Agriculture Is Still the Engine of Economic Growth: Empirical Evidence from Uttar Pradesh, India

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ABSTRACT

This paper assesses intersectoral linkages in Uttar Pradesh to identify the lead sector in its economy. It is based on time series data spanning 1980/81 to 2009/10 and used the vector autoregression framework to examine intersectoral linkages. The results suggest that agriculture is the main sector driving the other sectors (industry and services) in the state. Agriculture supports both the industry and service sectors through demand and production linkages. Despite being the leading sector in the economy, the performance of agriculture is far from satisfactory. The findings underscore the need to revive the agriculture sector to achieve high economic growth in the overall economy of the state. Further, the paper recommends developing the emerging food processing industry because of the state's strong potential for competitive advantage.

Keywords: lead sector, intersectoral linkages, Uttar Pradesh economy
JEL Classification: O11

INTRODUCTION

Economic performance has varied among Indian states and a number of studies (Nair 1971; Chaudhary 1974; Majumdar and Kapoor 1980; Rao, Shand, and Kalirajan 1999; Dasgupta et al. 2000; Ahluwalia 2000; Sachs, Bajpai, and Ramiah 2002; Kumar and Subramanian 2012) show rising inequality across Indian states. The divergence among Indian states has been observed in both pre-reform and post-reform periods, despite several positive changes in the country's macroeconomic policy.[1] This pattern of regional development has been maintained until the most recent decade (2001–2010) (Kumar and Subramanian 2012). Nevertheless, one positive pattern was recently seen within poor or lagging states (Bihar, Madhya Pradesh, Rajasthan, Orissa, and Uttar Pradesh).[2] Bihar, Madhya Pradesh, Rajasthan, and Orissa have begun to perform well. In fact, Bihar and Orissa have recorded some of the highest improvements in economic growth in 2001–2010. But the performance of Uttar Pradesh state did not improve significantly. In fact, its economic performance has fallen behind the rest of the country over the years. While there was not much difference in economic growth between Uttar Pradesh and the rest of the country in the 1980s, its output growth was much lower than India as a whole. In the 1990s and 2000s, India's gross domestic product (GDP) grew at the rate of 6 percent and 7.8 percent, respectively, but Uttar Pradesh GDP grew at only 4 percent and 5.77 percent, respectively (Tripathi 2012). Two questions come to mind: (1) Why has the economic performance of Uttar Pradesh not improved significantly? and (2) How can we strategize a high-growth path in the Uttar Pradesh economy?

Singh (2009) attempted to shed light on the issue of why the economic performance of Uttar Pradesh has not improved significantly, which was further supported by Shankar (2009). Singh (2009) found that low plan investments; poor investment climate; poor infrastructure; distortionary policy in the regulation of land, labor, and product markets; poor governance; and lack of development-oriented leadership are mainly responsible for slow and fluctuating economic growth in Uttar Pradesh. Shankar (2009) arrived at almost a similar conclusion. He pointed out that fiscal crisis, poor infrastructure, and red tape are the main constraints to the economic growth in the state. The state is not only struggling with poor economic performance,[3] its progress in terms of social development is also very bleak.[4] The state is well known for its high levels of mortality, fertility, morbidity, undernutrition, illiteracy, and social inequality (Dreze and Gazadar 1997; GoI 2007). Idle public policy is mainly responsible for inadequate social development in Uttar Pradesh (Dreze and Gazadar 1997). As Woolcock (1998) argued, social backwardness also hinders the growth of an economy.

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1 Macroeconomic policy has significantly changed in 1991/92 in India. Before 1991/92, India implemented state planning but the country started to implement market-oriented polices after 1991/92 (Sachs et al. 2002).

2 For details, please see Kochhar et al. (2006)

3 According to Nobel laureate Amartya Sen (1997), "Uttar Pradesh remains one of the most backward states in India, and had this state of 140 million people been an independent country, it would have been not only one of the largest, but also one of the most socially-deprived countries in this world, giving its citizens less than some of the worst-performing economies in sub-Saharan Africa."

4 Dreze and Gazadar (1997) considered Uttar Pradesh as a special case study of development in regions of India and they argue that the state lags behind much of the rest of the country in terms of well-being and social progress.

Following evidence cited above, one may consider investment promotion policy, better investment climate, infrastructural development, good governance and transparency, and social development as strategies for accelerating economic growth in Uttar Pradesh. Though the above options will facilitate economic growth, these will not be sufficient for the state to get out of its present low growth syndrome. Along with the above options, the state should also attempt to improve its own productive capacity. Then, the economy will not only be able to achieve high growth, the growth will be self-sustaining and long-lasting. Given the condition of scarcity of resources in the state, it cannot be possible to support all sectors at the same time.[5] Therefore, the main focus should be on the 'leading sector' of the economy.[6] This prescription is highly supported by lessons learned from developed economies which show that the growth process is highly unbalanced among sectors. The process of economic development can be accelerated by concentrating on the lead sector—the sector that stimulates greater economic activity in other sectors and thus have a larger multiplier effect on growth and development (Hirschman 1958).

Keeping the above views in mind, this paper primarily focuses on the leading sector in the Uttar Pradesh economy. This paper first attempts to identify the leading sector in the state economy and then assesses its performance in the last three decades. To identify the leading sector, intersectoral relations were examined using vector autoregression (VAR) model for the period from 1980/81 to 2009/10. The VAR model is used because its tools (such as impulse response function and variance decomposition) help in understanding causality between sectors. Moreover, in this study, intersectoral linkages are also studied at the disaggregate region level. Being a large state, Uttar Pradesh suffers from highly unbalanced economic and social development among its regions and districts (Tripathi 2012; Singh 2009; Diwakar 2009). Presently, the state is divided into four economic regions: western, central, eastern, and Bundelkhand. Economic prosperity, social cultures, and geography are distinctly different across these regions; the first three regions are well endowed with good soil and water resources while Bundelkhand forms part of the dry central plateau region. The western region is more developed than other regions and the eastern region is the most backward (Singh 2009). Hence, there might be a difference in intersectoral linkages among regions and the lead sector may also differ from region to region.

Many studies (Chakravarty and Mitra 2009; Joshi 2009; Goldar and Mitra 2008; Dasgupta and Singh 2005; Chowdhury and Chowdhury 1995; Dhawan and Saxena 1992; Hazari 1970) on economic growth in India attempted to discover the dominant sector in the economy, but these studies primarily focused on the country as a whole. Very few attempts have focused on a state, especially Uttar Pradesh. Only two studies (Srivastava 1985; Aggarwal 1996) are reported in the context of Uttar Pradesh so far. Srivastava (1985) studied intersectoral relationships using a semi-closed input-output model.[7] The study depicted that Uttar Pradesh has an agriculture-

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5 This refers to the balanced growth approach (Rosenstein-Rodan 1943) which is less feasible particularly in developing economies such as Uttar Pradesh because of shortage of resources of all kinds. However, it does not mean that the importance of a large-scale investment program and the expansion of complementary activities are denied. The argument is that in the absence of sufficient resources, striving for balanced growth may not provide a sufficient stimulus to the spontaneous mobilization of resources (Thirlwall 2003).

6 This basically follows the unbalanced growth approach (Hirschman 1958).

based economy in which the agricultural sector has less intersectoral dependency than the industrial sector. He argued that most of the industries in the state are agro-based industries drawing inputs from agriculture and allied activities. The study also found that the capital and intermediate goods industries are still in the developing phase in the state. Similarly, Aggarwal (1996) also assessed the magnitude of sectoral relations in Uttar Pradesh using an input-output table for years 1970/71 and 1977/78. The linkage analysis under this study revealed that though agriculture has low direct linkages, in terms of total backward linkages, this sector scores high. Both studies arrived at the same conclusion—that rapid agriculture growth had a favorable inducement effect on the other sectors of the economy. Though both studies are useful and theoretically rigorous, they are now outdated as information used in these studies are very old. Since then, several social and economic changes have taken place in the state.[8] This underlines the need for fresh knowledge on the state's sectoral linkages. This study tried to fill this gap and made an attempt to update existing knowledge on sectoral contributions in the Uttar Pradesh economy.

The rest of this paper is arranged as follows. Section 2 briefly presents temporal patterns of economic growth in Uttar Pradesh since pre-independence period. Section 3 discusses the methods and data used. Section 4 puts forward the findings of the empirical analysis. Prior to discussing the results, changes in sectoral compositions in the state are discussed. This section also discusses the past and present performance of the leading sector observed in the study. Section 4 concludes the study and suggests some policy implications for accelerating economic growth in Uttar Pradesh

OUTPUT GROWTH TREND IN THE UTTAR PRADESH ECONOMY

Uttar Pradesh, including Uttarakhand,[9] was known as United Province at the time of India's independence. The United Province was formed in 1902 when North-western and Oudh provinces were combined. The union of the two provinces was initially named United Provinces of Agra and Oudh, which was later renamed into United Province in 1935. At that time, this province was one of the richest parts of the country and there was no significant difference in per capita income between the province and India as a whole (Roy 2013). This status was maintained until the year 1950/51. During the initiation of the first five-year plan, there was only a 3 percent difference in per capita income between the United Province and India as a whole, but this gap has risen to around 51 percent.[10] The widening gap in per capita income is also indicative of the importance of the state economy in the country, which has been gradually shrinking in the last three decades. The share of Uttar Pradesh as a proportion of gross state domestic product has shrunk by one percentage point in the last two decades—from 9.22 percent in 1990/91 (GoI 2007) to 8.38 percent in 2010/11.[11] The widening gap is mainly caused by poor overall

7 The semi-closed input-output model is an improvement of the open model since it is capable of capturing overall effect.

8 For details, please see Uttar Pradesh Development Report (GoI 2007).

9 Uttarakhand used to be part of Uttar Pradesh. In 2000, Uttarakhand, which included 13 hilly districts, was separated from Uttar Pradesh.

10 Author's calculation based on Annual Plans 2012–2013 of the Government of Uttar Pradesh.

economic activity and high population growth. The total population growth[12] in Uttar Pradesh in 2001–2011 was 20.23 percent, which is almost 5 percentage points lower than the previous decade (1991–2001) at 25.80 percent. However, the population growth in the state is still higher compared to the country. For India as a whole, the population growth was observed at 17.64 percent in 2001–2011. In 2011, the population of Uttar Pradesh was 16.50 percent of India; it was lower in 2001 at 16.16 percent. On the other hand, the annual output growth in Uttar Pradesh is much lower than the country's annual output growth (Table 1).

Table 1 indicates that from 1980/81 to 2009/10, the state registered a 4.42 percent annual growth rate while the country as a whole grew at 6 percent. Breaking the whole sample period (1980/81 to 2009/10) into three subperiods (1980s, 1990s, and 2000s) presents a more dismal picture of the Uttar Pradesh economy—the difference in the output growth rate between Uttar Pradesh and India has broadened over the period. The table shows that it was only 0.44 percentage points during the 1980s and this has increased to 2.07 percentage points in the 2000s. The performance of the state economy was poorest in the 1990s when India's economic growth started accelerating faster than the previous decade. Barring the agriculture sector, all sectors in the state performed poorly during the 1990s. Political

Table 1. Growth pattern in Uttar Pradesh vs. India across decades

Period	Region	Agriculture		Industry		Services		Overall	
		GR	R^2	GR	R^2	GR	R^2	GR	R^2
1980s	Uttar Pradesh	2.43 [9.87]	0.92	7.66 [18.17]	0.97	6.04 [18.47]	0.98	4.81 [16.86]	0.97
	India	3.04 [6.67]	0.85	5.52 [23.42]	0.98	6.6 [61.61]	0.99	5.25 [28.33]	0.99
1990s	Uttar Pradesh	2.56 [8.18]	0.89	5.76 [11.14]	0.94	4.41 [17.24]	0.97	4.04 [14.95]	0.97
	India	3.31 [12.25]	0.95	6 [16.47]	0.97	7.41 [32.77]	0.99	6.05 [30.21]	0.99
2000s	Uttar Pradesh	2.41 [9.29]	0.92	8.78 [19]	0.98	6.32 [19.69]	0.98	5.77 [20.85]	0.98
	India	2.96 [7.55]	0.88	8.27 [26.85]	0.99	9.04 [47.52]	0.99	7.84 [34.71]	0.99
1980-81 to 2009-10	Uttar Pradesh	2.57 [48.98]	0.98	6.1 [42]	0.98	5.13 [62.18]	0.99	4.42 [60.53]	0.94
	India	2.95 [39.25]	0.98	6.13 [59.51]	0.99	7.29 [72]	0.99	5.99 [63.04]	0.99

Source: Author's calculation based on data from State Domestic Product, Central Statistical Organization, Ministry of Statistics and Programme Implementation, which is also available at http://mospi.nic.in

Note: Growth rate was calculated using log-linear model; GR = growth rate (in %), R^2= coefficient of determination; value in brackets are *t*-statistics.

11 Author's own calculation based on information collected from Central Statistical Organization, New Delhi. The comparison was not done for the period earlier than 1990/91 because information is only available for undivided Uttar Pradesh (Uttar Pradesh including Uttarakhand).

12 Both state and country level population growths were obtained from Census of India (2011) available at http://censusindia.gov.in.

instability, communal riots, poor infrastructure, and a financial crisis were the main reasons for the slow down of the state's economy in the 1990s (Pai et al. 2005; Singh 2009). The Uttar Pradesh Development Report (GoI 2007) also identified some factors undermining industrial growth in the state, which include inadequate infrastructure, decline in quality of governance, lack of quality human resources, low competitiveness, lack of proper incentives, and poor location of industries.

In the 2000s, a reviving trend was observed in Uttar Pradesh which was mainly led by the remarkable performance of the industry sector (Table 1), which recorded unprecedented growth of 8.78 percent per annum. Besides, the output growth in the service sector has also improved significantly. The state government has adapted many steps under the 2004 Industrial and Service Investment Policy to accelerate the pace of growth of industry, commerce, trade, and services. The state has also shown a high rate of infrastructure growth in the recent past particularly in transport and communication. There has been a considerable rise in the number of industrial clusters/hubs and public-private partnerships in the infrastructural domain. These improvements in investment climate and infrastructure along with political stability may be the main factors behind the reviving trend in the state's economy during the 2000s.

METHODS

The lead (key) sector is a sector which has potentially high linkages with other sectors (Hirschman 1958). Therefore, intersectoral linkages are analyzed to identify the lead sector in an economy. Three different approaches (input-output analysis, Kaldorian approach, and VAR approach) are often used to examine sectoral linkages. Input-output analysis has been widely used in India as well as abroad. This technique requires much mathematical knowledge and a large number of data. The Kaldorian approach is a comparatively simpler method and based on Kaldor's Growth Laws. Though this approach needs less information, it is not able to determine causality. The VAR approach addresses the shortcomings of the above methods. It is theoretically robust and able to explain the direction of causality between sectors. It also requires less data. In a less developed state like Uttar Pradesh, the availability of data is a common problem for researchers.

Keeping the above issues in mind, we used VAR framework to examine intersectoral linkages in this paper. The analysis was carried out for the period between 1980/81 and 2009/10. The analysis did not include information for the period before 1980/81 because there was no significant difference in economic growth between Uttar Pradesh and India as a whole. The coefficients obtained from the VAR approach cannot be interpreted directly (Litterman 1979). To overcome this shortcoming of the VAR approach, the innovation account technique, consisting of both impulse response function and variance decomposition, was used.

The VAR approach consists of a set of regression equations in which all the variables are considered endogenous. In this paper, it was presumed that the growth of a particular sector is determined by its past values and the past values of the growth rates in other sectors. Hence, VAR was here attempted by considering growth rates in all three sectors. Estimated VAR equations are represented as:

$$A_t = \alpha_{10} + \alpha_{11}A_{t-1} + \alpha_{12}I_{t-1} + \alpha_{12}S_{t-1} + e_{1t} \quad (1)$$

$$I_t = \alpha_{20} + \alpha_{21}A_{t-1} + \alpha_{22}I_{t-1} + \alpha_{23}S_{t-1} + e_{2t} \quad (2)$$

$$S_t = \alpha_{30} + \alpha_{31}A_{t-1} + \alpha_{32}I_{t-1} + \alpha_{33}S_{t-1} + e_{3t} \quad (3)$$

where, A_t, I_t, and S_t are growth rates in agriculture, industry and service sectors, respectively; α_{10}, α_{20}, and α_{30} are intercepts; e_{11}, e_{12}, e_{13}, e_{21}, e_{22}, e_{23}, e_{31}, e_{32}, and e_{33} are coefficients and e_{1t}, e_{2t}, and e_{1t} are white noise error terms. The noise error

terms have zero mean and constant variance and are individually serially uncorrelated.

In VAR estimation, we follow several steps: first, the selection of the variables to be included in the system; second, verification of stationarity property and order of integration of the selected variables; third, selection of the appropriate lag length; and finally, estimation of the equations. In this study, variables to be included in the systems have already been decided because it examined intersectoral linkages. The stationarity property and order of integration was examined using augmented Dickey-Fuller (ADF) test with and without trend. The ADF test was carried out for each variable in both levels and first lag difference form. The results presented in Appendix Table 1 indicate that all variables are stationary. The order of integration of these variables was also found to be the same. After deciding the order of integration, the lag length of each of the variable was determined following Akaike's information criterion and Schwarz-Bayes criterion; two lag lengths were decided for this analysis.

Lastly, each equation in the VAR model was estimated with dummy using EViews statistical software. A dummy was used to distinguish between pre-division period and post-division period. The cut-off line is the year 2000 when Uttar Pradesh was divided.

The above methods were used only for aggregate state-level analysis. For disaggregate region-level analysis, this study followed the Kaldorian approach because data was available for only a short span from 1997/98 to 2009/10.[13] One may argue how the findings obtained using different approaches will be comparable but we have few alternatives. Any econometric analysis with only ten observations is not justifiable because of low degrees of freedom. When we compare bivariate and multivariate regression[14] equations, one will prefer the former because the degrees of freedom will be higher in the bivariate case than in the multivariate case under the given conditions.

In the Kaldorian approach, Kaldor's third growth law is followed, which states that the growth of the rest of the economy depends on the growth of the lead sector (Kaldor 1967). In this case, the lead sector is the manufacturing sector. Following this principle, the growth of the rest of economy was separately regressed with the growth of each sector for each region of Uttar Pradesh.

Data used in this article were collected from State Account Statistics published by the Directorate of Economics and Statistics, Government of Uttar Pradesh.

RESULTS AND DISCUSSION

Results are presented and discussed in three subsections. The first discusses results of preliminary analysis. Prior to analyzing intersectoral linkages, the paper examined changes in sectoral composition over the years. The next subsection discusses results of intersectoral linkages. Results of VAR equations are discussed first, followed by results of variance decomposition and impulse response function. The last subsection studied the performance of the lead sector observed in this study to determine hindrances to its development.

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13 This was verified by the Deputy Director, Directorate of Economics and Statistics, Government of Uttar Pradesh, Lucknow through telephone conversation on 14 December 2012.

14 In this paper, bivariate regression equation refers to Kaldorian approach whereas multivariate equation refers to VAC model

Changing Sectoral Composition

Prior to analyzing sectoral linkages, changes in the sectoral composition of the gross state domestic product (GSDP) in terms of the share of agriculture, industry, and service sectors are studied because sectoral composition changes with growth in an economy. An economy is assumed to start as primary producers and later, as basic necessities of life are met, resources shift into manufacturing or secondary activities. Finally, with rising income, more leisure, and an increasingly saturated market for manufacturing goods, resources move into service or tertiary activities.

Temporal changes in the relative shares of different sectors in Uttar Pradesh are presented in Figure 1. The vertical line reflects the division of the state in 2000, when the state of Uttaranchal was created. Uttar Pradesh lost 16 percent of its land in the splitting of the state, whereas the economy was affected only marginally (Arora 2007).

Overall trends (Figure 1) suggest a decreasing share of agriculture and increasing shares of both industry and services. However, the year-on-year behavior of the above shares is different from the overall trend. There were many transition phases (i.e., years when long-term behavior was discontinued) observed in the temporal behavior of these shares. In agriculture, two phases were observed: one from 1989–1991 and the other from 1997–1999; the contribution of agriculture increased in these two sub-periods. The contribution of industry stagnated between 1988 and 1993 but decreased between 1997 and 2001. Industry registered an output growth rate of 2.55 percent and 2.18 percent in these two sub-periods, respectively, much lower than the 5.76 percent recorded in industry during the 1990s (Table 1). Political instability and communal violence were mainly responsible for these unusual trends (Pai et al. 2005).

Service sector contribution to Uttar Pradesh's domestic production rose gradually since 1980/81, the first year of the study period. This sector, however, does not absorb much of the labor force; it contributes around 50 percent to domestic production but absorbs only 30 percent of the labor force. This shows that labor productivity in the service sector is high. Around 60 percent of the labor force in the state still depends on the agriculture sector for their livelihood. Moreover, the structure of the labor force (Table 2) reflects another astonishing behavior—the manufacturing sector absorbs only about 10 percent of the total labor force. This further implicates the manufacturing sectors' poor employment generation. A poor manufacturing sector has several other implications, such as hindering economic growth, increasing inter-state migration, low level of total factor productivity in an economy, disguised unemployment, etc. Poor investment climate, lack of infrastructural facilities, policy constraints, and poor governance are mainly responsible for the poor performance of the manufacturing sector in the state (GoI 2007; Singh 2009; Shankar 2009).

Intersectoral Linkages in the State

Aggregate state-level analysis

Empirical estimates of each equation in the VAR model are summarized in Table 3. It shows that one-year and two-year lagged agriculture growth adversely affects current growth in the agriculture and industry sectors. Agriculture does not significantly affect service sector growth. As expected, industry has a significant positive impact on service sector growth. However, industry is not influenced by the service sector. These relationships are not very useful since the coefficients obtained from the estimation of the VAR model cannot be interpreted directly. To overcome this problem, we used the innovation accounting

Figure 1. Relative shares of different sectors in Uttar Pradesh's economy over the years

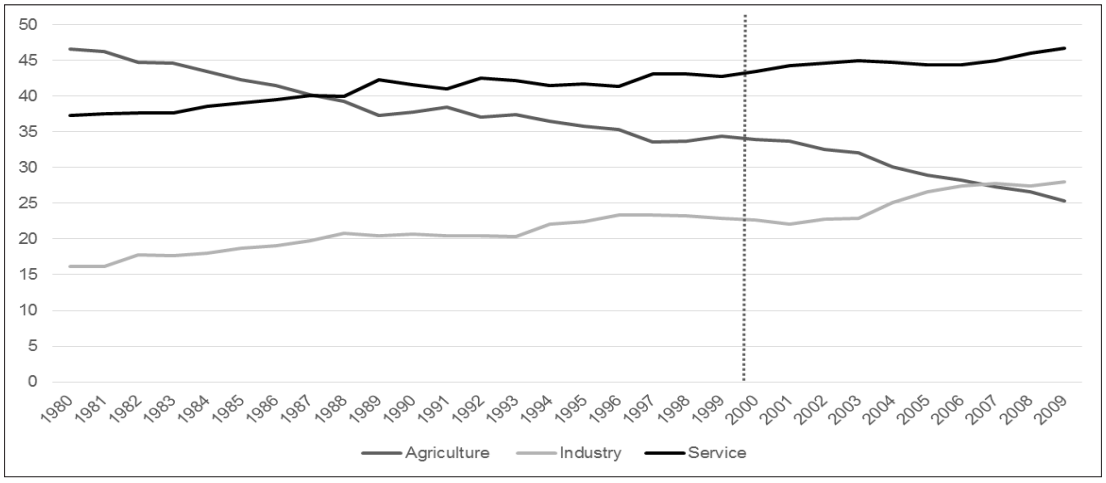


Table 2. Structure of employment (%) in Uttar Pradesh

Sector	1981	1991	2001
Agriculture	74.5	72.2	65.9
Manufacturing	9.0	7.6	5.9
Services	15.8	19.3	28.5

Source: Registrar General of India (2002)

Note: There are two sources of information on structure of employment: Census of India (CoI), which collects information from the whole population, and National Sample Survey Organization (NSSO), which collects from a sample. This paper used information from the CoI. In this table, information were provided up to year 2001 because information beyond 2001 is not yet available.

Table 3. Estimates of the VAR model

Equations	A(–1)	A (–2)	I (–1)	I (–2)	S (–1)	S (–2)	C	D	R^2
Agriculture	–0.62 (–2.62)	–0.47 (–2.07)	–0.04 (–0.28)	0.11 (0.71)	0.24 (0.72)	0.07 (0.22)	3.76 (1.97)	–0.99 (–0.72)	0.33
Industry	–0.57 (–1.64)	–0.79 (–2.28)	0.07 (0.31)	0.35 (1.54)	0.01 (0.03)	–0.18 (–0.36)	7.66 (2.70)	1.91 (0.94)	0.33
Service	0.05 (0.25)	–0.13 (–0.72)	0.02 (0.21)	0.25 (2.07)	0.24 (0.93)	–0.34 (–1.34)	4.04 (2.72)	1.22 (1.14)	0.34

Note: Value in parentheses are *t*-statistics.

technique (which consists of impulse response function and variance decomposition following Litterman [1979]).

The magnitude of variance explained at the 10th time horizon by different components is presented in Table 4. It is observed that 2.91 percent of the variance in agriculture at the 10th time horizon is explained by industry, whereas agriculture explains 25.10 percent of the variance in industry in the same time horizon. Hence, agriculture affects industry strongly in the long-run and, thus, causality seems to run from agriculture to industry. Consistent with the above finding, this study argues that agriculture still employs over 60 percent of the labor force. Hence, shocks originating from the agriculture sector spill over to industry. Besides demand-side justifications, there may also be supply-side justifications of the above finding because Uttar Pradesh's industries are predominantly agriculture-based (GoI 2007).

Similarly, it follows from Table 4 that causality runs from agriculture to the service sector because agriculture explains 26.56 percent of the variance in the service sector while the latter explains only 1.90 percent of the 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 the service sector's output. In the state, traditional services such as transport, storage, trade, etc. contribute around 60 percent of the gross value of the service sector's output whereas modern services account for only 40 percent (GoUP 2011). Furthermore, production linkage also works between the agriculture and the service sectors. Agriculture provides labor to the service sector, particularly in traditional services like transport, storage, etc. Many traditional services (such as transport, storage, trade, etc.) provide employment to unskilled and low-skilled labor.

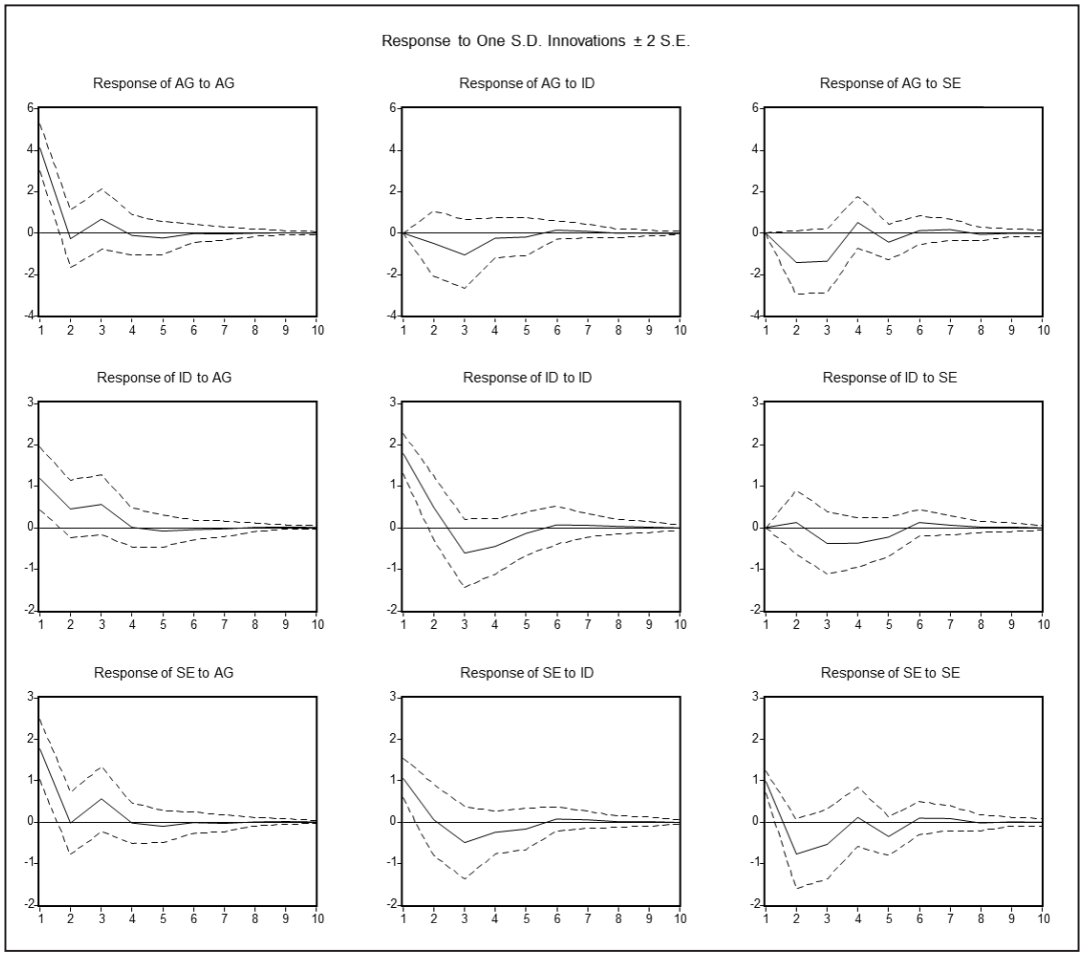
Between the service and industry sectors, only 1.86 percent of the variance in industry is explained by the service sector while industry explains 24.09 percent of the variance in the service sector. Thus, causality runs from industry to the service sector. All this suggests that agriculture is the main economic activity that controls most economic activities. This is a surprising finding, because both the industry and the service sector's share in GSDP have increasing tendency, and their output growth rates are also higher than agriculture (Table 1). However, the above finding is similar to the observation made by Srivastava (1985) using input-output approach. Srivastava (1985) observed that Uttar Pradesh has an agriculture-based economy in which the agricultural sector has less intersectoral dependency than the industrial sector. Intersectoral linkage between agriculture and industry has increased in the Uttar Pradesh economy over time (Aggarwal 1996).

The findings presented in Table 4 are compatible with the findings of the impulse response function. Figure 2 graphically presents the result of impulse response functions, which measures the effect of unit change in error at time t on a variable (say, y) at different points of time, holding all other variables constant. From Figure 2, it is evident that a one standard deviation shock in the growth

Table 4. Magnitude of variance explained at 10th time horizon by different components

Variance in agriculture explained by industry	2.91	Variance in industry explained by agriculture	25.10
Variance in agriculture explained by service	1.90	Variance in service explained by agriculture	26.56
Variance in industry explained by service	1.86	Variance in service explained by industry	24.09

Figure 2. Graphical representation of impulse response function



rate in the agriculture sector initially reduces its own growth rate as well as the growth rate of both industry and the service sector. On the other hand, it increases the growth rate of the industry and the service sectors, including its own growth rate, in the medium- and long-run. In the same period, a one standard deviation shock in the growth rates of the industry and the service sectors reduces their own growth rates as well as the growth rate of other sectors (except in a few cases). All this tends to suggest that though agriculture growth initially breaks the growth rate of other sectors, it boosts other sectors in the medium- and long-run.

Disaggregate region-level analysis

This subsection presents and discusses rsults obtained at the disaggregate region level. Uttar Pradesh is vast in both size and population. It is also diverse geographically. These conditions lead to heterogeneity in the state. Regional inequality can also be seen in the economic prosperity of the regions; the Western region is more developed than other regions. The per capita income is significantly higher in the western region (INR 17,273) compared to central (INR 13,940), Bundelkhand (INR 12,737), and eastern (INR 9,859) regions. Income dispersion across regions has widened

in the last 10 years. Figure 3 shows that the dispersion of per capita income has not behaved sytematically in 1999–2008. But, its overall trend suggests an increasing tendency in dispersion of per capita income across regions (Figure 4). It increased to 0.232 in 2007/08 from 0.226 in 1999/2000.

The above differences observed across regions inspire us to see whether or not there is a difference in the leading sector across regions. To do so, we regress the growth of the rest of the economy separately with each sector. The sector-wise estimated coefficients with *t*-statistics and coefficients of determination (R^2) are presented for each region in Table 5. The estimated coefficient indicates response of the growth of the rest of economy with respect to change in the growth of a sector. Among regions, the estimated coefficient was observed positive and statistically significant in each case. This shows the positive impact of each sector on the rest of economy in each region. The only difference is that the size of the coefficient varies from region to region. The estimated coefficient of the agriculture sector was observed to be highest within each region, which indicates that the agriculture sector plays the lead role in each region of the state. This confirms that there is no difference in the lead sector among regions in Uttar Pradesh. Since agriculture is predominant in all the above regions, one may claim that economic disparities across the regions are led by the disparate levels of agriculture development in the state.

Nevertheless, as Table 5 shows, we observed one difference among the regions in Uttar Pradesh. The industry sector was observed as the second-leading sector in three regions (central, Bundelkhand, and eastern), while service was the second-leading sector in the western region. Next to the agriculture sector, the service sector plays a predominant role in overall economic growth in western region. It is obvious because of high demand for services due to high per capita income in the region.

Figure 3. Regional dispersion of income across years

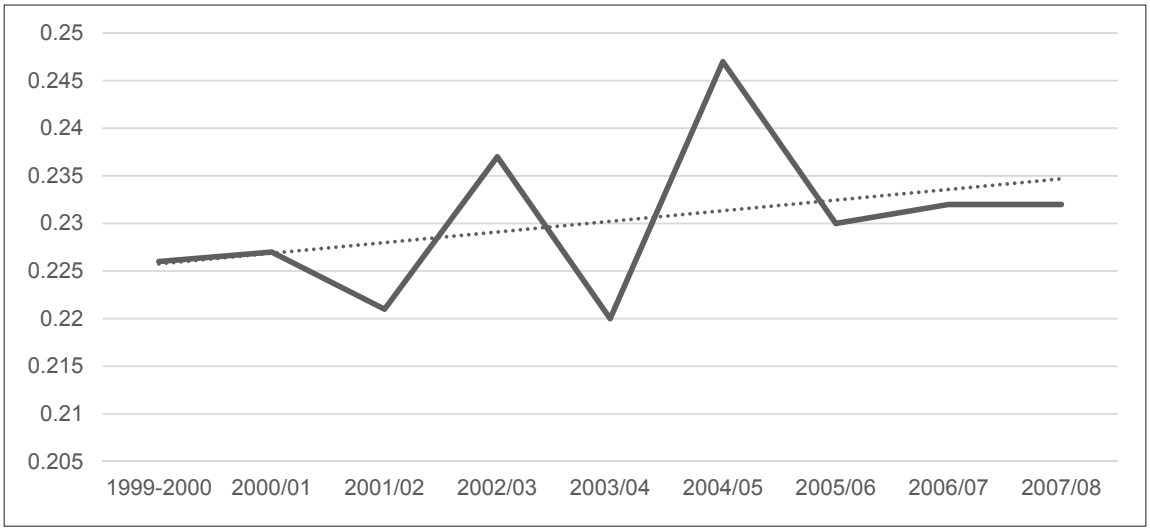


Table 5. Identifying lead sector at disaggregate regional level

Sector/ Region	Western	Central	Bundelkhand	Eastern
Agriculture	2.62 (17.07) [R^2 = 0.97]	2.74 (4.08) [R^2 = 0.96]	1.10 (2.87) [R^2 = 0.48]	2.97 (2.70) [R^2 = 0.45]
Industry	0.61 (17.64) [R^2 = 0.97]	0.83 (14.34) [R^2 = 0.96]	0.76 (8.36) [R^2 = 0.88]	0.69 (16.28) [R^2 = 0.96]
Service	0.78 (17.96) [R^2 = 0.97]	0.52 (25.18) [R^2 = 0.99]	0.66 (8.85) [R^2 = 0.89]	0.53 (15.12) [R^2 = 0.96]

Note: Values in parentheses are *t*-statistics.

PERFORMANCE OF THE LEAD SECTOR

In sectoral linkages, agriculture is identified as the main sector that controls most economic activities in the state where most of the population still depend on agriculture for their livelihood. Thus, stepping up agriculture output growth is an option to accelerate economic growth in the state because agriculture output growth has been stagnant for the past three decades in Uttar Pradesh. During the 1980s, agriculture recorded a 2.43 percent growth rate, which reduced to 2.40 percent in the first decade of the 21st century (Table 1). Agriculture output growth has been always lower in the state compared to the all-India scenario since the 1980s. The state has a strong agriculture base: it is the largest producer of foodgrains, pulses, sugarcane, and potato (Table 6). The state ranks first in wheat and sugarcane production and third in rice and pulse production. It also ranks first in potato production. Despite being the leading producer in the country, the output per hectare of almost all crops in the state is average (GoI 2011). The productivity of any crop depends on the size of land holdings, farm mechanization, irrigation, consumption of fertilizer, and the use of high-yielding variety seeds. Barring its western region, most of the above-mentioned factors are very weak Uttar Pradesh, which may be the main reason for the low average yield per hectare of almost all crops in the state. Moreover, total factor productivity of agriculture as a whole is very low in Uttar Pradesh compared to Haryana and Punjab. A recent study (Chaudhary 2012) estimated the total factor productivity performance in agriculture of 15 major states and found only a 1.14 percent productivity growth rate of Uttar Pradesh for the period 1983–1988 to 2005–2006, which is far below the country average (3.43%) and those of many states such as Haryana (8.35%), Punjab (10.67%), and Tamil Nadu (5.52 percent). Chaudhary (2012) further decomposed productivity growth into technical change and technical efficiency change. The results showed that both are responsible for poor total factor productivity growth in Uttar Pradesh as declining efficiency and low level of technological progress were observed in the state.

The level of crop productivity is clearly translated into crop profitability and rural poverty as shown in Table 7 and Table 8, respectively. Both profitability and poverty are closely linked with agriculture productivity (Datt and Ravallion 1998; Tripathi 2013) In Table 7, the profitability of three major crops (rice, wheat, and sugarcane) in Uttar Pradesh was compared with the profitability of these crops from two other largest producing states. Crop profitability was measured by subtracting the total cost from the gross value of output including the main product and its by-products. Crop profitability was presented in the form of two-years averages for four periods (1996–

Table 6. Crop-wise largest producing states in India

Food Grains	Rice	Wheat	Coarse Cereals
Uttar Pradesh (19.80)	West Bengal (15.60)	Uttar Pradesh (34.72)	Maharashtra (16.67)
Punjab (12.36)	Andhra Pradesh (13.16)	Punjab (19.14)	Karnataka (16.51)
Madhya Pradesh (7.34)	Uttar Pradesh (12.70)	Haryana (13.20)	Rajasthan (15.26)

Pulses	Oilseeds	Cotton	Jute & Mesta
Madhya Pradesh (27.33)	Madhya Pradesh (27.78)	Gujarat (32.40)	West Bengal (78.28)
Maharashtra (13.77)	Rajasthan (18.22)	Maharashtra (22.92)	Bihar (11.26)
Uttar Pradesh (13.34)	Gujarat (13.52)	Andhra Pradesh (14.68)	Assam (6.36)

Sugarcane	Potato	Onion
Uttar Pradesh (39.18)	Uttar Pradesh (35.99)	Maharashtra (29.84)
Maharashtra (21.62)	West Bengal (24.63)	Karnataka (17.22)
Tamil Nadu (10.83)	Bihar (14.65)	Gujarat (9.61)

Source: Author's calculation based on data from Agriculture Statistics at a Glance (GoI 2011).

Note: Values in parentheses are states's share (in %) to all-India production.

Table 7. Profitability (INR/ha) of select crops in Uttar Pradesh and two other largest producing states

Crops	Period	Uttar Pradesh	State A	State B
Rice	1996–1998	2525.81	16660.95	438.76
	2000–2002	76.21	–2927.19	380.45
	2004–2006	–428.80	–1838.25	3926.34
	2008–2010	7009.53	1303.56	10516.92
Wheat	1996–1998	5425.05	4895.19	6114.94
	2000–2002	3567.99	8751.40	6904.68
	2004–2006	1618.24	6870.61	5516.22
	2008–2010	8610.14	12978.30	16048.43
Sugarcane	1996–1998	13310.33	9071.51	NA
	2000–2002	12142.19	–53.955	25100.79
	2004–2006	24925.94	18231.03	22334.63
	2008–2010	47898.81	51922.43	51532.63

Source: Author's calculation based on annual reports of Commission of Agriculture Cost and Price, Ministry of Agriculture.

Notes: State A and B are West Bengal and Andhra Pradesh, respectively for rice; Punjab and Haryana for wheat; and Maharashtra and Tamil Nadu for sugarcane.

Table 8. Percentage of rural population below poverty line in select states

Year	Uttar Pradesh	Haryana	Punjab	All India
1993–1994	48.40	35.9	22.40	45.30
2004–2005	40.90	24.1	20.90	37.20
2011–2012	30.40	11.64	7.66	25.74

Source: Planning Commission, Government of India

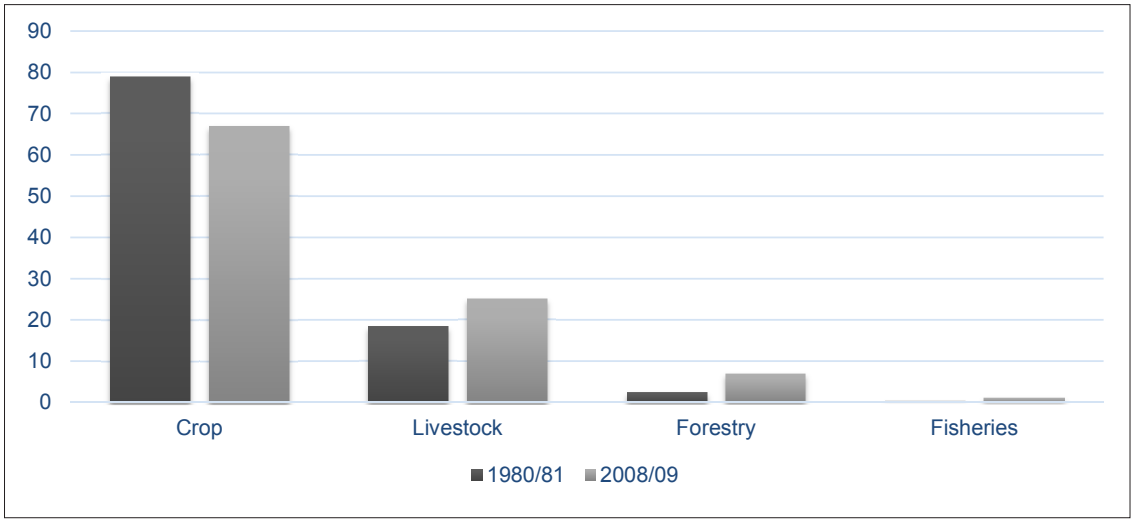
Notes: All poverty estimates were calculated by the Planning Commission using Tendulkar Methodology

1998, 2000–2002, 2004–2006, and 2008–2010) at intervals of two years. The three crops chosen are very important in Uttar Pradesh as together they account for around 70 percent of total cropped area in the state. In each case, except for rice in West Bengal, crop profitability was lowest in Uttar Pradesh. Similarly, the incidence of rural poverty was found significantly higher for Uttar Pradesh than Haryana, Punjab, and all India. Table 8 presents the percentage of rural population living below the poverty line in Uttar Pradesh and compares it with Haryana, Punjab, and the all India average. Both Haryana and Punjab were chosen for the comparison because these two states are also agriculture-predominant states and agriculture productivity is higher in these two states than Uttar Pradesh. The same phenomenon is observed within the state of Uttar Pradesh; rural poverty is very high in such districts where agriculture productivity is very low (Pandey and Reddy 2012).

The production portfolio shows that crops account for the largest portion of the value of agriculture output, but the contribution of other subsectors such as livestock, forestry, and fisheries also increased significantly between 1980/81 and 2008/09 (Figure 4). The above changes particularly in the livestock and fisheries subsectors are mainly attributed to the change in demand scenario. Demand for milk and milk products, and meat, egg, and fish in the state has increased significantly in the last two decades (GoI 2013). Among the reasons for the shift in demand are increase in income, changes in lifestyle, and urbanization.

These changes are not observed within the crop subsector of agriculture in the state. The share of cropped area under rice and wheat is still very high. Together, rice and wheat account for around 65 percent of total cropped area in Uttar Pradesh. Moreover, the temporal pattern (Table 9) suggests that the cropping pattern

Figure 4. Changing contribution of different sub-sectors in agriculture GDP



Source: Author's own calculation based on data collected from Central Statistical Organisation, New Delhi.

Note: All figures are in percent.

Table 9. Changing cropping pattern (%) in Uttar Pradesh across periods

Group	TE1982/83	TE1991/92	TE2001/02	TE2007/08
Paddy	36.02	23.14	25.40	24.72
Wheat	32.96	37.06	39.22	39.99
Coarse cereals	13.31	12.12	10.30	9.40
Cereals	82.29	72.32	74.92	74.11
Pulses	11.11	12.77	11.40	10.09
Oilseeds	1.58	5.16	3.59	4.23
Commercial crops	5.02	9.74	10.09	11.57

in Uttar Pradesh has shifted toward cereals, particularly wheat and paddy. This indicates the specialized nature of agriculture in the state, which has already been recognized by earlier studies (Fahimuddin 2010; Jha and Tripathi 2010). Fahimuddin (2010) evaluated the pattern of crop diversification achieved during the post-liberalization period (1990/91 to 2006/07) in Uttar Pradesh. He noted that the agriculture economy of Uttar Pradesh has been largely food crop-based during the post-liberalization period, indicating a slow pace of diversification in the state. Similarly, Jha and Tripathi (2010) calculated diversification indices for three different periods (1983/84, 1993/94, and 2003/04) and observed no significant changes in the indices across states and across periods. Irrigation development; availability and access of high-yielding and disease-resistant varieties; huge subsidies on water, power, and other inputs; and assured output prices and procurement by the government are the main reasons for the shift in cropping pattern in favor of fine cereals. The cropped area under commercial crops and oilseeds has increased slightly; this shows poor commercialization of agriculture in the state—this is because agriculture is less market-oriented in Uttar Pradesh than in Haryana and Punjab.

The performance of agriculture in Uttar Pradesh varies from region to region. The western region is agriculturally the most progressive region; the largest chunk of the state's agriculture output comes from this region (around 50%). The eastern region contributes around 28 percent, next to the total value of the western region. Bundelkhand accounts for only 4 percent of the state's gross value of agriculture output. Agriculture in the Bundelkhand region is vastly rain-dependent, diverse, complex, under-invested, risky, and vulnerable mainly because of its geographical condition. The average food grain yield in western region is 2,577 kilograms per hectare (kg per ha), which is much higher than other regions, particularly the eastern (1,997 kg per ha) and Bundelkhand (1,067 kg per ha) regions. Irrigation and fertilizer use are the major determinants of the variation in agriculture productivity across regions (Narain et al. 2001; Pandey and Reddy 2012).

Summing up, despite the state's geographical advantage in terms of soil, water, and climate, its agricultural performance is far from satisfactory. Its deteriorating performance as engine of economic growth, in turn, will affect the overall economic performance of the state. Declining public investment, poor infrastructure, high population pressure on agriculture, and mismanagement of resources may be the main reasons for the poor performance of agriculture in Uttar Pradesh. Therefore, the state government should focus on these factors along with technological progress, improvement in technical efficiency, and

encouraging crop diversification to accelerate agricultural growth. Besides, the government of Uttar Pradesh should attempt to gradually move toward the industry sector because there is limited scope for sustaining economic growth that is based on agriculture because it is a diminishing return activity due to the limited availability of land and inelastic demand for agriculture commodities.

The experience of developed countries suggests that we should start with industries in which we have a comparative advantage. Uttar Pradesh has a lot of potential in the food processing industry. There is abundant availability of raw materials as agriculture is the leading sector in the state; availability of market as the state itself has a large population; availability of human resources; and low production cost. The food processing industry is an emerging sector because of the shift in food demand toward processed food items. This shift in demand is mainly attributed to changing lifestyles, urbanization, and income growth. Developing the food processing industry will provide an opportunity for farmers to get better prices for their products and also absorb surplus labor from the agriculture sector. The current state government has recognized the importance of the food processing industry and has encouraged this industry in the state by providing a variety of incentives and concessions for the establishment of new units (e.g., capital investment subsidy, interest subsidy, etc.) and also developing related infrastructure facilities such as markets, transportation, etc. (GoUP 2013).

CONCLUSION

To devise an appropriate strategy for accelerating growth rate, this paper examines intersectoral linkages to identify the lead sector in the Uttar Pradesh economy using the VAR framework. Despite the substantial increase in the share of both the industry and the service sectors in GSDP, the results suggest that the agriculture sector plays the main role in determining the overall growth rate of the economy through its linkages to the other sectors. The analysis of intersectoral linkages identifies agriculture as the main economic activity that controls other economic activities. This finding is also sustained at the disaggregate region level analysis. Thus, economic development can be accelerated by concentrating on the agriculture sector.

The state has a strong agriculture base with the most fertile land masses and a well-connected river network. The state, however, does not support its agriculture sector well. The lack of support is reflected in both deteriorating performance and declining public investment. Therefore, if government supports agriculture, the state can play a significant role in the country's food and nutrition security program. This paper recommends that government should focus on rural infrastructure, technological progress and technical efficiency, and crop diversification because these are instrumental in accelerating the state's output growth. Further, the paper suggests promoting the food processing industry as it is an emerging industry and the state has strong potential in favor of this industry.

This study's findings are consistent with previous studies, which also found agriculture as the lead sector in the economy of the state. Despite this, minimal structural change has occurred in the state, which is reflected in the existing social rigidities (caste discrimination, gender discrimination, etc.); infrastructure facilities; political system; quality of governance; and law and order. There was no significant improvement observed in relation to the issues in the state (Sen 1997; Dreze and Gazadar 1997; GoI 2007; Shankar 2009; Singh 2009, among others). Unless these are addressed, Uttar Pradesh's ability to expand its

other sectors (industry and service sector) would be limited. Therefore, the state government must also improve infrastructure, quality of governance, social system, and law and order along with its focus on the agriculture sector.

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APPENDICES

Appendix Table 1. Results of ADF test for stationary

Variables	Level				First Difference		Growth Rate	
	Without Trend		With Trend		Without Trend		Without Trend	
	ADF-Stat	Critical Value	ADF-Stat	Critical Value	ADF-Stat	Critical Value	ADF-Stat	Critical Value
A	-0.229	-3	-2.11	-3.6	-2.968	-2.63	-3.06475	-2.975
I	-0.06	-3	-2.307	-3.6	-3.206	-2.63	-3.04907	-2.975
S	0.379	-3	-2.223	-3.6	-2.706	-2.63	-3.10637	-2.975
GSDP	0.577	-3	-1.79	-3.6	-2.759	-2.63	-3.106	-2.975

Note: A = Agriculture sector, I = Industry or secondary sector, S = service or tertiary sector, GSDP = gross state domestic product