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Agricultural Productivity, Inter-Sectoral Labor Shift, and Economic Growth in India

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ABSTRACT

In this paper, we study the transformation process Indian agriculture exhibited in the recent past, studying its policy implications. Between the years 2005-06 and 2015-16, more than 52 million workers left agriculture, which did not have any effect on agricultural output due to productivity improvements. We estimate the contribution of productivity growth and structural change in agriculture to national productivity growth during 1981-2016. We estimate differentials in agricultural productivity and in their ability to contribute to the structural change process for 21 major states of India. Using revised employment estimates, we trace major changes during the pre-reforms (before 1991) and post-reforms periods. Results show that in the pre-reforms period, the impact of productivity improvements in agriculture on agricultural output was equated by the new workforce entering into this sector, leading to a stagnant labor productivity trend. The labor-shift from agriculture during the early years of the post-reforms period, which increased further in the next decade, has led to a consistent rise in agricultural productivity. In the absence of reforms and the associated labor shift, the productivity growth in Indian agriculture would have been much lower. A similar labor shift during the last decade has not affected agricultural output, which has risen more rapidly. This result holds true for almost all states studied. There exists a positive relation between labor-shift and agricultural output in a cluster of states. Decomposition results indicate 'within-sector' productivity growth is the major source of overall growth, with a rising contribution of 'structural change'. Studying the sources of growth across states offers new scope to achieve inter-sectoral productivity convergence.

Keywords: structural change, agricultural growth, labor productivity, decomposition, India

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INTRODUCTION

Successful economic transformation is accompanied by a declining contribution of low-productive sectors like agriculture and an increasing share of manufacturing and services in national output resulting from a corresponding shift of labor from the former to the latter sectors (Fisher 1939; Clark, 1940; Lewis, 1954; Ranis, & Fei, 1961; Kuznets, 1973). While the historical trends of developed countries such as the United Kingdom, United States of America, Italy, Spain, Japan, and most of the Asian economies follow a definite path of structural change, there had been differences in patterns among many developing and emerging economies, especially among the Latin American nations (Dennis and Iscan, 2009; Neuss, 2019). Even in the developed economies, there is substantial heterogeneity in various activities within the high-productive services sector (Jorgenson & Timmer, 2011).

In India, the pattern of structural change is rather unique. While output-based transformation—a consistent decline in agricultural gross domestic product (GDP) share in the national GDP with a declining or stagnant industry share and rising services sector share—is clearly visible, rigidity is observed in the labor market. Even on the output side, the growth path observed is atypical, with an exceedingly high output growth in service sector (Goel & Echavarria, 2015) and a stagnant share in industry sector. On the employment side, the share of agricultural labor has declined over time, but agriculture still employs around half of the workforce (47%) (ILO, 2017). The industrial labor share is rising. It is yet to attain the peak, following which one would expect a decline. The labor share in services has dominated its industrial counterpart since independence. Thus, there is considerable deviation in the Indian structural change, especially in the labor market, and the pace of transformation has been relatively slower in the labor market than in the output market.

The employment trend indicates that India has maintained 'Jobless Growth' for more than two decades (Datt, 1994; Himanshu, 2011; Tejani, 2016; Abraham, 2017). The International Labour Organization's (ILO) statistics show that the low employment rate is believed to persist at least until 2022, and the annual number of jobs to be created to sustain the present employment rate is estimated to be around 8 million (World Bank, 2018). This pattern of faster transformation in output market and slower pace of change in labor market along with a 'no jobs' trend has caused huge productivity differentials across sectors. Our estimates based on RBI (2018) show that the labor productivity, measured in real terms as the ratio of Gross Value Added (GVA) to the number of persons employed, was 11.5 times more in finance sector, 3.4 times more in trade, and 2.6 times more in manufacturing than it was in agriculture during 1981. During 2016, these ratios increased to 18.5 times, 5.2 times and 4.7 times, respectively. Leaving aside construction sector, employment generation has either been slower or stagnant in all sectors.

Agricultural Transformation in India

Though the employment growth lagged behind the output growth in most of the sectors in the past, total workforce was rising gradually over time in absolute terms, indicating a slower pace of labor absorption. This was common in agriculture sector as well, but the trend persisted only until the mid-2000s. Since then, the sector witnessed a drastic reduction in the workforce, which includes both farmers and agricultural laborers. According to the National Sample Survey Office (NSSO), between 2004-05 and 2011-12, 21 million farmers left agriculture (Mehrotra et al., 2014). A recent estimate shows about 55 million laborers left agriculture sector between 2004-05 and 2015-16 (RBI, 2018).

The above trend raises three major questions. *First*, why did the labor force withdraw from agriculture? The possibility of declining 'real' agricultural wages could be seen as the 'push' factor behind this shift. However, studies indicate that the real wages were rising in agriculture over the years, and sometimes, they have surpassed the average nonagricultural wages. Growth in real wages was 1.5% between 1999-00 and 2004-05, which rose to 5.0% during 2004-05 to 2007-08 and doubled further to 11.8% during 2007-08 to

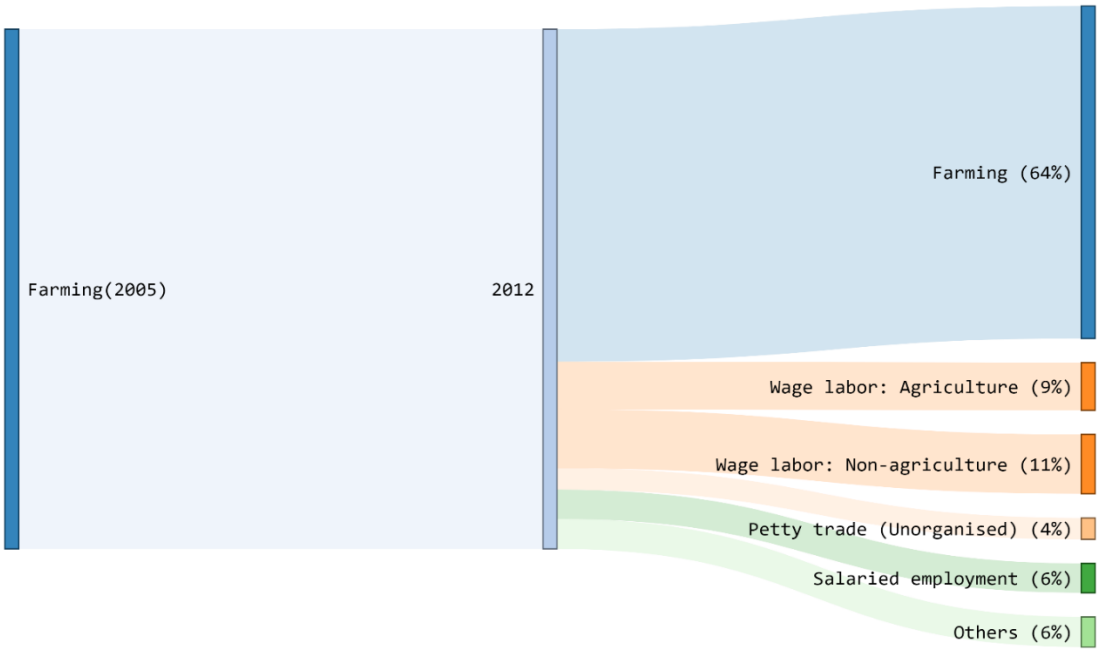
2011-12. The growth in nonagricultural wages during these periods was 1.5%, 3.9% and 8.4%, respectively (Himanshu & Kundu, 2016). Thus, as wages grew more rapidly in agriculture than nonagriculture, one could not argue that relative wage gains in nonagricultural sectors was the factor behind labor-shift from agriculture.

Second, does a fall in agricultural productivity growth, and hence a profitability-decline, cause farmers to quit agriculture? This seems to be not the case. Productivity growth in agriculture was steadily rising over the years, and it grew more rapidly since the mid-2000s (Chand & Parappurathu, 2012) when we witnessed farmers leaving agriculture more intensively. During 1995-96 to 2004-05, average growth in agriculture, forestry and fishery subsectors were 2.3%, 2.1% and 3.3%, respectively. Within the crop sector, growth in cereals, pulses, oilseeds, fruits and vegetables and fibers were 0.5%, 0.2%, -1.1%, 3.8% and -1.2%, respectively. During 2004-05 to 2011-12, growth improved in all sub-sectors and crop-groups mentioned above. Growth in agriculture rose to 3.4%, forestry rose to 2.3% and fishery rose to 4.4%. In crop subsector, the growth in cereals improved to 2.6%, it was 1.3% in pulses, oilseeds recovered from a negative growth to 1.4%, fruits and vegetables growth increased further to 5.0% and in fibers it was 8.0%.

After a decade long decline in growth, the period after the mid-2000s was known as 'growth recovery period' in agriculture (World Bank, 2014). Further, the terms-of-trade were in favor of agriculture (India, MoAFW 2016), the expenditure on agriculture and irrigation by the public sector increased across states (Bathla, 2017), and the Government provided support in the form of increased allocations for research (Singh & Pal, 2015). Growth turned more inclusive across states, leading towards convergence in productivity (Balaji & Pal, 2014). In short, as agriculture sector holistically recovered from the decelerating growth trend in the mid-1990s and entered into a higher growth trajectory, productivity growth was clearly not the factor behind farmers' withdrawal.

Third, what are the alternative sectors where the famers and laborers are moving? Existing evidence indicates construction sector rather than any other sectors. For example, Mehrotra *et al.* (2014) observed a decline of around 21 million farmers and 15 million laborers from agriculture between 2004-05 and 2011-12. This decline was accompanied by an increase of 25 million construction sector workers during the same period. Though one would not strictly assume the entire addition in construction came from agriculture, it is highly likely since there exists a limited possibility for workers flowing into construction from other nonagricultural enterprises where real wages are relatively high. Also, there exists demand for human capital factors like literacy and skill that restrict farmers and unskilled agricultural workers from moving into sectors like finance and communication. Our own estimates show that some farm households turned into agricultural laborers, others carried out petty trading, and some turned towards sectors like manufacturing and service-related nonfarm industries (Figure 1). Out of all households who carried out farming in 2004-05 as their primary occupation, only 64% remained in agriculture during 2011-12. About 9% of them turned into agricultural laborers, 11% entered as wage laborers into nonfarm enterprises, and 4% started carrying out petty trade activities.

Figure 1. Inter-sectoral shift of farm households between 2004-05 and 2011-12 (All-India)



Source: Authors' estimates based on India Human Development Survey (2004-05 & 2011-12).

In short, the discussions above clearly indicate agriculture has performed relatively well even in the phase of massive shift of farmers and laborers from agriculture. Such sustenance in production despite labor-shift has been the result of productivity improvements in agriculture resulting from increased use of inputs such as quality seeds and fertilizers, expansion in irrigated cropping due to higher allocations, higher research expenditures and favorable terms of trade. To the other end, the impact of inter-sectoral shift on overall economic growth had varied among nations with time. While in many cases it has shown larger positive impacts, there are nations in which it had little or no, or even negative, impact on growth.

For example, analyzing the case of developed nations, Jorgenson & Timmer (2011) show the effect of structural change on productivity growth was 'zero' in the United States, less than 5% in the European Union and less than 6% in Japan. In contrast, Diao et al. (2018) report as much as 80% of growth in Tanzania had been due to structural change process. In general, structural change was growth-enhancing in African nations during the early 1960s and 1970s, which was led primarily by improvements in manufacturing productivity. McMillan et al. (2014) shows it turned growth-reducing since 1990s, including in Latin American nations. In their study, de Vries et al. (2015) note the reallocation process has created static gains with dynamic losses in African economies. Diao et al. (2017) show that this labor-shift process has not only helped to attain higher growth but also assisted in poverty reduction in these nations. Among emerging economies, in India, structural change contributed around one-fourth (23%) of growth during 1990-2005 (McMillan & Rodrik, 2011).

In this paper we study the transformation process in Indian agriculture, estimate the contribution of productivity growth in agriculture, along with the agricultural labor-shift, to the national productivity growth and compare it with its earlier trends since the 1980s. Further, given the huge productivity-differentials in agriculture across regions and their ability-differentials to participate in the structural change process, varying contributions of these factors were also estimated for 21 major states of India for the said period, divided into different sub-periods, and their improvements have been traced.

METHODOLOGY

The approaches to analyze the sources of growth are several. One way is to model the indicator(s) of growth against different drivers identified by the theory and estimate the model econometrically through regression-based approaches. It helps in understanding the relative importance of each factor, their magnitude and the direction of causality (Barro and Lee, 1994; Jones, 2002). Another way is to follow growth accounting procedure and decompose the growth for a given period attributable to different factors. It provides a breakdown of observed economic growth into components associated with changes in factor inputs and a residual that reflects technological progress and other elements (Barro, 1999). While the second approach provides just the factor share(s), it is not devoid of theory. Discussions on basic growth accounting can be found in Solow (1957), Kendrick (1961), Denison (1962), and Jorgenson and Griliches (1967). Hsieh (2002) derived dual approach using the equality between output and income from factors, and Jorgenson & Timmer (2011) used cost-based measures.

The level of disaggregation of growth emerging from various sources varies with methods. Traditional shift-share analysis of Fabricant (1942) decomposes economic growth into 'within effect' that explains productivity growth within the sector and 'between effect' by contributing to aggregating inputs. Timmer and de Vries (2009) noted that interpretation of results from this traditional shift-share method is not straightforward and developed a modified shift-share analysis method in which they adjusted the between-effect of an expanding sector to take into account its relative productivity level. They divided sectors into expanding and shrinking and calculated the between-effect relative to the average productivity level of the shrinking sectors and reported substantial differences among the estimates of traditional and modified method.

The World Bank (2009)'s Shapley approach decomposes total growth into 8 different components in six stages. At stage-1, it decomposes the productivity growth into employment rate changes, changes in output per worker and demographic changes. At stage-2, employment changes are further decomposed into changes in employment by sectors. At stage-3, changes in output per worker is decomposed into changes linked to variations in output per worker within sectors and changes linked to sectoral relocation of workers between sectors. The fourth stage goes further in understanding the role played by each sector on the

aggregate effect of employment relocation across sectors while the fifth stage looks at the role of capital and TFP as sources of changes in output per worker at the aggregate level. The sixth stage puts all the elements together, to see how each factor affected total per capita growth. Alternatively, some researchers rely on advanced modeling systems such as Computable General Equilibrium (CGE) procedure for a detailed enquiry (Benfica *et al.*, 2019).

In this paper, with an objective to observe the contribution of productivity growth and structural change in agriculture to the overall economic growth, we followed the approach developed by McMillan and Rodrik (2011) that decomposes labor productivity growth into 'within' sector component and 'structural change' component. Several studies have followed their approach covering wide geographical regions to explain the structural change process and its implications for growth (Morley *et al.*, 2019; Bathla *et al.*, 2019; Diao *et al.*, 2018). They decomposed productivity growth using the equation

$$\Delta Y = \sum_{i=n} \theta_{i,t-k} \Delta y_{i,t} + \sum_{i=n} y_{i,t} \Delta \theta_{i,t}$$

where Y_t and $y_{i,t}$ refer to economy-wide and sectoral labor productivity levels, respectively, and $\theta_{i,t}$ is the share of employment in sector *i*. The Δ operator denotes the change in productivity or employment shares between $t - k$ and t.

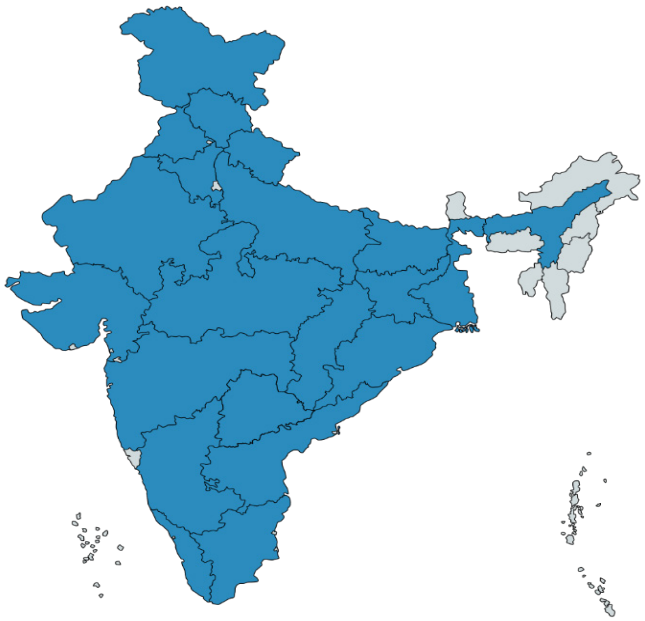
The first term in the decomposition is the weighted sum of productivity growth within individual sectors, where the weights are the employment share of each sector at the beginning of the time period, which they call as the 'within' component of productivity growth. The second term captures the productivity effect of labor reallocations across different sectors. It is essentially the inner product of productivity levels (at the end of the time period) with the change in employment shares across sectors. They call this as the 'structural change' term. When changes in employment shares are positively correlated with productivity levels this term will be positive, and structural change will increase economy-wide productivity growth.

The decomposition above clarifies how partial analyses of productivity performance within individual sectors (for example, manufacturing) can be misleading when there are large differences in labor productivities $y_{i,t}$ across economic activities. In particular, a high rate of productivity growth within an industry can have quite ambiguous implications for overall economic performance if the industry's share of employment shrinks rather than expands. If the displaced labor ends up in activities with lower productivity, economy-wide growth will suffer and may even turn negative. In the present case, the above procedure was applied separately for three different sub-periods *i.e.* 1982-83 to 1993-94, 1994-95 to 2004-05 and 2005-06 to 2015-16, and estimates were obtained for all states and the country as a whole.

DATA

Carrying out the decomposition analysis demands statistics pertaining to GVA and work force engaged in different economic activities. Since we attempt to capture the factor contributions across states, the detailed estimates need to be calculated for all states. In the present study, we considered 21 major states of India (Figure 2). While national level estimates form the basic framework in the National Accounts Statistics (NAS) system and can easily be retrieved, complexity arises when one attempts to study the economic process for the disaggregated units when the economic activities are classified into different sub-sectors. In the present study, we divide the total economy into three major sectors *i.e.* agriculture, industry and services. We cover the period between 1980-81 and 2015-16. The sub-periods considered are: a) 1982-83 to 1993-94; b) 1994-95 to 2004-05; and c) 2005-06 to 2015-16. The reason behind sub-periodization is discussed in the next section.

Figure 2. States covered in the present study



Source: Authors.

Output Estimates

Empirical research suggests the use of GVA than GDP in the decomposition framework. The country shifted to GVA based system very recently and the statistics for detailed sub-sectors are available only since 2011-12. For example, the GVA statistics for the entire nation are given by the Central Statistics Office (CSO) for the period 1951-2012. But it divides the economy only to five sub-sectors namely: a) Agriculture, forestry & fishing, mining; b) Manufacturing, construction, electricity, gas and water supply and quarrying; c) Trade, hotels, transport & communication; d) Financing, insurance, real estate and business services and e) Community, Social & Personal services. While this classification appears to be sufficient to study the transformation process, clubbing different sub-sectors into the mentioned five groups seems inappropriate for India. While the sector agriculture requires greater attention in our study, the output of the sector is combined with mining and quarrying in the data set. The other simpler and alternative way is to limit our study for the period 2011-12 to 2016-17 using the detailed sub-sectoral GVA statistics.

Since the transformation process relates to the changes in economic structure over a relatively longer span, shrinking the study to a few years would provide an incomplete picture. For the purposes of this study, alternate data sets that provide GVA statistics for India were considered. Notable among them were the Groningen Growth and Development Centre (GGDC)-10 Sector Database, United Nations Statistics Division (UNSD) Database, Penn World Table Database, World Economic Outlook Database, Total Economy Database and KLEMS Database. The GGDC database provides GVA and employment statistics for the period 1950-2012 dividing the economy into 10 sectors. The UNSD database divides the economy into 7 sectors covering the period 1970-2015 and provides GDP and GVA based statistics. While the Penn World Table Database provides statistics on a variety of macroeconomic variables, the GVA statistics is not provided and sub-sectoral classification is not available. Similar is the case with World Economic Outlook and Total Economy databases.

The KLEMS database released by the Reserve Bank of India (RBI, 2018) provides GVA and workforce statistics along with several interesting variables such as labor and capital share estimates etc., dividing the

total economy into 27 sectors for the period 1981-2016. In the present study, we used the KLEMS database for obtaining national estimates. As GVA estimates are not available for states for the entire period, we used the estimates of Net State Domestic Product (NSDP) given by the CSO of the Ministry of Statistics and Programme Implementation (MoSPI). The GVA and workforce estimates under different sectors were aggregated into three major sectors. The GVA estimates used are in real terms at 2011-12 prices.

Workforce and Laborforce Estimates

In principle, labor productivity should be measured based on number of hours the workers spend to produce a unit of output. In the absence of data pertaining to 'hours of work' spent in a given industry, it is more logical to follow 'major-time-use' criterion. Traditionally, the employment estimates in India based on this criterion are computed using the information collected in the Employment and Unemployment Surveys conducted quinquennially by the NSSO. The KLEMS database provides time-series of employment estimates generated using the surveys. Still, we generated our own estimates for the following reasons. The estimates of 'persons employed' provided in the KLEMS database is based on the 'principal + subsidiary' occupation status, meaning that even if a person has engaged in any occupation for a relatively shorter period, he/she is counted as employed. Since this approach to counting slightly inflates employment figures, it results in underestimated labor productivity values. To account for this bias, the number of persons employed in 'principal' occupation status in agriculture, industries, and services were computed using the household level survey data for the years 1983, 1987-88, 1993-94, 1999-00, 2004-05 and 2011-12.

Since NSSO estimates are still unavailable for the year 2015-16, the KLEMS estimates for the year 2015-16 was adjusted to obtain the desired values. To explain, the size of workforce for the year 2015-16 according to 'principal' status was computed using differences in workforce shares using 'principal' and 'principal + subsidiary' estimates provided in the Labor Bureau Survey at stage 1. At stage 2, using the differences in workforce and labor force shares of Labor Bureau, the size of workforce was estimated. The sectoral employment shares provided in KLEMS for the year 2015-16 was then used to derive the new sectoral workforce estimates. Labor Bureau provides annual employment estimates for the past few years but these data are not comparable with the NSS estimates.

The NSSO survey underestimates the population by design even though the sampling strategy it follows is based on the projected population estimates of the Population Census, and hence the workforce across sectors and states. Using these unadjusted figures at the national level would provide one slightly different labor productivity estimates. When such exercise is carried out for different states at a disaggregated level, may provide a biased productivity estimate. To avoid the bias, the employment statistics obtained using survey estimates were appropriated with the census estimates. The following corrections were carried out. First, the decadal census estimates were interpolated or extrapolated to obtain a long-time series for the period 1981-2016. Second, using the worker-population-ratios given by the NSSO, the time-series of workers were obtained. This series is adjusted for the reference survey period followed by the NSSO and a new series was obtained. Third, the differences in workforce in census and survey-based estimates were then distributed among different sectors. The resulting sectoral employment series provides the new estimates adjusted to the census estimates and are used in the present study.

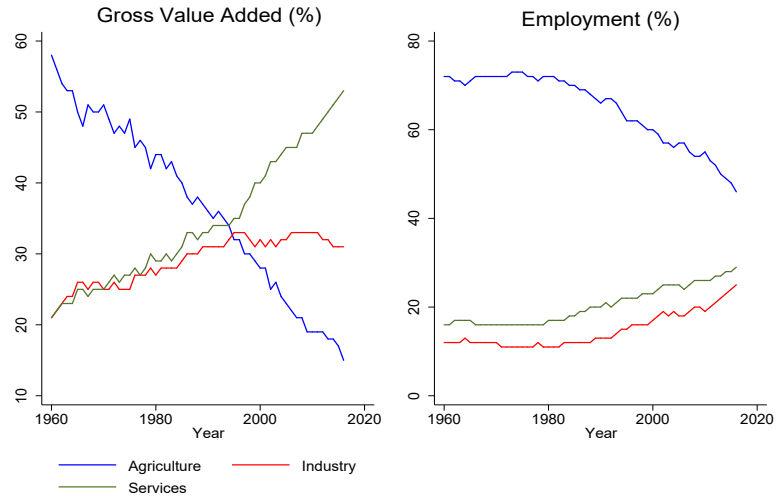
RESULTS

Sectoral Changes in Employment and Output

The long-run trends in sectoral output shares clearly indicate the pattern of shift into an industrial economy since the mid-1970s until the early 1990s, and the dominance of services-led growth thereafter (Figure 3). In agriculture, the share of GVA has declined consistently from 58% during 1960 to 15% during 2016, with

no major aberrations over time. Industrial and services sector output shares show notable changes. The industrial GVA has stagnated for about a decade since the mid-1960s and has risen consistently since then. But this rising trend has not persisted for more than two decades. Since the mid-1990s, the industrial share turned back to stagnate, the period which one would mind for realizing the benefits of economic reforms in the country. Since then, the services sector had dominated in generating higher output.

Figure 3. Sectoral trends in Gross Value Added and employment (All-India, 1960-2016)

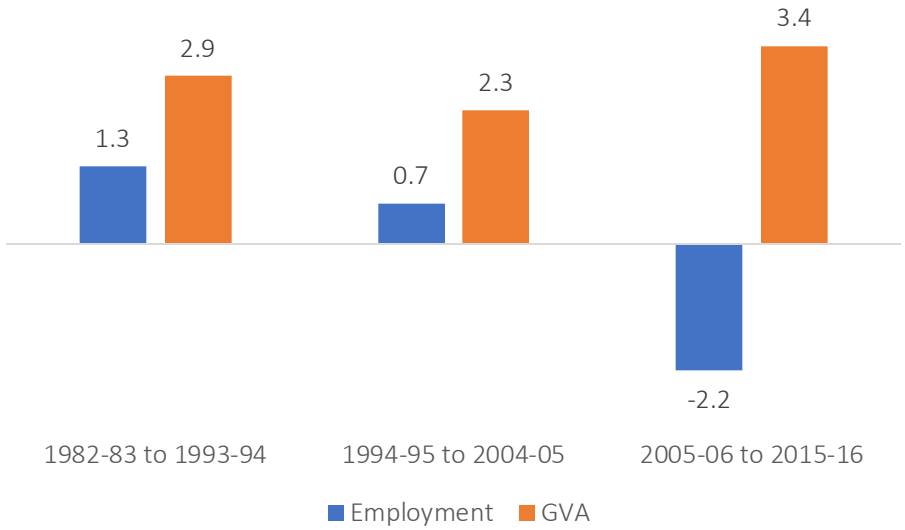


Source: Authors based on Groningen Growth and Development Centre (GGDC) & KLEMS database; Gross Value Added is at 2011-12 prices

This transformation in output components noted by a consistent decline in agricultural output and the rise in industries and services had rather failed to record corresponding labor-adjustments in respective sectors. The statistics for the year 2015-16 show that while 29% workers produced 53% of national output through services, 46% workers produce mere 15% output in agriculture sector. This reflects the inability to absorb labor along growth and had led to huge productivity differentials between these sectors. Our estimates show that the average labor productivity was highest in manufacturing during 1960, amounting Rs. 68,000 (US$ 903) at 2011-12 prices. The productivity levels were Rs. 31,000 (US$ 405) and 49,000 (US$ 651) in agriculture and services, respectively, during this period. By 2016, while productivity level rose only by 2.4 times in agriculture, it raised by 3.9 times in industries and 8.2 times in services.

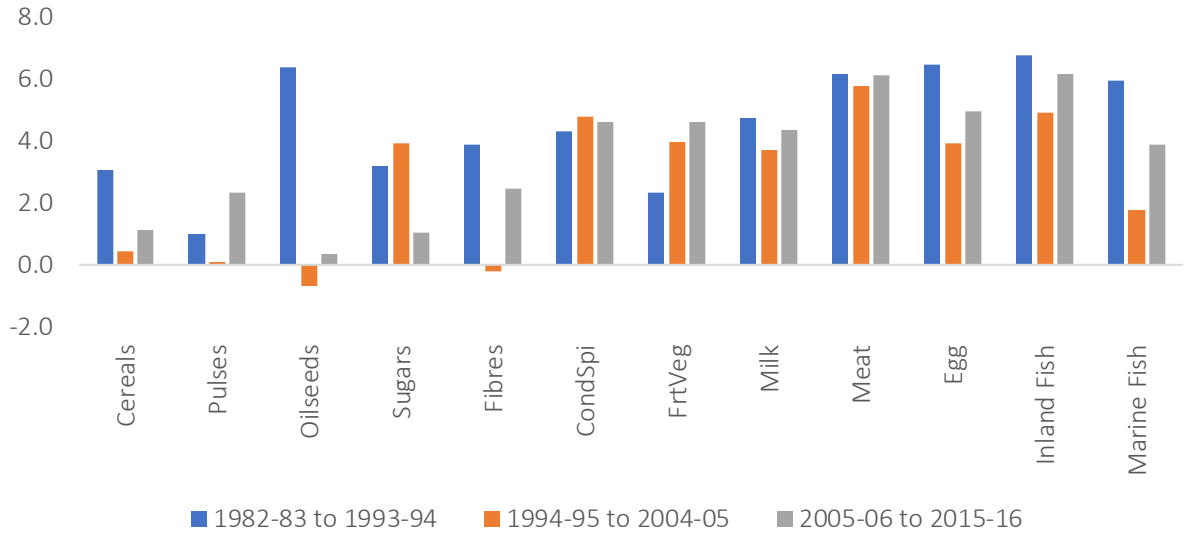
We observe that labor productivity was almost stagnant in agriculture for more than three decades since 1960s. Much of the increase was recorded since early 1990s when the structural reforms were introduced. The period following reforms in the country is noted for 'growth deceleration' in agriculture (Figure 4). Almost all the commodities registered a negative growth (Figure 5), and except for few states, growth deceleration was felt almost in all states. Between 1993-94 and 2004-05, growth was just 0.4% in cereals, 0.1% in pulses, -0.7% in oilseeds and -0.2% in fibers. Even the output in allied sector commodities like milk, meat, egg and fish declined during this period. This contrasting picture - that a deceleration in growth but an increase in labor productivity in agriculture - has essentially been the result of the phenomenon of structural change, explained by the changing composition of employment shares among sectors.

Figure 4. Trends in Gross Value Added and employment growth in agriculture (1981-2016, %)



Source: Authors' estimation based on KLEMS database.
Note: GVA = Gross Value Added. GVA is at 2011-12 prices

Figure 5. Sub-sectoral growth trends in agricultural value of output



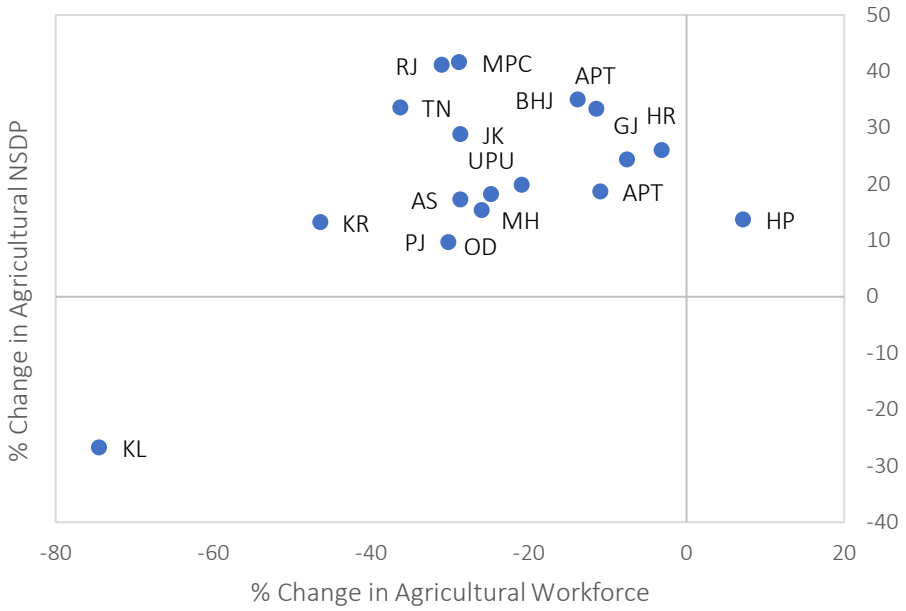
Source: Authors' estimation based on Central Statistics Office; Value of Output is at 2011-12 prices

The rate of labor absorption started to decline in agriculture since reforms. On an average, agricultural sector absorbed 4.4 million workers between 1970s and 1990s, which dropped by half to 2.2 million during the decade following reforms. This decline has led to the raising labor productivity trends in agriculture. More interesting is the pattern in successive periods. Since the mid-2000s, the agricultural workforce registered a negative growth, falling in absolute size. The employment growth was -2.2% 2005-06 and 2015-16. One would note that this was the period when the country's largest employment guarantee

program - The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) - was introduced. The result of such policy choice on agricultural labor demand and subsequent effect on farm wages are well documented in the literature (Gulati *et al.*, 2014). Given that labor cost roughly constitutes more than one-third total operational cost in agriculture, one would expect a negative impact on agriculture. Rather, the output growth was 3.4% during this period, registering improvements in growth in almost all major commodity groups (Figure 4). As stated earlier, this period is noted for 'growth recovery' in agriculture. Among various factors, a rise in public investment, improvements in terms of trade and improvements in input use are responsible for this recovery. This resulted in a shift in labor productivity to a higher trajectory than the earlier phase, combined together with the faster structural change process.

Observing the performance of output growth against labor-shift across states shows interesting picture. Plotting the change in share of NSDP against the share of agricultural labor-shift in each state, it is shown that the structural change process has not interfered with the output generation in most of the states (Figure 6). Though the degree of relation varied among them, except for the state of Kerala, none of the states registered negative output growth. Further, Himachal Pradesh was the only state where the workforce increased, that too marginally. In states like Madhya Pradesh and Rajasthan, the NSDP has raised by more than 40% against a reduction in labor share by 30%. In Bihar, Tamil Nadu and Andhra Pradesh, NSDP has risen between 30% and 40%. While the size of labor-share decline was 36% in Tamil Nadu, in Bihar and Andhra Pradesh, it was 14% and 11%, respectively. Assam, Haryana and Gujarat are the other states with notable increase in output. The rise in output share in these states was between 25% and 30%.

Figure 6. Response of agricultural NSDP to labor-shift (2005-06 vs 2015-16)



Source: Authors' estimates; States' full name can be found in Tables 1 to 3.
Note: NSDP = Net State Domestic Product.

Beyond this 'no effect' impact, to some extent, one could observe a positive correlation between NSDP and the agricultural labor-shift among cluster of states. In these states, when higher the share of labor shifting into nonfarm industries and services, higher is the agricultural output growth. The relative position of states like Madhya Pradesh, Rajasthan and Tamil Nadu at the one end and West Bengal, Gujarat and Haryana at the other end leads to such conclusion. Still, such results do not hold always. There are cluster of states with opposite trend. Punjab, Odisha, Jammu & Kashmir, Maharashtra and Uttar Pradesh on the one hand characterized by low changes in output share despite of higher share of labor-shift, and on the other, Bihar

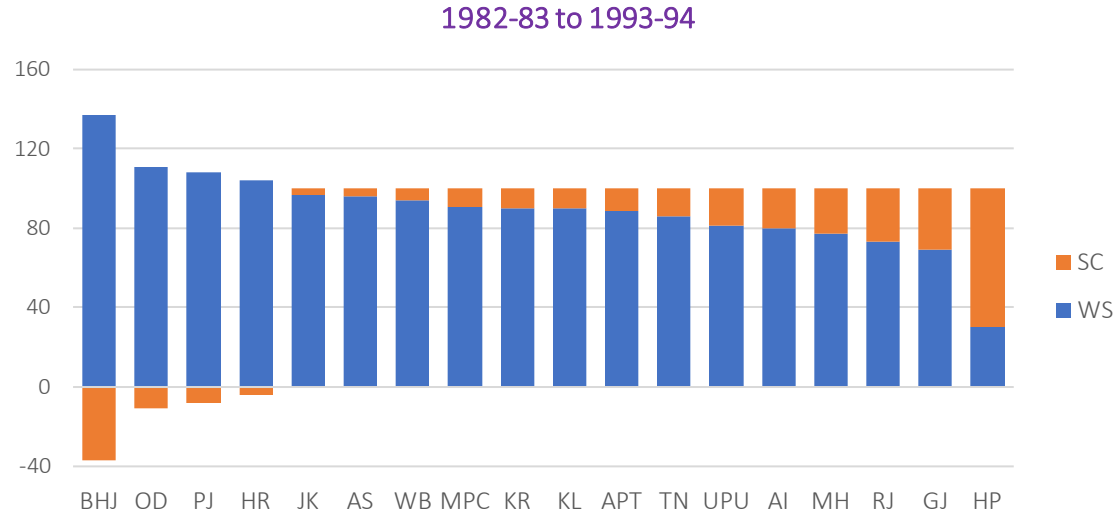
and Andhra Pradesh achieving higher output growth with smaller level of labor shift. In some sense, one could link such relations with the extent of diversification within agriculture and the capacity of nonfarm sectors in these states to absorb agricultural labor.

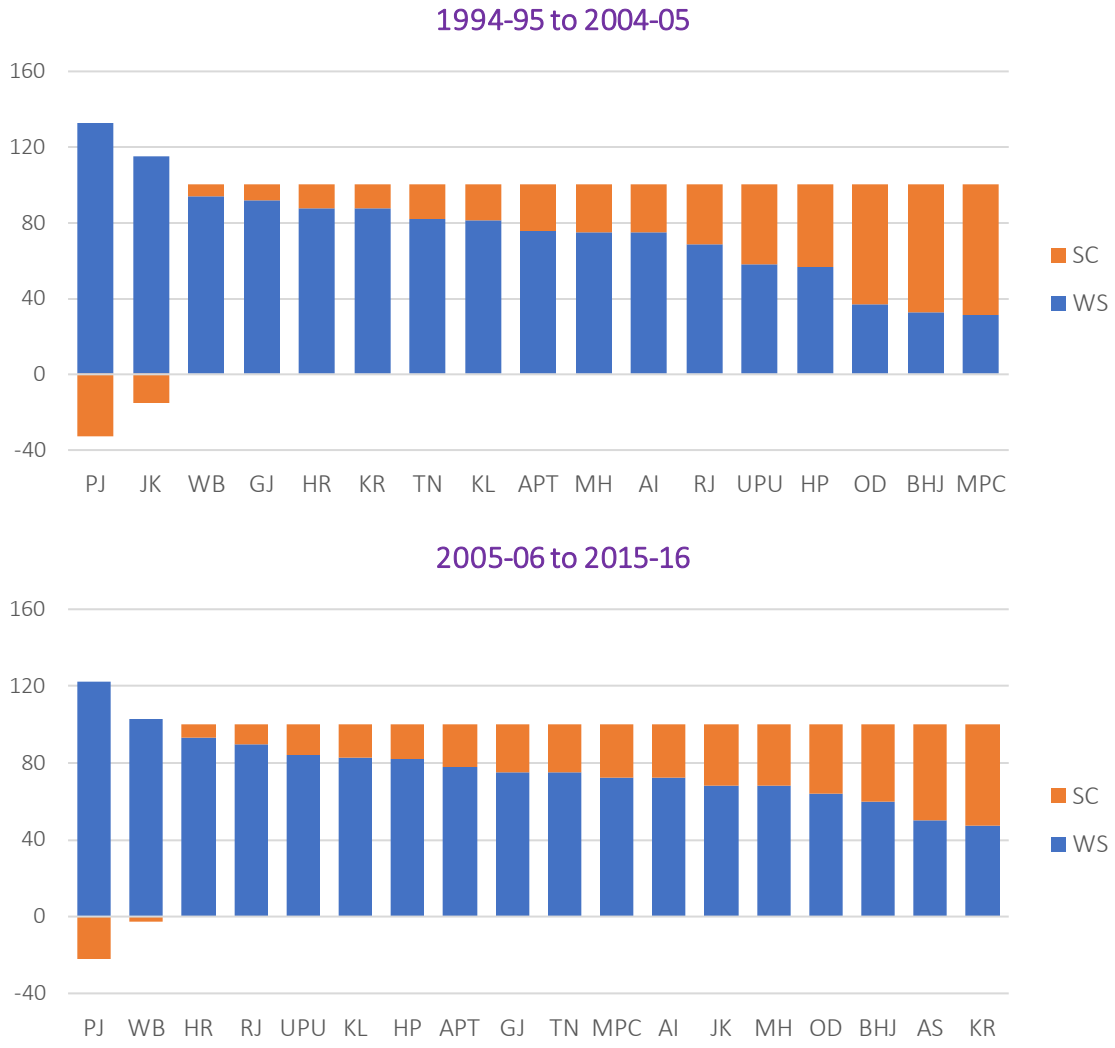
Following observations emerge from the above discussion. While in pre-reform period the impact of productivity improvements in agriculture were equated by the new workforce entered in this sector leading to constant labor productivity, structural change during the post-reform period led to a drastic shift towards a rising productivity. In the absence of change, productivity growth in agriculture today would have been much lesser. More importantly, the role of construction sector in absorbing agricultural workforce is worth mentioning. Estimates indicate that between 2005-06 and 2015-16, about 52 million workers left agriculture. During the same time, about 42 million new entrants joined in construction, signaling a major shift of agricultural workers into construction. Thus, the contribution of agriculture to national productivity growth is not constant and would shift with the shifting role of productivity and structural change.

Sources of Growth across Sectors

It is evident from above discussion that the contribution of within-sector productivity growth and inter-sectoral shift in agriculture has varied in different periods. The results of growth decomposition are displayed in Figure 7, and detailed estimates are presented in Tables 1-3. National level estimates consistently affirm 'within-sector' component was the major source of growth than structural change throughout the period. With the rising level of labor productivity over time, the contribution of productivity growth within the sectors as well has improved. During the pre-reforms period 1982-83 to 1993-94, the labor productivity growth was 3.3% a year. This rose to 4.2% during the post-reform period 1994-95 to 2004-05 and to 8.8% during 2005-06 to 2015-16. Accordingly, the contribution of within-sector growth as well rose to 2.6%, 3.2% and 6.4%, respectively during these periods. While the estimates across states also proved 'within-sector' component as the major source, relative shares of productivity growth had greatly varied across space and time.

Figure 7. Contribution of within-sector productivity growth and structural change (%)





Source: Authors' estimates
Note: AI = All-India; APT = Andhra Pradesh + Telangana; AS = Assam; BHJ = Bihar + Jharkhand; GJ = Gujarat; HP = Himachal Pradesh; HR = Haryana; JK = Jammu & Kashmir; KL = Kerala; KR = Karnataka; MH = Maharashtra; MPC = Madhya Pradesh + Chhattisgarh; OD = Odisha; PJ = Punjab; RJ = Rajasthan; TN = Tamil Nadu; UPU = Uttar Pradesh + Uttarakhand; WB = West Bengal; SC = structural change; WS = within sector productivity growth.

Table 1. Contribution of agriculture in productivity growth and structural change (1982-83 to 1993-94)

State	GW	WS	SC	WS			SC		
				A	I	S	A	I	S
Andhra Pradesh + Telangana (APT)	3.06	2.72	0.34	0.11	1.28	1.33	-0.16	0.17	0.32
Assam (AS)	-1.42	-1.36	-0.06	-0.65	-0.66	-0.05	-0.05	-0.18	0.17
Bihar + Jharkhand (BHJ)	1.74	2.38	-0.64	-0.05	1.80	0.63	0.04	-1.05	0.37
Gujarat (GJ)	3.11	2.14	0.97	-0.17	1.13	1.18	-0.52	1.10	0.38
Haryana (HR)	9.93	10.29	-0.36	7.91	1.41	0.98	-3.64	1.94	1.33
Himachal Pradesh (HP)	2.91	0.88	2.03	0.89	0.01	-0.02	-0.68	1.51	1.20
Jammu & Kashmir (JK)	19.52	18.97	0.54	4.72	11.14	3.11	-1.12	-2.74	4.41
Karnataka (KR)	4.70	4.23	0.47	1.03	1.47	1.74	-0.15	0.01	0.62
Kerala (KL)	3.08	2.77	0.31	1.12	0.74	0.90	-0.57	0.23	0.64
Madhya Pradesh + Chhattisgarh (MPC)	2.89	2.63	0.25	0.88	1.26	0.49	-0.14	-0.31	0.70
Maharashtra (MH)	5.70	4.41	1.30	1.34	1.71	1.36	-0.42	0.46	1.26
Odisha (OD)	2.61	2.90	-0.29	-0.05	2.12	0.83	0.02	-0.42	0.11
Punjab (PJ)	3.54	3.81	-0.27	3.17	0.67	-0.04	-1.33	0.25	0.82
Rajasthan (RJ)	4.78	3.47	1.31	1.79	0.65	1.03	-0.81	0.86	1.26
Tamil Nadu (TN)	3.93	3.40	0.54	1.66	0.48	1.25	-0.35	0.52	0.37
Uttar Pradesh + Uttarakhand (UPU)	1.57	1.27	0.29	0.19	0.52	0.57	-0.17	0.10	0.36
West Bengal (WB)	3.62	3.41	0.22	2.59	-0.10	0.91	-0.75	0.45	0.51
All-India (AI)	3.32	2.64	0.68	0.69	0.80	1.14	-0.28	0.29	0.67

Source: Authors' estimates

Note: GW=Annual Labor Productivity Growth; WS=Contribution of 'Within Sector' productivity growth; SC=Contribution of 'Structural Change'; A=Agriculture, I=Industry; S=Services

Table 2. Contribution of agriculture in productivity growth and structural change (1994-95 to 2004-05)

State	GW	WS	SC	WS			SC		
				A	I	S	A	I	S
Andhra Pradesh + Telangana (APT)	5.74	4.34	1.39	1.37	1.11	1.87	-0.51	0.83	1.07
Assam (AS)	0.13	-0.83	0.96	-0.73	-0.63	0.53	-0.09	0.96	0.10
Bihar + Jharkhand (BHJ)	2.59	0.86	1.73	0.26	-0.39	1.00	-0.33	1.45	0.61
Gujarat (GJ)	2.80	2.57	0.23	-0.30	1.13	1.74	-0.09	0.17	0.16
Haryana (HR)	2.62	2.32	0.30	-0.51	0.32	2.50	-0.31	0.95	-0.34
Himachal Pradesh (HP)	4.97	2.85	2.12	0.94	0.76	1.16	-0.60	1.78	0.93
Jammu & Kashmir (JK)	-3.26	-3.74	0.48	-0.49	-2.50	-0.75	-0.41	0.85	0.04
Karnataka (KR)	4.60	4.07	0.53	-0.46	1.91	2.62	-0.07	-0.39	0.99
Kerala (KL)	2.96	2.41	0.55	0.41	0.61	1.39	-0.86	0.39	1.02
Madhya Pradesh + Chhattisgarh (MPC)	1.55	0.48	1.06	-0.61	0.51	0.58	-0.22	0.84	0.44
Maharashtra (MH)	3.13	2.36	0.77	0.16	0.29	1.92	-0.17	0.38	0.55
Odisha (OD)	4.59	1.71	2.88	0.38	0.30	1.03	-0.56	2.64	0.79
Punjab (PJ)	1.79	2.39	-0.60	1.48	-0.14	1.06	-1.62	0.65	0.37
Rajasthan (RJ)	2.40	1.65	0.75	0.42	0.58	0.65	-0.49	0.57	0.67
Tamil Nadu (TN)	4.91	4.05	0.87	-0.08	1.10	3.02	-0.29	0.59	0.57
Uttar Pradesh + Uttarakhand (UPU)	2.11	1.22	0.89	0.71	-0.23	0.74	-0.61	1.08	0.42
West Bengal (WB)	4.50	4.25	0.26	0.23	1.60	2.41	-0.10	-0.27	0.63
All-India (AI)	4.20	3.17	1.04	0.39	0.87	1.90	-0.31	0.69	0.66

Source: Authors' estimates

Note: GW=Annual Labor Productivity Growth; WS=Contribution of 'Within Sector' productivity growth; SC=Contribution of 'Structural Change'; A=Agriculture, I=Industry; S=Services

Table 3. Contribution of agriculture in productivity growth and structural change (2005-06 to 2015-16)

State	GW	WS	SC	WS			SC		
				A	I	S	A	I	S
Andhra Pradesh + Telangana (APT)	8.18	6.35	1.83	1.83	0.44	4.08	-0.67	0.69	1.82
Assam (AS)	6.10	3.07	3.03	1.95	-1.16	2.28	-1.07	2.48	1.63
Bihar + Jharkhand (BHJ)	8.88	5.34	3.54	1.86	0.45	3.03	-0.95	2.09	2.40
Gujarat (GJ)	10.49	7.88	2.61	1.20	3.58	3.10	-0.81	2.41	1.01
Haryana (HR)	8.50	7.92	0.58	1.16	1.24	5.53	-0.60	0.92	0.26
Himachal Pradesh (HP)	7.00	5.77	1.23	0.19	1.95	3.63	-0.21	1.32	0.12
Jammu & Kashmir (JK)	0.87	0.59	0.28	1.22	-1.13	0.50	-1.68	0.89	1.06
Karnataka (KR)	9.70	4.58	5.12	1.16	0.47	2.95	-0.90	1.75	4.28
Kerala (KL)	7.00	5.83	1.16	0.82	0.79	4.22	-1.35	0.88	1.63
Madhya Pradesh + Chhattisgarh (MPC)	11.13	7.97	3.15	3.94	0.93	3.11	-1.34	2.86	1.64
Maharashtra (MH)	9.35	6.40	2.95	0.88	1.90	3.62	-0.56	1.09	2.42
Odisha (OD)	7.33	4.67	2.66	1.09	0.88	2.70	-0.63	1.70	1.59
Punjab (PJ)	4.56	5.57	-1.00	1.93	0.54	3.10	-2.20	0.97	0.23
Rajasthan (RJ)	9.91	8.91	1.00	4.05	0.88	3.98	-1.89	2.09	0.80
Tamil Nadu (TN)	9.30	6.99	2.31	1.84	1.44	3.70	-1.15	1.38	2.08
Uttar Pradesh + Uttarakhand (UPU)	7.37	6.16	1.21	1.74	0.38	4.04	-1.23	1.94	0.49
West Bengal (WB)	6.37	6.55	-0.18	1.02	-0.17	5.70	-0.79	0.99	-0.38
All-India (AI)	8.85	6.38	2.47	1.53	0.98	3.86	-0.88	1.73	1.62

Source: Authors' estimates

Note: GW=Annual Labor Productivity Growth; WS=Contribution of 'Within Sector' productivity growth; SC=Contribution of 'Structural Change'; A=Agriculture, I=Industry; S=Services

Within the post-reform context, the contribution of within-sector productivity growth was more than 90% in Punjab, Jammu & Kashmir, West Bengal and Gujarat during 1993-94 to 2004-05. In the subsequent period, while its contribution remained high in Punjab and West Bengal, it lagged behind in Jammu & Kashmir and Gujarat. However, in Haryana and Rajasthan, it emerged as the major source by contributing more than 90% to growth. Similarly, in the former period, in Karnataka, Tamil Nadu and Kerala, it contributed between 80% and 90%. In the following period, while its contribution in Haryana rose to more than 90%, remained same in Kerala, and was less than earlier period in Tamil Nadu and Karnataka.

Conversely, in states like Assam, Bihar and Odisha, the structural change component was the major source of growth. Its contribution was more than 60% in these states during 1994-95 and 2004-05. During 2005-06 to 2015-16, it declined to 50%, 40% and 36%, respectively. Further, looking at the sectoral contribution to growth, services sector's contribution was relatively high in the within-sector productivity growth, and as expected, it varied among states with time. Between 1994-95 and 2004-05, contribution of service sector in Madhya Pradesh, Bihar, Haryana and Maharashtra was more than 80%. During 2005-06 to 2015-16, the share in Madhya Pradesh has fallen to less than 40%, and in Bihar and Maharashtra it was less than 60%. In West Bengal and Jammu & Kashmir, services contributed the highest. Similar is the case when observing industry sector contribution. While in Madhya Pradesh, Assam and Jammu & Kashmir its contribution was larger in the former period, this has shifted to Gujarat, Himachal Pradesh, and Maharashtra in recent decade.

Role of Agricultural Sector

When compared with services and industries, the share of agricultural sector to productivity growth was relatively less. Looking at the national estimates, agriculture contributed only 26% to the national within-sector productivity component during 1982-83 to 1993-94. In the forthcoming period, it declined further to 12% between 1994-95 and 2004-05. When growth in agriculture recovered since the mid-2000s, as we noted in earlier discussions, agriculture sector's contribution raised back to the earlier level. The share of agriculture improved to 24% during 2005-06 to 2015-16. But as observed in industries and services sectors, agriculture sector's contribution differed in different states over time. The sector's contribution was relatively high in Himachal Pradesh, Punjab, Haryana and West Bengal in the pre-reforms period. The share was more than 80% in former two states and between 70% and 80% in the latter two. During the 1994-95 to 2004-05, while agriculture sector's share in total productivity growth of Himachal Pradesh reduced to less than 40%, the share was above 60% in Punjab's productivity growth. In Uttar Pradesh, agriculture emerged as the new source to contribute, raising its share from 15% in pre-reforms period to 58% in the post-reform decade. Since the mid-2000s, a new set of states witnessed high contribution from agriculture *i.e.* Jammu & Kashmir, Assam, Madhya Pradesh and Rajasthan. While the contribution of agriculture was more than 60% in the former two states, it was between 40% and 50% in latter two states.

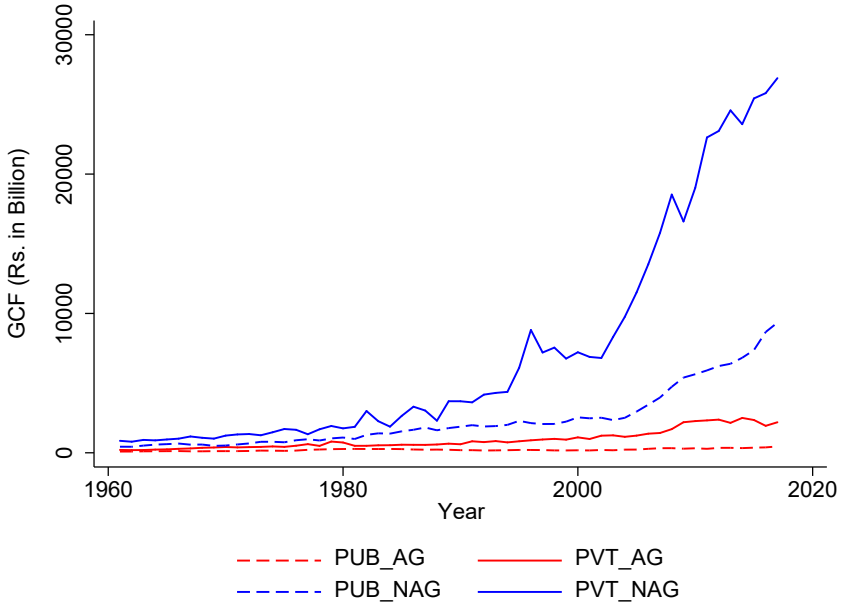
In terms of structural change, the contribution of agriculture was negative throughout the study period. This negative contribution has risen in the post-reforms period. The contribution was a negative by 30% between 1982-83 and 1993-94. It turned further to negative 36% in the next decade and remained at the same level of negative 36% during 2005-06 to 2015-16. Similar was the case when we look across states. Among all states, Punjab and Haryana were the only states where agriculture's contribution was positive to the states' overall structural change process in the pre-reforms period; but we note that the contribution of structural change to the state's productivity growth was negative by 8%. In early post-reform decade, it remained positive in Punjab, turned negative in Haryana. During the latest decade, except Punjab, there were no states in which a labor-shift from agriculture contributed positively to the state's overall structural change process.

POLICY IMPLICATIONS

The results of the analysis presented above have several policy implications for Indian agriculture. The trends in sectoral output and employment components over long-run clearly indicate the country's notable success in reducing the share of agricultural output in national output, but failure to relocate low-productive agricultural workers towards industries and services. The success factors had primarily been the expansion of industries sector during the mid-1970s to the mid-1990s, and the dominance of services sector since then. Turning our attention towards labor market, the factors behind failure of labor relocation could be attributed to a major extent to the dominance of capital component over labor in the growth process.

In other words, since the economic reforms in the early 1990s, the growth process has turned increasingly capital intensive than it was earlier, replacing more labor (Figure 8). This would be more evident while observing the pace of growth in capital formation in the country. While the level of capital formation in agriculture has increased only by 2.6 times between the years 1991 and 2017, the increase is 6.5 times in non-agriculture sector. Deeper analysis among different subsectors shows that this increase is as high as 19 times in the finance sector, 15 times in the construction sector and 5 times in the manufacturing sector. Corresponding decline in labor share had been 15.1%, 3.3% and 8.5%, respectively in these sectors. This was also reflected in the slowdown in employment growth in this period.

Figure 8. Trends in public and private capital formation (All-India, 1961-2017)



Source: Central Statistics Office.
Note: PUB_AG=Public Investment in Agriculture & Allied Sector; PVT_AG=Private Investment in Agriculture & Allied Sector; PUB_NAG=Public Investment in Non-agriculture Sector; PVT_NAG=Private Investment in Non-agriculture Sector.

Despite a major contribution of 'within sector' component to growth, the trends in different sub-periods clearly indicate increasing share of 'structural change' component in labor productivity growth. This has increased from 20% in the pre-reform period to 25% in the early decade of post-reform period and further to 28% in the recent decade. In some way, this signals an improvement as it helps to slowdown the inter-sectoral divergence in labor productivity. This has helped to shift agriculture sector, on which the present paper concentrates, from a stagnant level to a rising level of productivity with important welfare consequences. The association of negative employment growth with accelerated output growth reminds us

the need for diversifying cereal based monoculture towards cash crops, fruits and vegetables and high-value allied sector commodities like milk, meat, egg and fish, . Such a switch would lead to more output per unit of labor. We believe this was the major reason behind the non-negative output growth in most of the states in recent decade.

Further, we believe the reason behind 'no effect' of labor withdrawal on agricultural output is in part the left-out labor could be the "surplus", as described in the structural change theories. As elimination of labor surplus leaves the output untouched, the states could have observed a non-negative growth. The varying contributions of components of growth sources among states provide an opportunity to focus the regions where structural change can be encouraged. The continued positive contribution of agriculture in total structural change in Punjab indicates the flow of more productive labor from agriculture to less productive sectors and hence warrants discouraging such shift through appropriate policies. On the other hand, supporting labor-shift from agriculture in states with negative contribution signals that enabling further shift could lead to inter-sectoral productivity convergence. Investing in technologies that raise output per unit of labor, promoting practices such as farm mechanization and enhancing the farmers' and laborers' skills, not just in agricultural operations but also for industries and services sectors could further augment this convergence process. A set of carefully calibrated labor sector policies that improve both laborers' earnings in different sectors and encourage inter-sectoral productivity convergence is needed.

CONCLUDING REMARKS

In this paper we studied the transformation process in Indian agriculture by estimating the contribution of productivity growth and structural change in agriculture to the national productivity growth during 1981-2016. Given the huge productivity-differentials in agriculture across regions and their ability-differentials to participate in the structural change process, the varying contributions of these factors were also estimated for 21 major states of India for different sub-periods and major changes have been traced. In doing so, new employment estimates were used to address the differences in survey and census-based estimates.

Results show that in the pre-reforms period the impact of productivity improvements in agriculture was equated by the new workforce entering into this sector, leading to a stagnant labor productivity trend. Labor-shift from agriculture during the early years of the post-reforms period, which increased further in the next decade, led to a rise in productivity. In the absence of reforms and the associated labor shift, the productivity growth in Indian agriculture would have been much lower. A similar labor shift during the last decade has not affected agricultural output, which has risen more rapidly. This result holds true for almost all states studied. There exists a positive relation between labor-shift and agricultural output in a cluster of states. Decomposition results indicate 'within-sector' productivity growth is the major source of overall growth, with a rising contribution of 'structural change.' Studying the sources of growth across states offers new scope to achieve inter-sectoral productivity convergence.

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