2}$ (.012) (.181) $- .081D\_sva\_ind_{t-1} +.093D\_sva\_ind_{t-2} +.081$ (.638) (.598) (.007) $D\_sva\_ind_t = - .035D\_sva\_agr_{t-1} -.076D\_sva\_agr_{t-2}$ (.861) (.704) $- .254D\_sva\_ind_{t-1} - .298D\_sva\_ind_{t-2} +.062$ (.172) (.117) (.052)	No significant long run or short run relationship
Karnataka	$ECT_{t-1} = sva\_agr_{t-1} +.011sva\_ind_{t-1} – 16.64$ (0.975) (.003) $D\_sva\_agr_t = - .004ECT_{t-1} -.034sva\_agr_{t-1} +.377sva\_ind_{t-1}$ (.896) (.864) (.368) $D\_sva\_ind_t = .060ECT_{t-1} -.034sva\_agr_{t-1} +.011sva\_ind_{t-1}$ (.000) (.734) (.957)	No significant long run or short run relationship
Kerala	$ECT_{t-1} = sva\_agr_{t-1} +.131sva\_ind_{t-1} – 16.69$ (0.054) (.000) $D\_sva\_agr_t = - .192ECT_{t-1} +.068sva\_agr_{t-1} +.516sva\_ind_{t-1}$ (.003) (.677) (.008) $D\_sva\_ind_t = .154ECT_{t-1} -.184sva\_agr_{t-1} +.373sva\_ind_{t-1}$ (.014) (.251) (.048)	No significant long-run relationship; sva_ind has significant positive impact on sva_agr in the short run
Madhya Pradesh	$ECT_{t-1} = sva\_agr_{t-1} – 1.106sva\_ind_{t-1} – 1.75$ (0.271) (.912) $D\_sva\_agr_t = - .027ECT_{t-1} -.538sva\_agr_{t-1} - .352sva\_ind_{t-1}$ (.003) (.001) (.270) $D\_sva\_ind_t = - .019ECT_{t-1} -.014sva\_agr_{t-1} - .027sva\_ind_{t-1}$ (.001) (.898) (.895)	No significant long run or short run relationship
Maharashtra	$D\_sva\_agr_t = -.437D\_sva\_agr_{t-1} - .589D\_sva\_agr_{t-2}$ (.007) (.001) $+.240D\_sva\_ind_{t-1} - .288D\_sva\_ind_{t-2} +.073$ (.409) (.351) (.006) $D\_sva\_ind_t = - .034D\_sva\_agr_{t-1} -.124D\_sva\_agr_{t-2}$ (.739) (.240) $+.232D\_sva\_ind_{t-1} +.252D\_sva\_ind_{t-2} +.026$ (.199) (.188) (.109)	No significant long run or short run relationship
Manipur	$ECT_{t-1} = sva\_agr_{t-1} - .877sva\_ind_{t-1} – 1.544$ (0.0) (0.484) $D\_sva\_agr_t = -.338ECT_{t-1} - .040sva\_agr_{t-1} - .518sva\_agr_{t-2}$ (.000) (.799) (.003) $- .761sva\_ind_{t-1} -.118ind_{t-2}$ (.002) (.611) $D\_sva\_ind_t = -.035ECT_{t-1} - .339sva\_agr_{t-1} +.212sva\_agr_{t-2}$ (.692) (.034) (.232) $+.237sva\_ind_{t-1} +.187sva\_ind_{t-2}$ (.333) (.426)	Significant positive relationship in long run; however, in the short run sva_agr has a significant negative impact on sva_ind (which is unexpected)
Meghalaya	$ECT_{t-1} = sva\_agr_{t-1} - .366sva\_ind_{t-1} – 7.492$ (0.000) $D\_sva\_agr_t = -.144ECT_{t-1} -.080sva\_agr_{t-1} +.019sva\_ind_{t-1} - .003$ (.001) (.635) (.820) (.816) $D\_sva\_ind_t = - .126ECT_{t-1} -.251sva\_agr_{t-1} +.241sva\_ind_{t-1} +.003$ (.290) (.582) (.296) (.921)	Significant positive relationship in long run only
Mizoram	$ECT_{t-1} = sva\_agr_{t-1} +.029sva\_ind_{t-1} – 22071.51$	No significant long-run relationship;

	(0.603) (0.031) $D\_sva\_agr_t = .036ECT_{t-1} + .088sva\_agr_{t-1} + .023sva\_agr_{t-2}$ (.451) (.770) (.942) $+.028sva\_ind_{t-1} - .013ind_{t-2}$ (.693) (.862) $D\_sva\_ind_t = .866ECT_{t-1} - .598sva\_agr_{t-1} - 3.34sva\_agr_{t-2}$ (.000) (.526) (.001) $-.124sva\_ind_{t-1} - .352sva\_ind_{t-2}$ (.575) (.126)	sva_agr has significant negative impact on sva_ind in the short run (which is unexpected)
Odisha	$ECT_{t-1} = sva\_agr_{t-1} - .371sva\_ind_{t-1} - 8.867$ (0.000) $D\_sva\_agr_t = -.635ECT_{t-1} - .278sva\_agr_{t-1} - .150sva\_ind_{t-1} + .002$ (.004) (.113) (.528) (.935) $D\_sva\_ind_t = -.021ECT_{t-1} + .062sva\_agr_{t-1} + .0003sva\_ind_{t-1} + .069$ (.915) (.688) (.999) (.005)	Significant positive relationship in long run only
Puducherry	$D\_sva\_agr_t = -.391D\_sva\_agr_{t-1} + .047D\_sva\_ind_{t-1} + .011$ (.027) (.722) (.676) $D\_sva\_ind_t = -.223D\_sva\_agr_{t-1} - .072\_sva\_ind_{t-1} + .102$ (.402) (.715) (.010)	No significant long run or short relationship
Punjab	$D\_sva\_agr_t = -.197D\_sva\_agr_{t-1} + .274D\_sva\_ind_{t-1} - .0001$ (.252) (.026) (.991) $D\_sva\_ind_t = .067D\_sva\_agr_{t-1} + .394\_sva\_ind_{t-1} + .037$ (.782) (.023) (.006)	No significant long-run relationship; sva_ind has a significant positive impact on sva_agr in the short run
Rajasthan	$ECT_{t-1} = sva\_agr_{t-1} - .810sva\_ind_{t-1} - 1.988$ (0.0) (.487) $D\_sva\_agr_t = .1004ECT_{t-1} - .644sva\_agr_{t-1} - .122sva\_ind_{t-1}$ (.157) (.000) (.764) $D\_sva\_ind_t = .133ECT_{t-1} - .012sva\_agr_{t-1} - .169sva\_ind_{t-1}$ (.000) (.878) (.343)	Significant positive relationship in long run only
Sikkim	$ECT_{t-1} = sva\_agr_{t-1} - .387sva\_ind_{t-1} - 6.333$ (0.0) (.000) $D\_sva\_agr_t = -.414ECT_{t-1} + .103sva\_agr_{t-1} - .165sva\_ind_{t-1}$ (.000) (.496) (.098) $D\_sva\_ind_t = -.311ECT_{t-1} - .014sva\_agr_{t-1} + .263sva\_ind_{t-1}$ (.215) (.972) (.306)	Significant positive relationship in long run only
Tamil Nadu	$D\_sva\_agr_t = -.207D\_sva\_agr_{t-1} - .222D\_sva\_agr_{t-2}$ (.246) (.204) $+.431D\_sva\_ind_{t-1} + .362D\_sva\_ind_{t-2} - .023$ (.249) (.325) (.568) $D\_sva\_ind_t = .033D\_sva\_agr_{t-1} + .018D\_sva\_agr_{t-2}$ (.701) (.830) $+.049D\_sva\_ind_{t-1} - .317D\_sva\_ind_{t-2} + .078$ (.788) (.077) (.000)	No significant relationship in the long run and short run
Telangana	$D\_sva\_agr_t = -.321D\_sva\_agr_{t-1} - .106D\_sva\_agr_{t-2}$ (.096) (.542) $+.562D\_sva\_ind_{t-1} + 1.21D\_sva\_ind_{t-2} - .053$ (.106) (.001) (.232) $D\_sva\_ind_t = -.109D\_sva\_agr_{t-1} + .013D\_sva\_agr_{t-2}$ (.418) (.912) $-.155D\_sva\_ind_{t-1} + .047D\_sva\_ind_{t-2} + .065$ (.520) (.849) (.035)	No significant long-run relationship; sva_ind has significant positive impact on sva_agr in the short run
Tripura	$ECT_{t-1} = sva\_agr_{t-1} - .145sva\_ind_{t-1} - 11.759$ (0.235) (.000) $D\_sva\_agr_t = -.509ECT_{t-1} - .285sva\_agr_{t-1} + .023sva\_ind_{t-1}$ (.003) (.098) (.811) $D\_sva\_ind_t = -.146ECT_{t-1} - .136sva\_agr_{t-1} - .136sva\_ind_{t-1}$ (.000) (.708) (.118)	No significant relationship in the long run and short run
Uttar Pradesh	$ECT_{t-1} = sva\_agr_{t-1} - .419sva\_ind_{t-1} - 9.420$ (0.235) (.000) $D\_sva\_agr_t = -.298ECT_{t-1} + .112sva\_agr_{t-1} - .207sva\_ind_{t-1}$ (.000) (.549) (.176) $D\_sva\_ind_t = -.256ECT_{t-1} + .303sva\_agr_{t-1} + .190sva\_ind_{t-1}$ (.057) (.304) (.429)	No significant relationship in the long run and short run
Uttarakhand	$ECT_{t-1} = sva\_agr_{t-1} - .128sva\_ind_{t-1} - 11.418$ (0.000) $D\_sva\_agr_t =$ $-.693ECT_{t-1} + .256sva\_agr_{t-1} + .322sva\_agr_{t-2} + .264sva\_agr_{t-3} -$ (.030) (.403) (.213) (.242) $.092sva\_ind_{t-1} + .145sva\_ind_{t-2} + .002sva\_ind_{t-3} + .031$	Significant positive relationship in long run only

	(.537) (.179) (.980) (.085) $D\_sva\_ind_t$ = $.784ECT_{t-1}$ -$.457sva\_agr_{t-1}$-$.338sva\_agr_{t-2}$ - $.471sva\_agr_{t-3}$ + (.094) (.308) (.371) (.154) $.430sva\_ind_{t-1}$+$.247sva\_ind_{t-2}$ - $.132sva\_ind_{t-3}$+ .027 (.048) (.118) (.424) (.298)	
West Bengal	ECT_{t-1}= sva_agr_{t-1} - $.294sva\_ind_{t-1}$– 11.0004 (0.000) $D\_sva\_agr_t$ = -$.493ECT_{t-1}$ -$.346sva\_agr_{t-1}$ - $.073sva\_ind_{t-1}$+.021 (.004) (.022) (.500) (.022) $D\_sva\_ind_t$ = $.166ECT_{t-1}$ +$.108sva\_agr_{t-1}$ -$.039sva\_ind_{t-1}$+.063 (.606) (.706) (.850) (.000)	Significant positive relationship in long run only

Source: The Author

On the basis of the results shown in Table 5, the states can be classified into four groups.

Group A consists of four states for which the relationship is found to be significant both in the short run and long run. This group includes Bihar, Chandigarh, Gujarat and Manipur.

Group B includes ten states, viz., Andhra Pradesh, Haryana, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Odisha, Rajasthan, Sikkim, Uttarakhand and West Bengal for which the long run relationship is significant only.

Group C comprises five states, viz., Delhi, Kerala, Mizoram, Punjab and Telangana, for which the relationship is significant in the short run only.

Group D consists of the remaining fourteen states for which the relationship is significant neither in the short run nor in the long run.

The results also indicate that in the long run SVA_IND and SVA_AGR are positively related for all states in Groups A and B. In the short run, except for Delhi, Manipur and Mizoram, SVA_IND is expected to affect SVA_AGR positively in six States; for Delhi, Manipur and Mizoram only, SVA_AGR is found to have significant impact on SVA_IND; but estimated coefficients have unanticipated negative sign. Further, the estimated adjustment parameters do not have correct signs and are not significant for all states.

We cannot compare the results of the present study with the findings of a similar study conducted by Kalirajan and Sankar (2001), because the study periods are different.

4.3 Impact of the Relationship on the Average Growth Rate of NSDP

To examine whether the relationship between sva_agr and sva_ind has any impact on the average growth rates of the net state domestic products of the states during the study period we run a cross-section regression of average growth rate on the relationship dummy.

Model: $av\_growth\_rate = \gamma + \delta\ relation + error$

$$\text{where relation} = \begin{cases} 0 \text{ if there is no relationship} \\ 1 \text{ if there is any relationship} \end{cases}$$

The regression output is presented below:

Estimated regression equation: $av\_growth\_rate = 2.49 + 0.16\ relation$

$R^2 = 0.0349$

(0.000) (0.306)

Adjusted $R^2 = 0.0028$

The null hypothesis H_0: $\delta = 0$ [i.e. relation does not affect average growth rate] cannot be rejected at any level of significance. Thus, the results indicate that average growth rate is not affected by presence/absence of relationship between the two sectors. The result of Breusch-Pagan test indicates absence of heteroscedasticity.

5. Concluding Remarks

In this paper we intended to study the interdependence between agriculture and industry in India and in the states of India. During the period 1950-51 – 2022-23 we found a significant positive long run relationship between the gross value added by the agricultural sector and the gross value added by the industrial sector for India. However, a change in the nature of interdependence was noted after liberalization. The positive relationship was noted before liberalization; but after liberalization, the relationship was significant in the short run only.

The state-level analysis indicated a significant positive relationship in the long run in 14 out of 33 states. Out of those, in four states the relationship was significant in short run also. In five states we observed only short run relationship. Out of the nine states where short run relationship was significant, in six of them SVA_ind was found to affect SVA_agr positively; in the remaining three states we observed negative impact of SVA_agr on SVA_ind, which is unexpected.

The country-level study revealed no evidence of a long-run relationship in the period after liberalization; the state-level study also showed that during the same period for majority of the states (19 out of 33) long run relationship was not significant.

We tried to examine whether existence of such relationship had any impact on the economic growth of the states during the study period. The regression analysis showed no evidence of such impact.

This paper focused on the interlinkages between agriculture and industry in the country and in the states, and, revealed some observations. While many such studies were made on India, the studies at the state-level could be explored more. We note down the limitations of our study and the scope of further studies in this area. First, the role of the service sector is not incorporated in our study. The service sector would have impacts on both agricultural and industrial sectors and the structural change in the economy leading to an increase in the share of service sector over time would have important implications on the agriculture-industry relationship. So, an extension of the study incorporating the role of service sector can be suggested. Second, regarding the study of impact on the economic growth of states we can note that average growth rate of NSDP depends not on this relationship only; the model we have considered for the regression analysis does not include the determinants of economic growth of the states. For a useful regression analysis, we need to control for those determinants and study the effect. Thus, extension of the model in this line may provide significant results. Third, we have examined the relationship between SVA by agriculture and SVA by industry for the analysis. A similar study can be conducted using the growth rates of the two sectors also.[5]Moreover, our study has classified the states on the basis of short and/or long run relationship between agriculture and industry. Further studies may try to analyse the characteristics of the states for identifying the factors behind existence or non-existence of such relationship between agriculture and industry.

References

[1] Alagh, M. (2011). Agricultural Economy of India and Macroeconomic Effects: Some Empirical Results and a Research Agenda based on the Literature, Indian Institute of Management Ahmedabad, India, WP No. 2011-09-01. Available at www.iimahd.ernet.in/.../workingpaper pdf/3517779602011-09-01.pdf accessed 3 September 2012.

[2] Arendonk, A. van (2015). The Development of Share of Agriculture in GDP and Employment: A Case Study of China, Indonesia, the Netherlands and the United States, M.Sc. Thesis, Wageningen University. Available at https://edepot.wur.nl/342795 accessed 9 October 2024.

[3] Bharadwaj, K. (1987). Analytics of Agriculture-Industry Relations, Economic and Political Weekly, Vol. 22, No. 19/21, pp. AN15-AN20.

[4] Bhardwaj, R.N. and Chadha, R. (1991). Sources of Growth and Inter-Industry Linkages in Indian Economy with Special Reference to the Manufacturing Sector, Indian Economic Review, Vol. 26, No.2, pp. 189-219.

[5] Bhattacharya, B.B. and Mitra, A. (1989). Industry-Agriculture Growth Rates: Widening Disparity – An explanation, Economic and Political Weekly, Vol. 24, No. 34, pp. 1963-1965+1968-1970.

[6] Biswas, A. K. (2016). Agriculture-Industry Inter-Dependence in Bhutan, International Journal of Science and Research, Vol. 5, No. 9, pp. 892-894.

[7] Chatterjee, A. and Mani, N. (2013). Economic Survey of India and its States: 2012-13, New Century Publications, New Delhi.

[8] Enders, W. (2018). Applied Econometric Time Series, Wiley India Pvt. Ltd., New Delhi.

[9] Francks, P. (2002). Rural Industry, Growth Linkages, and Economic Development in Nineteenth-Century Japan, The Journal of Asian Studies, Vol. 61, No. 1, pp. 33-55.

[10] Gani, A. and Scrimgeour, F. (2019). Trade, Industry and Inter-Industry Spillover Effects in Fiji, The Journal of Developing Areas, Vol. 53, No. 4, pp. 193-206.

[11] Ghosh, M. (2006). Economic Growth and Human Development in Indian States, Economic and Political Weekly, Vol. 41, No. 30, pp. 3321-3327+3329.

[12] Ghosh, A., Sinha, A., Chakraborty, D. and Bhattacharyya, S. (1991). Measurement of the impact of Agricultural Output on the Market for Manufacturers, Himalaya Publishing House, Delhi.

[13] Gopalakrishna, B. V. and Rao, J. (2012). Economic Growth and Human Development: The Experience of Indian States, Indian Journal of Industrial Relations, Vol. 47, No. 4, pp. 634-644.

[14] Jha, R. (2010). The Analytics of the Agriculture-Industry Relationship in a Closed Economy: A Case Study of India, Economic and Political Weekly, Vol. XLV, No. 17, pp. 94-98.

[15] Kalirajan, K. P. and Sankar, U. (2001). Agriculture in India's Economic Reform Program, Journal of Asian Economics, Vol. 12, No. 3, pp. 383-399.

[16] Kalirajan, K., Bhide, S. and Singh, K. (2009). Development Performance across Indian States and the Role of the Goverments, ASARC Working Paper.

[17] Koo, W.W. and Lou, J. (1997). The Relationship between the Agricultural and Industrial Sectors in Chinese Economic Development, Agricultural Economics Report No. 368. Department of Agricultural Economics, North Dakota State University. Available at https://www.semanticscholar.org accessed 16 July 2024.

[18] Krishna, K. L. (2004). Patterns and Determinants of Economic Growth in Indian States, Working Paper, No. 144, Indian Council for Research on International Economic Relations (ICRIER), New Delhi.

[19] Kumar, S. and Baliyan, S.K. (2013). An Inter-State Analysis of the Performance of Indian Manufacturing Sector, The Indian Economic Journal, Special Issue, pp. 161-169.

[20] Kumar, S. and S. Kumar (2013). An Inter-State Analysis of the Performance of Indian Manufacturing Sector, Indian Economic Journal, Special Issue, pp. 161-169.

[21] Lall, S. V. (1999). The Role of Public Infrastructure Investments in Regional Development: Experience of Indian States, Economic and Political weekly, Vol. 34, No. 12, pp. 717-725.

[22] Matahir, H. (2012). The Empirical Investigation of the Nexus between Agricultural and Industrial Sectors in Malaysia, International Journal of Business and Social Science, Vol. 3, No. 8, pp. 225-31.

[23] Mathur, A. (1987). Why Growth Rates Differ within India – An alternative approach, Journal of Development Studies , Vol. 23, No. 2, pp. 167-199.

[24] Mureithi, L. P. and Sharma, K. L. (1984). Growth Linkages between Agriculture and Industry in Kenya,

[5] Kalirajan and Sankar (2001) studied that for the pre-reform period.

Journal of Eastern African Research and Development, Vol. 14, pp. 147-161.
[25] Nag, R.N. and P.P. Ghosh (2003). Industry-Agriculture Interlinkage, Agricultural Trade Liberalization and Supply Constraints: A Post WTO Perspective, Indian Economic Review, vol. 38, issue 2, pp. 235-251.
[26] Nayyar, G. (2008). Economic Growth and Regional Inequality in India, Economic and Political weekly, Vol. 43, No. 6, pp. 58-67.
[27] Panda, M. and Sahay, S. (2020). Determinants of Economic Growth across States in India, IEG Working Paper No. 399.
[28] Purfield, C. (2006). Mind the gap – Is Economic Growth in India Leaving Some States Behind? IMF Working Paper WP/06/103.
[29] Rangarajan, C. (1982). Agricultural Growth and Industrial Performance in India, Research Report No. 33, International Food Policy Research Institute. Available at www.ifpri.org/sites/default/files/publications/rr33.pdf accessed 3 September 2012 2pm.
[30] Rattso, J. and Torvik, R. (2003). Interaction between Agriculture and Industry: Theoretical analysis of the Consequences of Discriminating Agriculture in Sub-Saharan Africa, Review of Development Economics, Vol. 7, No. 1, pp. 138-151.
[31] Sahoo, K. and Sethi, N. (2012). Investigating the Impact of Agriculture and Industrial Sector on Economic Growth of India. OIDA International Journal of Sustainable Development, Vol. 5, No. 5, pp. 11-22.
[32] Saikia, D. (2009). Agriculture-Industry Interlinkages: Some Theoretical and Methodological Issues in the Indian Context, Institute of Financial Management & Research, MPRA Paper No. 27820, Web site: http://mpra.ub.uni-muenchen.de/27820/ accessed 3 September 2012.
[33] Saikia, D. (2011a). Analyzing Inter-Sectoral Linkages in India, African Journal of Agricultural research, Vol. 6, No. 33, pp. 6766-6775. Available at http://www.academicjournals.org/AJAR accessed 3 September 2022.
[34] Saikia, D. (2011b). Trends in agriculture-industry interlinkages in India: Pre- and post-reform scenario. SSRN Electronic Journal. Available at https://mpra.ub.uni.muenchen.de/ accessed 21 October 2024. DOI 10.2139/ssrn.1858203
[35] Saksena, S. and Deb, M. (2016). Transition Pattern of Indian States across Different Categories of Growth and Development: Post Economic Liberalization Experience. BEH- Business and Economic Horizons, Vol. 12, No. 3, pp. 121-140.
[36] Sanyal, S. and Arora, A. (2024). Relative Economic Performance of Indian States: 1960-61 to 2023-24. EAC-PM Working Paper Series EAC-PM/WP/32/2024.
[37] Sarkar, D. and Das, D. (2011). Performance of Manufacturing Industry in Indian States: Who Loose and Why? MPRA Paper No. 33645. Available at https://mpra.ub.uni.muenchen.de/33645/ accessed 28 June 2024.
[38] Sastry, D.V.S., Singh, B., Bhattacharya, K. and Unnikrishnan, N. K. (2003). Sectoral Linkages and Growth Prospects: Reflections on the Indian economy, Economic and Political Economy, Vol. 38, No. 24, pp. 2390-2397.
[39] Satyasai, K.J.S. and Viswanathan, K.U. (1999). Dynamics of Agriculture-Industry Linkages. Indian Journal of Agricultural Economics, Vol. 54, No. 3, pp. 394-401.
[40] Shifa, A. B. (2015). Does Agricultural Growth Cause Manufacturing Growth? Econometrica, Vol. 82, Supplement 1, 1107-1125. DOI: 10.1111/ecca.12142
[41] Syed, A.A. (1986). Analysis of Inter-Industry Relations in Pakistan: Some Further Experiments with the 1975-76 data, The Pakistan Development Review, Vol. XXV, No. 4, pp. 649-670.
[42] Tiwari, A. and Kg, S. (2010). Relationship between Industry, Agriculture, and Service Sectors and GDP: The Indian Experience, The International Journal of Economics and Business, Vol. 1, No. 1, pp. 1-15.
[43] Vogel, S. J. (1994). Structural Changes in agriculture: Production linkages and Agricultural Demand-led Industrialization, Oxford Economic Papers, Vol. 46, No. 1, pp. 136-156.