

Understanding Agriculture-Industry Inter-Linkages for Agrarian Development: Empirical Evidence from India

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Introduction

The importance of the agrarian sector has long been debated in development theory. The sector not only serves as a pool of surplus labor, but also provides food security to the economy, employment while industry is at its nascent stage, raw-materials to fledgling industry and a source of demand for the industrial sector's products (Karunaratna, 2014). However, the Indian agricultural sector has been reeling under socio-economic distress over the past two decades. Agricultural output growth in the 1980s was 3.19% and it fell to 1.58% in the 1990s. Per capita availability of arable land has experienced a fast decline in the recent past, falling from more than .2 hectares per person in 1980s to less than .15 hectares per person. The productivity rates for all major crops; wheat, paddy, pulses etc., have been falling. The same period has also witnessed incidence of suicides among farmers. The toll has reached about three lakh farmers. With agriculture providing only 14% of the national GDP, roughly 50% of the population depends directly or indirectly on the sector.

Against this background, it becomes important to study the changing role of the agriculture sector when confronted with structural transformation. Structural transformation in its core also means changing inter-sectoral linkages over time. Empirically, in the context of India a number of studies have focused on explaining the trend of these linkages. Mathur (1990) concluded that agricultural growth is a necessary condition but not a sufficient condition for industrial growth. There are various non-agricultural

factors like power, transport infrastructure, institutional finance, etc. that are important for the growth of industry. Kanwar (2000) studied cointegration of different sectors in a multivariate autoregressive framework and found that growth in agriculture, infrastructure and services sector affect income generation in the manufacturing sector, while the reverse is not true. Sastry et al (2003) using the input-output tables found that agriculture still plays a significant role in determining the overall growth of the economy through its linkages with other sectors. Kaur et al (2009) used both input-output tables and co-integration analysis and found that agriculture exhibits strong demand linkages with the industry sector, while the industry sector's demand dependence on agriculture has weakened since the 1990s. Further, through cointegration analysis they find strong long-run equilibrium among primary, secondary and tertiary sectors.

Objective

The Agriculture Sector is thought to be the initial reservoir of resources until other sectors start producing a surplus of their own for re-investment. Transfer of surplus from one sector to another happens through exchange where the exchange can either happen in a free market or can be mediated by the government. However, it is argued that over time the industrial sector diversifies beyond agro-based industries. Further, with the opening up of the economy domestic sectors form important linkages with the foreign sector thereby affecting domestic sectoral inter-dependence (Thirlwall, 1986; Vogel, 1994). Our hypothesis is that over time, the agriculture sector's exchange either in quantity or in value with other sectors has become weak, which has exacerbated the distress. If the people in the agriculture sector are not able to generate enough value for their commodities so they can reap enough surplus for investing in the next cycle then surely they will be left to subsist with minimum means.

Methodology

Data is obtained from the Data Book for Planning Commission prepared by Central Statistical Organisation of India. This provides time series data from

1950 to 2014 on GDP at factor cost for the sectors; agriculture, industry, manufacturing and services at constant 2004-05 prices.

We apply causality test in a bivariate framework on the long time series data based on Granger (1969). According to Granger (1969) the notion of causality is based on the assumption that the future cannot cause the past. Consider a bivariate VAR model with two variables, X_t and Y_t , where both X_t and Y_t are two stationary stochastic processes. In such a framework, X_t is said to Granger cause Y_t if we are able to make better forecasts of Y_t with all the information available than if the information independent of X_t had been used. To test the causality relationships following model is used.

$$Y_t = \sum_{i=1}^n \alpha_i X_{t-i} + \sum_{j=1}^n \beta_j Y_{t-j} + \mu_{1t}$$

$$X_t = \sum_{i=1}^n \gamma_i X_{t-i} + \sum_{j=1}^n \delta_j Y_{t-j} + \mu_{2t}$$

Toda and Yamamoto (1995) present a lag-augmented approach to rectify the non-standard Wald statistic. The T-Y approach ensures that the asymptotic distribution is valid regardless of the order of cointegration and is immune to lag selection tests. Instead of the VAR (p) in the above equations, they estimate an augmented VAR ($p+d$) model, where d is the order of integration. For most macroeconomic data, the order of integration is 1, so $d=1$ in most cases. Further, a non-parametric test based on Heimstra Jones (1994) improved upon by Diks and Panchenko (2005, 2006) is applied. Apart from bivariate VAR, multivariate VAR is also applied. It tests the conditional independence of the variables with critical values based on asymptotic theory. The test can be run for a multivariate case where, under the null the conditional distribution of Z given $(X, Y) = (x, y)$ is the same as the conditional distribution of Z given only $Y = y$.

Results and Discussion

The analysis was started at a broader level to test the causality between agriculture sector and non-agriculture sector as a whole. The non-agriculture sector includes the industry sector, which, in turn includes manufacturing and infrastructure, and the services sector. As can be observed, our results tell us that there is uni-directional causality from non-agriculture towards agriculture. In other words, growth in the non-agriculture sector GDP Granger causes growth in the agriculture sector GDP. Further, the non-agriculture sector was broken down into its component parts and the same analysis was run. As it turned out, no test projected significant results for the individual sectors. Since, the data on national GDP already includes the data on agricultural growth, so there could be a feedback from the agriculture sector to itself. There could be a problem of double counting of the agriculture data.

1990 served as a period of tectonic structural change for the economy. Based on this we break our period of analysis into two: before and after the reforms. A uni-directional linkage was observed between the agriculture sector GDP and the industry sector GDP; i.e. growth in industry sector GDP Granger causes growth in the agriculture sector GDP. So, the causality running from national GDP to agriculture can be explained through this link between industry and agriculture.

Parametric tests make quite rigid assumptions about the density functions of the time-series data. Moreover, they assume that the relationship between variables is linear in nature. We are unable to reject the null hypothesis of non-causality. There could be a case where the presence of a third variable might be affecting results. Hence, Multivariate non-Parametric causality tests were also performed, which control for the presence of the third variable. As can be observed, once the restrictions were removed and more variables were added, the results changed completely. The agricultural sector's growth has followed a variable path over the years (Twelfth Five Year Plan, 2013). This erratic behavior in the output growth of the agriculture sector could have been normalized due to the restrictions that were placed on the parameters of the first test. However, once restrictions are removed the causality is no

longer sustained. The literature on inter-sectoral linkages has argued that growth in agriculture is linked to growth in non-agriculture. However, we have found no evidence to support the argument that the growth of the sectors is inter-dependent.

Conclusion

The theory on economic development, and growth models have consciously or inadvertently talked about the linkages between different sectors of the economy. Our focus in this study has been to explore the linkages between the two sectors i.e. agriculture and industry. If the framework of growth follows a pattern of a feedback, from within and externally imported from other sectors, then our understanding is that this relationship can help us recognize the reasons why the individual sectors are suffering from lower growth. To begin with, we initiated the study by developing a macro picture of the situation and how it has evolved over the years. We ran a series of parametric and non-parametric tests. However, our results from non-parametric tests have completely overturned these conclusions. When we loosen the strict assumptions of parametric tests on our data of 63 years, the models show us that no long-term relationship exists between the sectors. Even if it did exist, it was not sustained over the years. Both our conclusions give us new information that is different from the results of our academic contemporaries who have undertaken similar studies. Through similar and less robust techniques they have concluded that agriculture still plays an important role in economic development and there is feedback from agriculture to other sectors. However, that has not been the case in our study.

On the contrary, our results, from parametric tests, show the causality runs from the other sectors towards the agrarian sector. This understanding when juxtaposed with the current predicament of the agrarian sector is quite ironic. The lack of inter-dependence of the sectoral growth rates means that the sectors have been financing their own growth over the years. Given that the agriculture sector employs around 50% of the population with limited ability to trade with other sectors and small employment elasticity of the non-agricultural sector, agriculture sector does not generate enough value for investing in the next cycle of production. This leaves the sector at the mercy

of banking and insurance companies whose presence in the rural areas has also diminished in the last two decades. India has followed an unbalanced growth strategy with focus on the industrial sector and currently, the service sector. Over the last two decades the agriculture sector has witnessed a falling rate of public investment. The decoupling of growth means that investment and growth are not trickling down from the modern industrial sector and public investment in the agriculture sector needs to be revived to bring the sector out of distress.

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