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Structural change and economic growth in India[☆]

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ABSTRACT

Using detailed sectoral data from India KLEMS, we analyze the role of structural change in determining India's aggregate productivity growth during 1980–2011. In general, the impact of *static structural change* on aggregate labor productivity growth has been positive, as workers moved to sectors of a relatively higher labor productivity level. However, *dynamic reallocation effects*—worker movement to fast-growing industries—have not been observed. The pro-market reforms in the 1990s did help a TFP growth-enhancing allocation of capital across sectors. The relative importance of the manufacturing sector for aggregate TFP growth has increased in recent years. Yet, India's structural transformation features the absorption of workers in the construction sector and slow and stagnant job creation respectively in services and manufacturing sectors. This poses a challenge, as the potential for productivity growth in construction and services are limited, and the changing nature of manufacturing production provides less room for absorbing less-skilled workers.

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1. Introduction

India's Gross Domestic Product (GDP) growth has increased consistently since the mid-1990s averaging from 6 to 7 percent, and even reaching 9 to 10 percent in some years in the mid-2000s. There have been many studies discussing various aspects of this growth process (Das et al., 2016; Bhagwati and Panagariya, 2013; Verma, 2012; Balakrishnan, 2010; Eichengreen et al., 2010; Bosworth and Collins, 2008; Panagariya, 2008; Kochar et al., 2006; Vaidyanathan and Krishna, 2007). One crucial aspect, which is less considered from an overall economy perspective, is the role of productivity growth and structural change, which are essential in achieving

sustainable economic growth. Improving productivity and competitiveness was one of the objectives of India's economic reforms since the 1990s. The productivity literature in India is vast, but mostly confined to the formal¹ manufacturing sector (see Goldar, 2014, 2015; Kathuria et al., 2014; Das and Kalita, 2011; Goldar, 2004; Balakrishnan and Pushpangadan, 1994; Ahluwalia, 1991). Only a few studies have attempted to analyze the productivity of the entire economy – inclusive of both formal and informal sectors – (Erumban and Das, 2016; Das et al., 2016; Verma, 2012; Bosworth and Collins, 2008). When looked from an aggregate economy perspective, productivity growth can be achieved either by improving productivity growth at the industry level or by moving resources from low productive uses to high productive uses. This resource reallocation is often called the process of structural change.

This paper tries to understand the role of industrial productivity growth and structural change in determining aggregate productivity growth—both labor productivity and total factor productivity (TFP)—in the Indian economy over three decades since

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¹ The two terms “formal” and “organized” are used synonymously in this paper. So are the terms “informal” and “unorganized.”

1980. Using the 2015 version of the India KLEMS² database, we examine whether the observed economic growth is broad-based and whether it features the traditionally hypothesized structural transformation observed in many advanced countries during their development process. This has been accomplished by analyzing the industry origins of India's labor productivity growth, and TFP growth, along with the role of resource reallocation—how the factor inputs, labor, and capital, moved across industries, during the growth process.

The paper differs from previous research in that it uses detailed industry-level data to understand the growth process in India. Earlier studies on structural change in India have used highly aggregate data in a three-sector framework to analyze the growth process, which conceals possible industry heterogeneity (e.g., Bosworth and Collins, 2008) or use measures of partial productivity (de Vries et al., 2012).³ This paper, which uses detailed industry data for 27 sectors, is perhaps the first comprehensive attempt to understand the structural change process at this level of industry detail, including both formal (organized) and informal (unorganized) sectors of the economy, and using both labor productivity and total factor productivity measures. Often growth and structural change analysis of developing economies rely on aggregate economy data or data that excludes or severely undercounts the role of the informal sector, which can be misleading especially when the informal sectors are large. The employment share of informal activities is quite high in India, especially, in agriculture, construction and trade, and the informal jobs constitute more than 90 percent of all jobs (de Vries et al., 2012). At the same time, the productivity of the informal segment is relatively low, which can pull down aggregate productivity.

A related stream of literature that looked into resource misallocation – both at the firm level and industry-level – have established that weak productivity performance in poor countries can be attributed to misallocation of resources (Banerjee and Duflo, 2005; Hsieh and Klenow, 2009; Bartelsman et al., 2013). Econometric evidence from Hsieh and Klenow (2009) suggests the importance of banking and financial sector weaknesses in nurturing capital misallocation among manufacturing firms in India. Further, their econometric model predicts a 60 percent improvement in productivity in Indian manufacturing, if resource allocation is improved to the US level. Our analysis, which is complementary to this literature, differs in terms of method and coverage. We use a growth accounting approach, compared to their econometric approach, and our analysis goes beyond the manufacturing sector, taking the entire economy into account. This helps us understand how workers and capital move across the whole economy, say from agriculture to non-agriculture – be it manufacturing, services, utilities or construction. Finally, this paper uses better measures of capital and labor inputs that take account of heterogeneity among different types of capital assets and different types of labor.

We find that the impact of structural change on aggregate labor productivity is generally positive, as workers moved from low productivity industries to high productivity industries. However, dynamic structural change effects—the movement of workers to fast-growing industries—are hardly observed during the period of analysis. This has been primarily because, the large declines in agricultural employment has been compensated by increases in the construction sector, where productivity growth—both labor productivity and TFP—has been consistently low and mostly negative. One reason why workers move to the construction sector is the easy

access to this job market, as it is substantially informal and less skill-intensive, compared to the more stringent formal manufacturing job market. Our TFP decomposition suggest that the pro-business reforms in the 1980s did not help a growth-enhancing allocation of capital, while the pro-market reforms in the 1990s did. The post-1990 period was also characterized by relatively less volatility in macroeconomic indicators (Ghate et al., 2013), which may also have facilitated a relatively better investment climate in the country.

The remainder of the paper is presented in eight sections. In the second section, we provide an overview of economic reforms in India, which has important implications for structural change and productivity growth. In the third section, we discuss the importance of structural change for economic growth, and in the fourth section, we describe the methodology used to decompose aggregate labor productivity growth and TFPG. In section five, we discuss the India KLEMS dataset, version 2015 and the construction of variables for the present paper, and in section six we discuss the changing structure of Indian economy in terms of industry distribution of employment and GDP. The empirical analysis of our decomposition results is documented in section seven. The final section concludes the paper.

2. Economic reforms in India – a brief overview

Understanding structural change and productivity dynamics in India gains importance also in the context several economic policies that the country has pursued over the years since its independence from British colonial rule in 1947. In this section, we provide a brief overview of various economic policies that are expected to have an impact on structural change and productivity growth in India. Economic reforms in the first three decades of post-independent India were characterized by stringent control and licensing, with limited role attributed to the private sector. With an intention to create a solid capital goods base, Indian policymakers have given a strong focus to heavy industries such as iron and steel. Moreover, the policies also featured import substitution, capacity constraints on domestic firms, and hesitation to accept foreign investment and technology. The role of market forces – both in the factor market and product market – were quite limited. The economy during this period, spanning from 1947 to early 1980s, responded poorly to these strict policies, by growing at a poor rate of 3.5 percent per year.

The dismal growth of Indian economy during the first phase has raised several questions about the success of strict policies adopted by the government, leading to a change in the policy attitude in the 1980s (Bhagwati and Desai, 1970; Little et al., 1970). In the 1980s, the government adopted several industrial and trade policy measures aiming to relax licensing and import restrictions. Yet, India still did not completely move onto a market economy, and the limits on foreign investment and high rates of tariff continued to persist. The policies in the 1980s were primarily helping the incumbent firms in the domestic economy without encouraging competition and were, therefore, less considered as a pro-market or pro-liberalization policy (Rodrik and Subramanian, 2005). However, with the flourishing of the domestic business sector, the GDP growth had a turnaround in the 1980s (Rodrik and Subramanian, 2005; Parameswaran and Balakrishnan, 2007). India's GDP growth has improved from 3.5 percent during 1950–1979 to 5.5 percent during 1980–1990, and per capita income growth has increased from a mere 1.4 percent to 3.3 percent. The pro-business reforms, nonetheless, did not help sustain the growth for longer, and India witnessed a severe balance of payment crisis in the early 1990s. In the turbulent years of 1991 and 1992, India's growth has slowed to just 3.2 percent, with per capita income growth slowing to 1.3 percent.

² KLEMS stand for capital (K), labor (L), energy (E), materials (M), and services (S).

³ A recent study by Vu (2017) analyzes the effect of structural change on growth in Asian economies, including India. It uses only labor productivity, and more importantly the analysis is based on 9 industries, i.e. 1/3rd of the industry detail we use in this study.

As a consequence, further reforms which featured a full rehaul of entire industrial and trade policy were introduced in 1991. The structural reforms introduced in the 1990s attributed prominent role for the private sector, opened the Indian market to foreign investors, included significant de-licensing, decontrolling and privatization programs. This was indeed a hard hit on the Indian economy, and the initial response during the transition period was not promising. The GDP growth between 1992 and 2000 was just 6 percent, a mere half percentage point higher than the previous period. However, growth gained momentum since the early 2000s, which is often argued to be a delayed response to the reforms in the 1990s (Parameswaran and Balakrishnan, 2007; Rodrik and Subramanian, 2005).

The changes in the policy perspective of India has essential implications for structural change and productivity growth. The pro-business policies in the 1980s have relaxed several capacity constraints for incumbent businesses, helping them expand in size and create more jobs. However, it is ambiguous whether the resources would have moved to productive sectors of the economy, as the resource allocation was still not entirely driven by market forces. The complete opening of the Indian economy in the 1990s to the private and external sector is expected to channel economic resources to more productive sectors of the economy. Since market forces drive the resource allocation, one would expect it to be moving toward more productive and expanding industries. This makes it important to understand the process of structural change and its impact on productivity growth under different policy regimes.

3. Structural change and economic growth

Structural change has been at the heart of development economics for a long time and has been argued to be an important aspect of economic development. In the famous Lewis model of economic growth, the movement of workers from the agricultural sector to the nonagricultural sector entails the process of development (Lewis, 1954). When workers are released from less productive agricultural activities to the more productive industrial sector, industrialization happens, and overall productivity increases. Lewis model was, however, a two-sector model, with no service sector being present. Subsequent literature (Kuznets, 1966; Chenery and Syrquin, 1975) defined structural change as a shift of resources (inputs and output) from agriculture to manufacturing, and further from manufacturing to services, a process that features post-war economic growth across several advanced economies (Denison, 1967; Maddison, 1987; Jorgenson and Timmer, 2011).⁴

Recent literature on economic growth development reiterates the importance of nature and the speed of structural transformation in enhancing and sustaining economic growth (Lin, 2011; McMillan and Rodrik, 2011). In the modern literature, structural transformation is viewed as the evolution of an economy's structure from low productivity activities to higher productivity modern activities (Naude et al., 2015; Szirmai, 2013; Lin, 2011; McMillan and Rodrik, 2011). This would mean that structural change could happen within the broadly defined manufacturing or service sectors and does not have to be necessarily between agriculture, manufacturing, and services. Workers could move from low productive agriculture to high productive industries or services or from low productive manufac-

turing industries to high productive manufacturing industries or from low productive service industries to high productive ones. Moreover, productivity patterns could differ significantly across industries, as technological change happens mostly at the level of industries (de Vries et al., 2012). Therefore, taking account of industry heterogeneity at a more detailed level is of high importance in understanding structural change. Such structural transformation is indeed desirable as a source of higher productivity growth and per capita income. As workers and resources move from low productive activities to high productive activities, overall productivity and growth accelerate. Such patterns have been also observed in developing countries such as Africa in the early post-independence years (de Vries et al., 2015). In addition, such movement of resources across sectors helps achieve greater diversity in the economic structure of a country, reducing vulnerability to external shocks (Naude et al., 2015). It requires suitable policies that facilitate the movement of resources from low productivity to high productivity uses and therefore understanding structural change and its implications are important for countries like India.

Economic growth in India is often compared with that of neighboring China, despite substantial differences between the two countries in the historical development path and institutional environment (see for instance Eichengreen et al., 2010). A major difference between the observed growth process in India and China is the importance of manufacturing in the aggregate growth in China and that of services in India. While China's development process appears to be more in line with the traditionally hypothesized structural transformation, where resources have moved from primary sector to manufacturing and now increasingly moving into services, India's growth process seems to have substantially bypassed the second stage in the structural transformation. However, the move to a services economy is not unique to India, though its pace is quite high and comes without a solid manufacturing base. For instance, Vu (2017) shows that the service share in employment has increased in the twenty Asian economies considered in his study.

4. Methodology

To understand the role of structural change in driving aggregate productivity growth – both the labor productivity and the TFP growth – we use decomposition methods. This helps us quantify the contributions of various sectors and structural change to aggregate labor productivity and total factor productivity growth. The labor productivity decomposition is based on the decomposition method suggested by Fabricant (1942). Variations of this approach have been widely used in the literature, where the basic idea is to decompose the growth rate of labor productivity into a within-industry productivity growth component and a between effect.⁵ The latter term – the reallocation term – out of this decomposition is used as a measure of structural change (e.g., Bosworth and Collins, 2008; McMillan and Rodrik, 2011; de Vries et al., 2012; OECD, 2013; de Vries et al., 2015). The methodology for total factor productivity decomposition is heavily drawn from Jorgenson et al. (2007), further discussed and applied in Erumban and Das (2016).

Estimates of labor productivity growth, total factor productivity growth, and output growth are analyzed for 27 industries that cover the entire Indian economy for the time period 1981–2011. In addition, in order to get a detailed picture of the pattern of observed productivity growth, we also provide a graphical representation of the observed industry productivity growth, using the

⁴ However, structural change might also involve a change in the scale of activities (e.g., mass production), and a shift from self-employed jobs to more organized production. Structural change doesn't have to be confined to economic, but it could also happen to institutions and policies, and often policy changes can stimulate economic structural changes (Naude et al., 2015; Szirmai, 2013). For instance, Ghate et al. (2013) define structural change as a shift from state dominated economy to market economy, and shows that the impact of policies in accelerating that process was quite substantial in India.

⁵ See de Vries et al. (2015) for a detailed discussion on different variations of this decomposition approach.

approach suggested by Harberger (1998), and employed in Timmer et al. (2010).

4.1. Static and dynamic reallocation effects—decomposition of labor productivity growth

The most common approach to measure aggregate economic growth and its sources is to assume an aggregate production function. Assuming that there exists an aggregate production function (PF),⁶ we can obtain aggregate value added (V_t^{PF}) by summing value added across industries and, aggregate employment (L) as the sum of the number of workers across industries. Then aggregate labor productivity level in year t can be obtained as:

$$v_t^{PF} = \frac{V_t^{PF}}{L_t^*} \quad (1)$$

where $V_t^{PF} = \sum_i V_{i,t}$, with V_i , being the real value added in industry i and $L_t^* = \sum_i L_{i,t}$ with L_i being the number of workers in industry i . v_t^{PF} is the labor productivity, real value added per worker.

Following de Vries et al. (2015), we decompose the annual change in labor productivity levels into within industry productivity change and a reallocation effect using the following decomposition:

$$\Delta v_t^{PF} = \sum_i \Delta v_{i,t} \cdot u_{i,t-1} + \sum_i \Delta u_{i,t} \cdot v_{i,t-1} + \sum_i \Delta u_{i,t} \cdot \Delta v_{i,t} \quad (2)$$

where $u_{i,t}$ is the employment share of industry i in aggregate employment, and the symbol Δ indicates change over the previous year (i.e. $\Delta u_{i,t} = [u_{i,t} - u_{i,t-1}]$). The first term in Eq. (2) is the *within effect* or the effect of productivity change within each industry. It is nothing but the sum of changes in productivity levels in individual industries, each industry productivity change weighted by its respective employment share in the previous period. The second term is a measure of worker reallocation across sectors; change in employment share weighted by levels of productivity – often considered as a *static reallocation (or static between) effect*. A positive sign of the static reallocation effect indicates worker movement to sectors with above-average productivity levels. It is the structural change term, which measures whether workers are moving to industries that have higher levels of productivity. The last term in the equation is an interaction of change in employment share and change in productivity, and thus it measures the combined effect of changes in employment shares and industry productivity—a *dynamic reallocation term* (van Ark, 1996; Timmer, 2000). A positive dynamic reallocation term would suggest workers moving to industries that see positive productivity growth. Dividing both sides of Eq. (2) by aggregate labor productivity in the previous period (v_{t-1}^{PF}), we can obtain the decomposition of labor productivity growth rate.

4.2. Contribution of growth of factor inputs and TFPG to aggregate value added growth

As in the case of labor productivity growth decomposition, using the PF approach, aggregate value added (V_t^{PF}) growth can be decomposed into the contribution from aggregate capital input (K), aggregate labor input (L) and aggregate total factor productivity (A) growth using the standard growth accounting method as:

$$\Delta \ln V_t^{PF} = \bar{s}_{K,t} \Delta \ln K_t + \bar{s}_{L,t} \Delta \ln L_t + \Delta \ln A_t^{PF} \quad (3)$$

where s_K is the share of aggregate capital compensation in aggregate nominal value added, and s_L is the share of aggregate labor compensation in aggregate nominal value added, both averaged over the current and previous periods (over-bars on variables will indicate the average of current and previous periods, throughout in this paper). Aggregate capital and labor compensation are derived from the identity that total nominal value added is the sum of aggregate labor and capital compensation.⁷ $\Delta \ln K$ is the aggregate capital services growth rate and $\Delta \ln L$ is the aggregate labor input growth rate. Aggregate capital and labor inputs are also the sums of industry labor and capital inputs. $\Delta \ln A^{PF}$ is the growth of aggregate total factor productivity, assuming an aggregate production function. Note that decomposition in (3) uses log differences of output and input, whereas the decomposition in (2) uses differences in levels, which are later converted to percent changes. Therefore, they are not strictly comparable in terms of the absolute magnitude.

The above approach is built on restrictive assumptions on the existence of an aggregate production function, which requires identical industry value added functions. Jorgenson et al. (2005) use a less restrictive production possibility frontier approach, which relaxes the restrictions on industry value-added function. In this approach, the measurement of output differs from the aggregate production function, but the measurement of inputs remains the same (see Jorgenson et al., 2007). Defining aggregate value added growth as a translog index of industry value added growth and keeping capital and labor unchanged as in (3), we can express aggregate value added growth as:

$$\Delta \ln V_t = \sum_i \bar{s}_{i,t} \Delta \ln V_{i,t} = \bar{s}_{K,t} \Delta \ln K_t + \bar{s}_{L,t} \Delta \ln L_t + \Delta \ln A_t \quad (4)$$

where V_i is the real value added in industry i . Note that $\Delta \ln V$ in Eq. (4) is different from $\Delta \ln V^{PF}$ in Eq. (3), as Eq. (4) uses a translog aggregation of industry value added growth while Eq. (3) is the growth rate of simply aggregated value added across industries. The difference between the two is the reallocation of value added across industries.

In (3) and (4), aggregate capital and labor inputs are measured as the flow of services from these inputs to the production process. Aggregate capital and aggregate labor inputs consist of different types of capital assets (e.g., machinery, computers, buildings, etc.) and labor types (e.g., low-skilled, high-skilled, old, young, etc.), with differing marginal productivities. Therefore, following Jorgenson (1963), we define aggregate capital services and labor input as translog aggregates of heterogeneous types of capital and labor.

$$\Delta \ln K_t = \sum_k \bar{v}_{k,t} \Delta \ln K_{k,t}; \quad \text{and} \quad \Delta \ln L_t = \sum_l \bar{v}_{l,t} \Delta \ln L_{l,t} \quad (5)$$

where v_k is the share of each type of capital k in aggregate capital compensation, and v_l is the share of each type of labor l in total labor compensation, defined as:

$$v_{k,t} = \frac{P_{K,k,t} K_{k,t}}{\sum_k P_{K,k,t} K_{k,t}} \quad \text{and} \quad v_{l,t} = \frac{P_{L,l,t} L_{l,t}}{\sum_l P_{L,l,t} L_{l,t}} \quad (6)$$

where $P_{K,k}$ is the rental price of capital type k , and $P_{L,l}$ is the price (wage rate) of labor type l . As before $\bar{v}$ in (5) is the two-period averages of these shares. In our analysis, we distinguish between five types of labor, and three types of capital assets (see the section

⁷ There is a recent literature that invites attention to the possible endogeneity of factor shares, as labor and capital income are not fully insulated from the process of growth (see Piketty, 2015; Grossman et al., 2017). While acknowledging this issue, we believe that it is less of a problem for the standard growth accounting approach. This approach does not try to establish a causal relationship, rather document the proximate sources of growth by decomposing an assumed identity of input growth and output growth (see Maddison, 1987). We are thankful to one of the anonymous referees for bringing up this issue.

⁶ We discuss this assumption further in the next section.

on data). They are respectively employees with education (1) up to primary; (2) primary school; (3) middle school; (4) secondary and higher secondary school; and (5) above higher secondary school and capital assets are transport equipment; machinery; and construction.⁸ The above decomposition (Eq. (4)) is used to obtain total factor productivity growth for the aggregate economy. Aggregate economy productivity growth can be attained either by improved productivity within industries or by moving labor and capital from low productivity to high productivity industries.

4.3. Contribution of industry TFPG and factor reallocation to aggregate TFPG

In order to trace the industry origins of aggregate total factor productivity, and to quantify the relative importance of various industries and factor reallocation (or structural change) in driving aggregate TFP growth, we use the direct aggregation method suggested by Jorgenson et al. (2007). This approach relaxes many assumptions on input and output measurement that exist in the PF approach. In this approach, the aggregate production function is a value added function and the aggregate value added growth is measured as a translog index of industry value added, with weights being the industry share in aggregate nominal value added (as in Eq. (4)). The production function at the industry level, however, is a gross output (Y) function, and therefore, industry output growth can be decomposed into contributions from capital (K), labor (L) and intermediate input (X) as:

$$\Delta \ln Y_{i,t} = \bar{s}_{K,i,t} \Delta \ln K_{i,t} + \bar{s}_{L,i,t} \Delta \ln L_{i,t} + \bar{s}_{X,i,t} \Delta \ln X_{i,t} + \Delta \ln A_{i,t} \quad (7)$$

where s_K , s_L , and s_X are respectively the shares of capital, labor and intermediate input in total nominal output in industry i . Since nominal value of gross output is the sum of the nominal value of industry value added and nominal value of total intermediate inputs, the industry output growth can be obtained as a weighted sum of industry value added growth and industry intermediate inputs growth with the weights being respectively the nominal share of value added in output and nominal share of intermediate inputs in output.⁹ Assuming that aggregate value added is a translog sum of industry value added, we can decompose the aggregate value added growth as (see Jorgenson et al., 2007):

$$\begin{aligned} \Delta \ln V_t = \sum_i \bar{s}_{i,t} \Delta \ln V_{i,t} = \sum_i \bar{s}_{i,t} \frac{\bar{s}_{K,i,t}}{\bar{s}_{V,i,t}} \Delta \ln K_{i,t} + \sum_i \bar{s}_{i,t} \frac{\bar{s}_{L,i,t}}{\bar{s}_{V,i,t}} \Delta \ln L_{i,t} \\ + \sum_i \sum_j \bar{s}_{i,t} \frac{1}{\bar{s}_{V,i,t}} \Delta \ln A_{i,t} \end{aligned} \quad (8)$$

In Eq. (8), aggregate value added growth is the sum of the weighted contribution of industry capital input, industry labor input, and industry TFPG. The weights on capital and labor consist of $\bar{s}_i$, the share of industry value added in aggregate value added, $\bar{s}_{K,i}$ and $\bar{s}_{L,i}$, the share of industry capital and labor compensation in industry gross output and $\bar{s}_{V,i}$, the share of industry value added in

industry gross output.¹⁰ The first and last components of the input weights ($\bar{s}_i$ and $\bar{s}_{V,i}$) are also reflected in the TFPG weights.

In Eq. (4) we have the production possibility frontier – with aggregate value added growth being the weighted sum of industry value added growth, and capital and labor inputs being the simple sum across industries, whereas in Eq. (8), input growth rates are also weighted growth rates of industry capital and labor. Therefore, the difference between the two is factor reallocation effects. Subtracting (4), i.e. with the simple summation of factor inputs, from (8), i.e. the weighted aggregates of factor inputs, and rearranging, we obtain:

$$\begin{aligned} \Delta \ln A_t = \sum_i \frac{\bar{s}_{i,t}}{\bar{s}_{V,i,t}} \Delta \ln A_{i,t} + \left(\sum_i \bar{s}_{i,t} \frac{\bar{s}_{K,i,t}}{\bar{s}_{V,i,t}} \Delta \ln K_{i,t} - \bar{s}_K \Delta \ln K_t \right) \\ + \left(\sum_i \bar{s}_{i,t} \frac{\bar{s}_{L,i,t}}{\bar{s}_{V,i,t}} \Delta \ln L_{i,t} - \bar{s}_L \Delta \ln L_t \right) \\ = \sum_i \frac{\bar{s}_{i,t}}{\bar{s}_{V,i,t}} \Delta \ln A_{i,t} + \text{REAL}_{K,t} + \text{REAL}_{L,t} \end{aligned} \quad (9)$$

Eq. (9) suggests that aggregate TFPG can be decomposed into a weighted average of industry TFPG and the capital and labor reallocation across industries. Note that the weight attributed to industry TFPG in this setting is equivalent to the well-known Domar weight (Domar, 1961). The difference between Domar-weighted TFPG and the aggregate TFPG is the sum of labor and capital reallocation effects, which reflects the movement of these resources across industries.

5. Moving from aggregate to disaggregate industry analysis—the India KLEMS database

While there is a significant number of studies analyzing sources of growth and dynamics of productivity in India's organized manufacturing sector, which constitutes only less than 11 percent of total GDP (National Accounts Statistics, 2014), analysis beyond this sector is constrained by lack of consistent data on investment, employment and value added. The India KLEMS research project, with financial assistance from the Reserve Bank of India,¹¹ is a major initiative to fill this data gap. The India KLEMS version 2015 provides data on value added, gross output, intermediate inputs (all in both current and constant prices¹²), employment by education levels, labor quality, wage share in GDP including estimates for self-employed workers, capital investment and capital services by asset type along with indicators of labor productivity growth and total factor productivity growth. All these data are available for 27 detailed industries comprising the Indian economy over the 1980–2011 period.

The main source of data used in the India KLEMS is the National Accounts Statistics (NAS), published annually by the Central Statistical Organization. This data is supplemented by Input–Output tables, Annual Survey of Industries (ASI) and various rounds of National Sample Survey Office (NSSO) surveys on employment & unemployment and unorganized manufacturing sectors. This section provides a description of the data, their sources, construction of variables, and the industrial classifications used in this study. We require industry wise data on nominal, and real value added, invest-

⁸ See Erumban and Das (2016) for a growth accounting analysis breaking machinery capital further into ICT and non-ICT machinery.

⁹ This implies that the real value-added of industry i can be derived as: $\ln V_{i,t} = \Delta \ln Y_{i,t} \frac{1}{\bar{s}_{V,i,t}} - \Delta \ln X_{i,t} \frac{\bar{s}_{X,i,t}}{\bar{s}_{V,i,t}}$, and when combined with (7), it can be rewritten as: $\Delta \ln V_{i,t} = \frac{\bar{s}_{K,i,t}}{\bar{s}_{V,i,t}} \Delta \ln K_{i,t} + \frac{\bar{s}_{L,i,t}}{\bar{s}_{V,i,t}} \Delta \ln L_{i,t} + \frac{1}{\bar{s}_{V,i,t}} \Delta \ln A_{i,t}$. Combining this with (4) – the production possibility frontier –, we obtain $\Delta \ln V_t = \sum_i \bar{s}_{i,t} \Delta \ln V_{i,t} = \sum_i \bar{s}_{i,t} \frac{\bar{s}_{K,i,t}}{\bar{s}_{V,i,t}} \Delta \ln K_{i,t} + \sum_i \bar{s}_{i,t} \frac{\bar{s}_{L,i,t}}{\bar{s}_{V,i,t}} \Delta \ln L_{i,t} + \sum_i \bar{s}_{i,t} \frac{1}{\bar{s}_{V,i,t}} \Delta \ln A_{i,t}$ (i.e. Eq. (8)).

¹⁰ These input weights are industry share of capital and labor compensation in aggregate value added, and the TFPG weight is the industry output share in aggregate value added.

¹¹ Reserve Bank of India is the Central Bank of the Indian economy.

¹² India KLEMS use a double deflation approach to construct constant price value added series (see Balakrishnan and Pushpangadan, 1994 for a first use of double deflation in Indian manufacturing).

ment by asset type, number of employees, and labor compensation by type of workers and nominal and real values of intermediate inputs.

Gross output, value added and intermediate inputs: India KLEMS provides estimates of gross output and value added by industry at both current and constant prices, which are consistent with NAS 2004–2005 base series. The real value added data in NAS are single deflated, except for agriculture. However, in our growth accounting analysis, we use double deflated value added series, which are derived using gross output, and intermediate input series obtained from the India KLEMS database. Nominal values of intermediate input are basically the difference between nominal value added and nominal output. The commodity inputs going into the production process of output industries are aggregated into energy (E), material (M) and service (S) inputs. To generate a price deflator for intermediate inputs, we use wholesale price indices published by the Office of the Economic Advisor, Ministry of Commerce and Industry. We use weighted deflators for materials, energy, and service inputs for each of the industries (*ala* Balakrishnan and Pushpangadan, 1994).

Employment and labor composition: Employment data in India KLEMS is based on usual principal and subsidiary status (UPSS) concept, and are obtained from the quinquennial rounds of Employment and Unemployment Surveys (EUS) published by NSSO. The aggregate labor input, used in this study is obtained as the weighted sum of employment growth rates of workers of various educational levels using Eq. (5). Employment and wage data by educational categories—up to primary school, primary school, middle school, secondary & higher secondary school, and above higher secondary school—are also available from EUS. Since EUS does not provide self-employed wage compensation, India KLEMS uses econometrically estimated compensation rates, using demographic and socio-economic characteristics of workers.

Capital services: Capital services for the aggregate economy and for industries in India KLEMS are arrived at using Eq. (5). In order to do this, it was essential to obtain investment data by asset type. Industry level investment in three different asset types—construction, transport equipment, and machinery—are gathered from the NAS for broad sectors of the economy, the ASI for the formal manufacturing industries, and the NSSO rounds for unorganized manufacturing industries. These industry-level data are used to construct capital stock using a perpetual inventory method, i.e.

$$K_{k,t} = K_{k,t-1} (1 - \delta_k) + I_{k,t-1} \quad (10)$$

where K_k is the capital stock in asset k , δ_k and I_k are respectively the depreciation rate for and the real investment in asset k , and the subscript t stands for year. For the practical implementation of the above equation, we require estimates of initial benchmark stock. In the literature, there has been various approaches followed, and the most common approach is to use a steady state capital output ratio (Harberger, 1978). The choice of initial stock will have implications for both the levels and growth rates of capital stock for subsequent years (see Erumban, 2008 for a discussion on this issue). However, since the India KLEMS dataset estimates capital stock for years as early as 1950, the impact of the choice of initial capital is substantially limited, as much of the capital will be depreciated by 1980, the first year of our analysis. For the initial capital stock in our data, we rely on the National Accounts Statistics, which provides estimates of net capital stock since 1950 for all the broad sectors by asset type. We take these estimates as our benchmark stock for all non-manufacturing sectors, and for manufacturing sectors the

same is taken for the year 1964.¹³ However, since these net capital stock estimates are available only for the broad sectors, we use industry distribution of gross fixed capital formation in the initial year in order to create net fixed capital stock estimates by asset type for all the 26 sectors. The assumed depreciation rates are 8 percent for machinery, 2.5 percent for construction and 10 percent for transport equipment. The rental price of capital $P_{K,k}$ in (6) is measured assuming an external rate of return (r), as

$$P_{K,k,t} = P_{I,k,t-1}r + P_{I,k,t}\delta_k \quad (11)$$

where the external rate of return, r , is represented by a long-run average of real lending rate and government security rate, obtained from Reserve Bank of India.¹⁴ $P_{I,k}$ in Eq. (11) is the investment price deflator for asset k .

6. Changing structure of Indian economy

As mentioned before, this study is conducted considering the significant industry heterogeneity within the Indian economy and its consequences for aggregate economic growth using data on 27 industrial sectors of the economy. However, for expositional clarity, we aggregate the 27 industry groups into different subsectors using appropriate aggregation procedures (see Table 1 for the industry groups). In our industry discussions, we will mostly follow these groupings. This aggregation, however, does not imply that we compromise on the sectoral heterogeneity. All the basic calculations are done using 27 sector data, and the final results are aggregated for ease of exposition.

Since agriculture is a major employment providing sector in the Indian economy, which is often argued to be an important and key sector for the future sustainability of India's economic growth (Balakrishnan, 2010), we keep it as a distinct sector. Mining, utilities, and construction are clubbed into one single sector, which we call as other goods production. Manufacturing is divided into two broad groups, consumer and intermediate goods manufacturing – with a further split of consumer goods and intermediate goods¹⁵ – and investment goods manufacturing, where the latter includes machinery and transport equipment manufacturing. The service sector is divided into five distinct sectors; trade and distributive services, business services, financial services, all other market services, and nonmarket services.

In this section, we document the changing industry shares of value added and employment in the Indian economy since 1980. Industry shares of value added and employment in 27 industries of the aggregate economy are provided in Tables 2 and 3, respectively. As the theory suggests, the share of agriculture has declined steadily over the past three decades. In terms of value added the share of agriculture declined from 36 percent in 1980 to 17.9 percent in 2011 and in terms of employment it declined from 69.8 percent to 48.1 percent. Even though during the process of development, employment and output share of primary sector declined, it still employs nearly half of Indian workers.

The decline in the share of agriculture, however, is not mirrored in an increase in the manufacturing share. The size of manufacturing value added declined from 16.4 percent to 14.7 percent and

¹³ This choice is driven by the fact that the first year of availability of investment data for detailed manufacturing sectors from Annual Survey of Industries is 1964–1965.

¹⁴ The real rates are obtained by subtracting consumer price inflation rate from nominal interest rates and are then averaged over a 15 year time period. On average these rates have increased from 3.9 percent during 1981–1993 to 4.4 percent during 1994–2002 but dropped to 2.1 percent during the 2003–2011 period.

¹⁵ We are thankful to one of the anonymous referees for providing some guidelines on how to group the available 2-digit industries into consumer and intermediate groups.

Table 1
Industry groups and corresponding ISIC codes.

SI Nr.	Industry group (sector)	ISIC	Industries in the group
1	Agriculture	AtB	Agriculture, hunting & fishing
	Goods production		
	Manufacturing		
	Consumer & intermediate goods		
2	Consumer goods Mfg.	15 to 22 + 36 to 37	Food, beverages; textiles; wood; paper; other manufacturing
3	Intermediate goods Mfg	23 to 28	Petroleum; chemicals; rubber & plastics; non-metallic minerals; basic metals & metal products
4	Investment goods Mfg.	29 to 35	Machinery, nec.; electrical & optical equipment; transport equipment
5	Other goods production	C + E + F	Mining & quarrying; electricity, gas & water; construction
	Services		
	Market services		
6	Trade and distribution	G + 60 to 63	Wholesale & retail trade; transport & storage
7	Finance services	J	Financial services
8	Business Services	71 to 74	Renting of machinery & business services
9	Other market services	H + 64 + K + O + P	Hotels & restaurants; post & telecommunication & all other market services
10	Non-market services	L + M + N	Public administration & defense; compulsory social security; education; health & social work

Note: A detailed industry classification consisting of all 27 industries considered in the analysis is given in Appendix Table A1.

Table 2
Industry shares in aggregate nominal value added, 1980, 1990, 2000, and 2011.

Industry/Industry group	1980	1990	2000	2011
Agriculture	36.0	29.4	23.0	17.9
Goods production	24.4	26.5	26.0	27.2
Manufacturing	16.4	16.2	15.3	14.7
Consumer & intermediate mfg.	13.8	12.9	12.8	11.8
Consumer goods manufacturing	9.1	7.0	6.6	4.8
Food products, beverages & tobacco	1.7	1.8	1.7	1.6
Textiles, leather & footwear	4.0	3.1	2.8	1.7
Wood & products of wood	1.6	0.7	0.8	0.3
Pulp, paper, printing & publishing	0.5	0.6	0.5	0.4
Mfg., nec. recycling	1.3	0.8	0.8	0.8
Intermediate goods manufacturing	4.7	5.9	6.2	7.0
Coke, ref. petroleum & nuclear fuel	0.3	0.7	0.7	0.7
Chemicals & chemical products	1.1	1.3	1.8	2.0
Rubber & plastic products	0.3	0.5	0.6	0.5
Other non-metallic mineral products	0.7	1.0	1.0	0.9
Basic metals & metal products	2.2	2.5	2.1	2.9
Investment goods mfg.	2.7	3.3	2.6	2.9
Machinery, nec.	0.9	1.1	0.8	0.9
Electrical & optical equipment	0.7	1.0	0.8	0.8
Transport equipment	1.0	1.1	1.0	1.2
Other goods production	8.0	10.3	10.7	12.5
Mining & quarrying	1.7	2.6	2.3	2.7
Electricity, gas & water supply	1.6	2.1	2.4	1.6
Construction	4.7	5.5	6.0	8.2
Services	39.5	44.1	51.0	54.9
Market services	31.1	33.9	38.7	43.7
Trade & distribution	14.5	16.9	19.3	22.1
Trade	10.7	11.7	13.2	15.9
Transport & storage	3.8	5.2	6.1	6.3
Financial services	3.0	3.9	5.4	5.7
Renting of mach. & business services	0.5	0.9	2.4	5.0
Other market services	13.1	12.2	11.6	10.8
Hotels & restaurants	0.8	1.0	1.3	1.5
Post & telecommunication	0.6	0.9	1.5	1.1
Other services	11.8	10.3	8.8	8.3
Non-market services	8.4	10.2	12.3	11.2
Public administration & defense etc.	5.0	5.9	6.5	5.9
Education	2.5	3.1	4.1	3.9
Health & social work	0.9	1.2	1.6	1.4
Total	100	100	100	100

Source: India KLEMS dataset, version 2015.

the share of employment increased only marginally from 10.4 percent to 11.4 percent in the course of three decades. Except for a slight increase in value added share during the mid-1990s, the stagnation in manufacturing is visible throughout. A large part of the decline in agricultural employment is reflected in an increase in the construction jobs, which has increased from 2 percent in 1980 to 10 percent in 2011 and in trade and other market services that increased from 12 to 21 percent. However, the output share

Table 3
Industry shares in aggregate employment, 1980, 1990, 2000, and 2011.

Industry/Industry group	1980	1990	2000	2011
Agriculture, hunting, forestry & fishing	69.8	64.7	59.8	48.1
Manufacturing	10.4	10.7	11.1	11.4
Consumer & intermediate mfg.	9.9	10.1	10.3	10.3
Consumer goods manufacturing	7.8	7.8	7.8	7.6
Food products, beverages & tobacco	2.2	2.3	2.5	2.4
Textiles, leather & footwear	3.7	3.4	3.0	2.9
Wood & products of wood	0.9	0.9	1.1	0.8
Pulp, paper, printing & publishing	0.3	0.3	0.3	0.3
Mfg., nec. recycling	0.7	0.9	0.8	1.3
Intermediate goods manufacturing	2.1	2.3	2.5	2.7
Coke, ref. petroleum & nuclear fuel	0.0	0.0	0.0	0.0
Chemicals & chemical products	0.4	0.4	0.5	0.4
Rubber & plastic products	0.1	0.1	0.2	0.2
Other non-metallic mineral products	0.9	0.9	0.9	1.0
Basic metals & metal products	0.7	0.8	0.9	0.9
Investment goods mfg.	0.5	0.7	0.8	1.1
Machinery, nec.	0.2	0.2	0.3	0.4
Electrical & optical equipment	0.2	0.2	0.3	0.4
Transport equipment	0.2	0.2	0.2	0.3
Other goods production	2.8	4.5	5.4	11.3
Mining & quarrying	0.5	0.7	0.6	0.6
Electricity, gas & water supply	0.3	0.4	0.3	0.3
Construction	2.0	3.4	4.6	10.4
Services	16.9	20.0	23.7	29.2
Market services	12.0	15.0	18.3	23.4
Trade & distribution	7.7	9.9	12.5	13.8
Trade	5.8	7.4	9.2	9.7
Transport & storage	1.9	2.6	3.4	4.1
Financial services	0.3	0.5	0.6	0.9
Renting of mach. & business services	0.2	0.3	0.7	1.6
Other market services	3.8	4.3	4.5	7.1
Hotels & restaurants	0.8	0.9	1.2	1.7
Post & telecommunication	0.1	0.2	0.3	0.4
Other services	2.9	3.1	3.0	5.1
Non-market services	4.9	5.0	5.4	5.8
Public administration & defense etc.	2.8	2.8	2.5	1.8
Education	1.6	1.6	2.2	3.0
Health & social work	0.6	0.6	0.7	1.0
Total	100	100	100	100

Source: India KLEMS dataset, version 2015.

of construction increased only from 5 percent to 8 percent and in trade and other market services from 28 percent to 33 percent, thus suggesting a decline in productivity levels.

Within manufacturing sectors, sectors that did not witness a decline in value added share are mostly investment goods manufacturing and some consumer and intermediate goods manufacturing (such as petroleum refining, chemicals, rubber & plastics, nonmetallic minerals, basic metals & metal products). Textiles group has

witnessed the highest decline in value added share within manufacturing, from 4 percent in 1980 to 1.7 percent in 2011.

In terms of employment, textiles constituted more than 1/3rd of total employment within the manufacturing in 1980 (i.e. 3.7 out of 10.4 percent share of manufacturing in aggregate employment), which declined to a quarter by 2011 – the largest decline in employment share within the manufacturing sector. The sectors that gained in terms of employment share include rubber & plastic, basic metals & metal products, machinery, electrical & optical equipment, and transport equipment. Thus, within manufacturing, while traditional sectors lost their importance, some modern segments, including engineering and chemicals did see a moderate improvement in absorbing workers.

The emergence of the service sector as the largest contributor to aggregate GDP is an important feature of the structural transformation of the Indian economy. The service sector has been the single largest contributor to value added in the post-1980 period. The share of the sector in overall GDP increased from 39.5 percent in 1980 to 54.5 percent in 2011. Within which market services¹⁶ constituted 31.1 percent of overall GDP in 1980, which increased more rapidly to 43.7 percent, with greater acceleration since the 1990s. However, in terms of employment, the service sector is still less than one-third of the economy, with the market services being at slightly below a quarter of overall employment (Table 3). The market services share in employment increased from 12 percent to 23.4 percent, and that of total services (including nonmarket services) increased from 16.9 percent to 29.2 percent. Within the market services, business services increased its output share from half a percent to 5 percent, whereas its employment share increased from a trivial 0.2 percent to 1.6 percent. Financial services doubled its output share from 3 percent to 6 percent; post & telecom increased from 0.6 percent to 1.1 percent; trade sector from 11 percent to 16 percent; and transport and storage from 4 percent to 6 percent. However, the employment shares of these sectors did not increase in tandem with their output shares.

6.1. The stagnant role of manufacturing in India's structural change

The slow pace of industrialization is quite visible in India's structural transformation process, despite a moderate increase in diversity and sophistication within manufacturing, causing some positive dynamics within the sector. As we observed, it is not the manufacturing sector, but the construction sector that has compensated most of the decline in agricultural employment. There are at least two reasons why construction sector increasingly absorbs workers – one demand side, and the other supply-side. The first is that with a rising middle class, and growing housing needs in India, the demand for construction and real estate workers continue to rise. However, this rising demand does not appear to have translated into faster wage growth in the construction sector, relative to other sectors of the economy.

India KLEMS provides data on labor compensation by industries, inclusive of formal and informal sectors, and imputed self-employed compensation. In Table 4, we provide the relative wages of selected broad sectors of the economy (wages per employee in each sector relative to the aggregate economy wage rate). The average wage rate in the construction sector was more than 6 times higher than that in the agriculture sector in 1980, which has declined by half – i.e. only 3 times higher – by 2011, as the wages in the construction sector grew much slower than the agricultural sector. However, the wage rates in the construction

Table 4

Relative wages in Indian industries (total economy = 1), 1980, 1990, 2000, and 2011.

Industry group/sector	1980	1990	2000	2011
Total economy	1.00	1.00	1.00	1.00
Agriculture & allied activities	0.53	0.47	0.41	0.41
Goods production	1.60	1.42	1.34	1.07
Manufacturing	1.39	1.21	1.09	0.87
Consumer & intermediate goods	1.22	1.04	0.97	0.79
Consumer goods	0.33	0.22	0.15	0.10
Intermediate goods	2.43	1.40	1.01	0.71
Investment goods	4.52	3.75	2.68	1.62
Mining	3.91	2.74	3.71	2.94
Utilities	4.86	5.02	6.22	4.76
Construction	3.41	2.47	2.03	1.23
Services	2.26	2.21	2.11	1.86
Market Services	1.93	1.74	1.68	1.66
Trade & distribution	1.68	1.52	1.39	1.58
Financial services	10.02	6.84	7.63	3.83
Business services	1.39	1.95	2.39	1.55
Other services	2.62	2.43	2.05	1.25
Non-market services	2.41	2.93	3.22	3.03

Notes: Relative wages are obtained as total nominal labor compensation per employee in any given industry divided by total labor compensation per employee in the total economy. The wages used in this calculation refers to both formal and informal sectors of the economy, including imputed wages for self-employed workers. For details about the imputation of self-employed wages, please see India KLEMS data manual (2015).

Source: Authors' calculation using India KLEMS database, version 2015.

sector still remain relatively high, at more than 20 percent higher than the aggregate economy. The second reason is related to more of a supply-side factor. The jobs in this sector, which are mostly unorganized and seasonal, require less skill, and with a low skill intensity of a majority of the Indian labor force, there is a relatively larger availability of workers in this sector. Obviously, it was attractive for unskilled workers to move away from the farm sector to the construction sector.

Given that the manufacturing sector is a more productive sector than the construction sector, an obvious question is why Indian workers did not move to the more productive manufacturing sector. Interestingly, even after a relatively faster wage growth in the manufacturing sector, its relative wage rate is still nearly 30 percent lower than the construction sector. While the construction sector wage rates are 23 percent higher than the aggregate economy wages, the manufacturing sector is only 87 percent of total economy wages (Table 4). This low wage level in the manufacturing sector is almost entirely driven by consumer and intermediate goods manufacturing sectors, which had the second lowest relative wages in 2011 after agriculture. At the same time, this sector constitutes more than 90 percent of all manufacturing jobs and produces 80 percent of all manufacturing output. The relatively low wages in this sector makes the manufacturing less attractive to semi and low skilled workers. The investment goods manufacturing, which includes electrical machinery, computer production, transport equipment, etc., has a relatively higher wage rate. But the job opportunities in that sector are likely more skill intensive, and also with relatively high capital intensity, the job creation might be limited. In general India's manufacturing sector is becoming increasingly capital intensive, with limited job creation, and the income distribution is increasingly favoring capital. The lower relative wages in the labor-intensive manufacturing sectors, compared to the construction sector, might be making it more appealing to workers move to construction jobs. Moreover, the changing manufacturing technology that allows rising capital intensity in more advanced manufacturing sectors seems to be creating fewer job opportunities in the manufacturing sector. Two other factors that may also play essential roles in low job creation in manufacturing are related to labor market dynamics. The rigidities in the labor market, which makes it hard for firms to hire and fire workers

¹⁶ Market services include trade, transport services, financial services, business services, post & telecom, and hotels & restaurants services.

Fig. 1. Decomposition of labor productivity growth, 1981–2011 average annual—3 subperiods.

Source: Authors' calculations using India KLEMS dataset, version 2015.

provides little incentive to firms to expand in size,¹⁷ and the mismatch between available skill and required skill of workers makes it difficult to obtain workers with the apt skills.

7. Industry origins of aggregate growth, and the role of structural change – empirical results

This section discusses the decomposition results for labor productivity growth rates for Indian economy during 1980–2011. The Indian economy has witnessed significant policy changes since the mid-1980s, ranging from a partial liberalization (often termed as pro-business policies)¹⁸ in the mid-1980s to the initiation of more aggressive liberalization and globalization policies since the early 1990s. Following the policy breaks, scholars typically analyze India's growth process before and after reforms (e.g. [Rodrik and Subramanian, 2005](#)), and we follow that tradition. The period of analysis in the paper roughly covers the three phases of economic reforms in India, say the pre (or partial) reform period, the transition period and the full reform period. For the convenience of analysis, we subdivide the entire period 1980–2011 into 3 subperiods that roughly tally with the pre- and post-reform era—1981–1993, 1994–2002 and 2003–2011. The first period falls more into the pro-business policy regime. In 1991, amid severe balance of payment crisis, India introduced significant reforms, yet we begin our second period in 1994, because, the years 1991–1993 were transition years with significant turbulence in the economy. This post-reform period is divided further into two sub-periods, 1994–2002 and 2003–2011. Barring the years of global financial crisis, the years after 2003 have witnessed relatively faster growth in the Indian economy, which warrants this second break in our periodization. With a booming global trade, both manufacturing and services sectors did recover around this time, which has been often seen as a breakpoint in India's post-reform growth ([Nagaraj, 2008](#)). This timing also coincides with the joining of China in the WTO and the acceleration of manufacturing production fragmentation globally. These dynamics helped India to improve its exposure to global trade. In the domestic economy, several incremental policies were also introduced, including the abolition of reservation of

several sectors for the small-scale sector, further reduction in tariff rates, and an increase in the investment ceiling for several items ([Ahluwalia, 2002](#)). These measures were aimed to modernize the Indian industry, accelerate investment activity and also to improve its exposure to the international market.

7.1. Industry decomposition of aggregate labor productivity growth

The growth rate of aggregate labor productivity, measured as output per worker, over 1981–2011 period, broken down to within industry productivity growth, and static and dynamic reallocation is depicted in [Fig. 1](#). Labor productivity growth increased from 2.8 percent during 1981–1993 to 3.8 percent during 1994–2002. During 2003–2011 labor productivity did further increase by more than 3.5 percentage point, reaching at 7.5 percent. The market-friendly policies in the 1990s and the subsequent period seem to have supported better productivity growth.

The figure also provides the magnitude of the reallocation effects—both static and dynamic in relation to the within-industry productivity growth. If workers are moving into industries with above average productivity levels, the static reallocation term will be positive, and if workers are moving to industries that witness faster productivity growth, the dynamic reallocation term will be positive. In general, 50 percent to 80 percent of aggregate productivity growth is explained by within industry productivity growth, and the rest can be attributed to structural change. As was the case with aggregate productivity growth, within industry productivity growth was also the highest during the 2003–2011 period. The impact of overall labor reallocation has been positive throughout, which is also in accordance with the recent findings in [McMillan and Rodrik \(2011\)](#) and [de Vries et al. \(2012\)](#). On average the structural change effect has been larger during the 2003–2011 period, followed by the first half of 1981–1993, whereas it has been lowering during the mid-1990s through early 2000s.¹⁹ In relative terms, its role has declined from nearly half in the 1980s to 1/5th in the two subsequent periods.

When looked at static and dynamic effects separately, we observe that on average there have been almost no dynamic reallocation effects throughout the period. It has been contributing less and mostly negative in most of the years, suggesting that employ-

¹⁷ [Moreno-Monroy et al. \(2014\)](#) shows that several formal manufacturing sectors outsource labor-intensive activities to informal sectors with relatively higher capital intensity. This helps the formal sector firms to evade many labor market rigidities, but at the same time limits the job creation in the formal, more productive economy.

¹⁸ See [Rodrik and Subramanian \(2005\)](#) and [Kohli \(2006\)](#). Also see section 2 of this paper.

¹⁹ [Vu \(2017\)](#) also suggests an increasing rate of structural change in India over years. However, his results, which are based on a smaller number of industries, suggest a high reallocation effect in the mid-1990s compared to the 1980s.

Table 5

Sectoral contributions to aggregate labor productivity growth, 1981–2011: 3 subperiods.

Industry group/sector		1981–1993	1994–2002	2003–2011	1981–2011
Aggregate labor productivity growth	2.8	3.8	7.5	4.5	
Static reallocation effect		1.5	0.8	1.6	1.3
Dynamic reallocation effect		–0.1	–0.01	0.02	–0.03
Within industry productivity growth	1.5	3.1	6	3.3	
Contribution from:					
Agriculture		0.5	0.4	0.8	0.6
Goods Production		0.2	0.6	2.4	1.0
Manufacturing		0.9	0.5	2.3	1.2
Consumer & intermediate goods	0.8	0.4	1.8	1.0	
Consumer goods		0.4	0.1	0.6	0.4
Intermediate goods		0.4	0.2	1.2	0.6
Investment goods		0.0	0.1	0.5	0.2
Other goods		–0.7	0.0	0.1	–0.2
Services		0.8	2.1	2.9	1.8
Market Services		0.4	1.5	2.4	1.3
Trade & distribution		0.0	0.7	1.2	0.6
Financial services		0.1	0.3	0.4	0.3
Business services		0.0	0.1	0.1	0.1
Other services		0.3	0.4	0.6	0.4
non-Market Services		0.4	0.6	0.5	0.5

Notes: All growth rates are average of annual log differences (numbers calculated in percent changes are converted to log changes to keep consistency with other tables). Aggregates may not add up, due to rounding.

Source: Authors' calculations using India KLEMS database, version 2015.

ment was hardly generated in sectors which were witnessing faster productivity growth. The magnitude of the static reallocation effect has been low during the 1994–2002 period as compared to the first and last periods of the analysis. Apparently, the employment share in industries with higher productivity level has increased in the 1980s, while it declined drastically during the second half of the 1990s, i.e., 1994–2002, and has increased subsequently since 2003. In the most recent period, 2003–2011, the dynamic effect is also positive, though very tiny. In general, the effect of structural change, in terms of workers moving to sectors of high productivity level, on labor productivity growth has been positive, though the magnitude of the effect varies substantially over the subperiods.

Earlier, we have observed that workers were hardly moving from agriculture to manufacturing, though there has been some dynamics within the manufacturing, and the sectors that were expanding in terms of jobs included construction, trade and distribution, business services and other market services. Productivity level in the construction sector was much higher than in agriculture in the 1980s, which gradually declined, and the decline has accelerated since the mid-1990s but is still higher than agricultural productivity level (Appendix Fig. A1). The large-scale movement of workers to this sector, where productivity growth is extremely slow—reflecting in negative dynamic reallocation term—still features a positive static reallocation term, as productivity level is higher than agriculture. Marginal increases in manufacturing employment, where productivity levels are higher than agriculture, in particular in investment goods, also contribute to this positive structural change. Productivity levels are also higher in financial services, business services, communication, and trade, with all of them except trade seeing no decline over years.

In Table 5, we provide the sectoral contributions to within industry labor productivity growth rate. Labor productivity growth during the partial reform period 1981–1993 was almost entirely driven by the manufacturing and services sectors. Almost all of manufacturing growth occurred in the consumer and intermediate goods group – with both consumer goods and intermediate goods being equal contributors – while productivity growth contribution from the investment goods sector was nearly zero. Of the 0.8 percentage point contribution from the services sector to 1.5 aggregate labor productivity growth, market services, and non-market services each contributed half.

The picture has changed during the 1994–2002 period when labor productivity growth increased by almost a full percentage point to 3.8 percent, of which 3.1 percent is a within-sector productivity gain. The relative importance of both manufacturing and agriculture sectors declined during this period. However, within manufacturing, investment goods subsector improved its productivity contribution marginally, while that of consumer and intermediate group has dropped, with the magnitude of loss being less in the intermediate goods sector. Thus, even while the overall economy witnessed an increase in labor productivity growth, it was indeed not due to improvement in manufacturing and agriculture, but alone from the service sector. The service sector contribution improved from 0.8 percentage point in the previous period to 2.1 percentage point—with almost 70 percent of it coming from market services.

Indian economy achieved impressive labor productivity growth during the last period of our analysis, 2003–2011, with improvement from 3.8 percent to 7.5 percent, nearly double the rate at which it grew during the previous period. Improving productivity within sectors constituted 80 percent of this growth (i.e. 6 percent), and this improvement in aggregate productivity growth was reflected in almost all segments of the economy, except in the non-market services. In absolute terms, agricultural sector doubled its contribution from 0.4 percentage point to 0.8 points, whereas manufacturing improved significantly from 0.6 points to 2.4 percentage points. Both consumer and intermediate sectors and investment goods manufacturing did see improvement in productivity during this period, with the highest improvement being in the intermediate goods-producing sectors. Similar to the manufacturing sector, market services also contributed a 2.4 percentage point to the aggregate labor productivity growth, thus both manufacturing and market services each constituted almost 40 percent of aggregate within industry labor productivity growth of 6 percent. Moreover, all market service sectors, except the business services improved their productivity contribution in the 2000s.

Even though in absolute terms productivity contribution of the services sector increased to 2.9 percentage point, an increase of 0.8 percentage point from the previous period, the relative importance of services sector (market and nonmarket services combined) in overall productivity growth has declined in the later part of the 2000s. Its relative contribution declined from 68 percent in the

Fig. 2. Domar-weighted TFPG and capital and labor reallocation across industries.

Source: Authors' calculation using India KLEMS dataset, version 2015.

1994–2002 period to 48 percent during 2003–2011, with market service declining from 48 percent to 40 percent, and nonmarket service losing massively to 8 percent. The relative contribution of manufacturing improved from 16 percent to 38 percent, clearly suggesting a productivity surge in the sector. The importance of agriculture for achieving higher aggregate labor productivity growth did not fade away completely, as it maintained its relative contribution to aggregate productivity growth during the last two subperiods.

7.2. Contribution of within industry and factor reallocation to aggregate TFPG

In Fig. 2, we depict the decomposition of aggregate TFPG obtained using aggregate production possibility frontier, into contributions from within industry productivity growth (Domar weighted industry TFPG) and the reallocation of capital and labor across sectors. Note that the factor reallocation effects discussed here would be different from the labor productivity decomposition in the previous section as the methodologies used in the two decompositions are significantly different. Sectoral TFPG in this section are obtained using a gross output production function, as a value added function is less appropriate at the industry level (Jorgenson et al., 2007).

Aggregate TFPG increased from 0.7 percent during the partial reform period to 1 percent during the first phase of market reforms and a further 2.3 percent during the last period. An important observation is that the aggregate TFPG is primarily a reflection of TFPG in the underlying industries, particularly before 1994. It explains more than 100 percent of aggregate TFPG in this period, whereas the overall reallocation effect was negative and therefore dragged productivity growth down by 0.09 percentage point. In our results, TFP growth from the PPF is always higher than Domar-weighted industry TFP growth, except in the first period, implying a positive reallocation term.²⁰ Overall the average reallocation effect is about 0.27 percentage point, which however varies considerably over periods, with 1981–1993 being the only period with a negative overall reallocation effect. The reallocation term increased to 0.37 percentage point during 1994–2002 and further to 0.68 during 2003–2011 (respectively consisting of 16 and 29 percent of aggregate TFPG).

When looked at the reallocation effects of capital and labor separately, we see that, in general, the capital reallocation term has been positive except for the first period. From a theoretical perspective, the reallocation term quantifies the deviation of the data from assumptions in the PPF that industries face the same factor prices on different types of capital and labor. For instance, a positive capital reallocation would suggest that prices of capital differ across industries, and capital is moving to sectors with high capital prices. If prices are assumed to be proxies of productivities, then it would suggest a movement of capital to productive sectors. The large reallocation of capital, particularly since the mid-1990s, therefore indicates that industries, where capital was more productive, witnessed a faster expansion of investment. It has been negative during 1981–1993, suggesting that investment was taking place in industries which are relatively less productive. During the last period, 2003–2011, there seem to have an acceleration in investment in industries that have a higher return over the capital, as reflected in a positive capital reallocation term. During this period, nearly 20 percent of aggregate TFP growth was due to positive capital reallocation. Rodrik and Subramanian (2005) argue that the reforms in India in the 1980s were more pro-business, which helped mostly established incumbents, rather than pro-market reforms helping new entrants. Perhaps the accumulation of capital during this period must have happened in such incumbent firms and was hence not necessarily productivity growth enhancing. Reforms in the 1990s, and in the subsequent years were mostly pro-market, and we see a positive capital reallocation during this period.

Labor also shows a positive reallocation term in the TFPG decomposition, except for 1994–2002 period, indicating a movement of labor from low wage to high wage sectors. Employment seems to have been growing slowly in sectors with higher wages during the entire mid-1990s through early 2000s; the labor reallocation during this period was negative. This is not in consistency with our results on the labor productivity decomposition in Section 7.1, where we found positive, though relatively tiny, reallocation during this period. While a strict comparison is hard to make,²¹ it might suggest that wages and productivity do not go hand in hand. The wage levels in several consumer and intermediate goods manu-

²⁰ Similar findings are observed in Jorgenson et al. (2007) in the case of the United States.

²¹ Note that the two decompositions differ substantially in their weighting schemes, and the labor input data that is used in Eq. (2) is based on the number of employees, whereas the labor input data used in Eq. (9) takes the skill composition of workers into account.

Fig. 3. Harberger diagram of total factor productivity growth, 1981–2011—3 subperiods. *Note:* Industry TFPG's are obtained using gross output function, and aggregate TFPG is Domar-weighted industry TFPG.

Source: Authors' calculations using India KLEMS dataset, version 2015.

facturing such as food products, textiles and wood products, and services like trade and hotels & restaurants are not higher, or even in some cases, lower than other sectors because of the large presence of informal sector. Also, the level of wages was higher in sectors such as financial services, telecommunication services, and some public sector services, where no substantial employment has been generated.²² Moreover, the labor reallocation in labor productivity was also lower during this period compared to other periods. Since 2003, however, the reallocation again moved to positive territory, suggesting that job growth has been higher in sectors where wages are relatively higher. In general, the trend in labor reallocation term in both labor productivity decomposition and TFPG decomposition are quite comparable, except for the opposing signs during 1993–2002.

7.3. The pattern of industry TFPG

Since the aggregate TFPG masks the industry heterogeneity, to understand how the TFPG varied across the 27 industrial sectors,

we use a Harberger diagram (Harberger, 1998; Timmer et al., 2010). The Harberger diagram plots the cumulative contribution of individual industries to aggregate growth, against the cumulative share of these industries in aggregate output. It provides a summary of how widespread or localized productivity growth and changes in growth are within an economy. On the x axis of Fig. 3, we have the cumulative industry output share, and on the y axis we have cumulative TFPG contribution. The dotted horizontal lines show the aggregate Domar-weighted TFPG. In Appendix Table A2, we further provide detailed industry contributions that underlie the Harberger diagram.

In the 1980s 3/4th of industries, that constituted 80 percent of total value added, had a positive TFPG (Table 6). The positive contributions of these industries aggregate to 1.3 percent and the growth reducing effect of negative TFPG industries brought the aggregate Domar-weighted TFPG down to 0.77 percent. The share of industries with positive TFPG has declined substantially to 56 percent, producing less than half the value added in the immediate years after the reforms in the 1990s. The effect of negative TFPG industries was large enough to pull down aggregate TFPG from 0.77 percent to 0.61 percent. Even though the number of industries with positive TFPG and their output share has improved in the post-2002 period, there were still 1/3rd of industries with negative TFPG, and they constituted 60 percent of value added.

The table also provides the relative area under the Harberger curve, which is a summary statistic indicative of whether the productivity growth across sectors is localized in a few sectors – often

²² It would be interesting to examine the movement of real wages in comparison with labor productivity growth to see the evolution of the gap between productivity growth and real wage (wages adjusted for consumer prices) growth. This could happen due to changing composition of capital and labor income share in GDP, which can be caused by, among other factors, the rapid expansion of informal sector, or the changes in workers' terms of trade (relative price of goods that workers produce, and they purchase).

Table 6
Industry pattern of TFP growth, 1981–2011: 3 subperiods.

	1981–1993	1994–2002	2003–2011	1981–2011
Aggregate TFP growth*	0.77	0.61	1.63	0.97
Percentage of industries with positive TFPG	74.1	55.6	66.7	74.1
Output share of industries with positive TFPG	80.6	46.7	60.5	78.1
Relative area under Harberger	0.56	0.63	0.52	0.48

Note: * These are Domar –weighted aggregate TFPG, as reported in Table 6. Relative area under Harberger is the curvature measured by the area between the Harberger diagram (Fig. 3) and a diagonal line divided by the total area below the diagram.

Source: Authors' calculations using India KLEMS dataset, version 2015.

called a mushroom-like pattern – or whether it is more broad-based – a year-type pattern. The relative area ranges between 0.52 in the latest period to 0.63 during 1994–2002. This indicates that the TFP growth is unevenly distributed across sectors – or it displays more mushroom type pattern. This has been the case in all the three periods, with it being more uneven in the years of pro-market reforms.

7.4. Industry origins of aggregate within industry TFPG

In this section, we look at the industry origins of aggregate Domar weighted within sector TFPG. Among the three broad sectors—manufacturing, services, and agriculture—both manufacturing and services contributed nearly equally to the aggregate TFPG in the 1980s whereas agriculture's contribution was far lower. Among the broad industry groups in Table 7, only trade and other goods producing sectors had negative TFPG during this period. Consumer and intermediate goods sector – with the dominant role played by the consumer goods sector – was the driving force of manufacturing TFPG during this period, which contributed 0.36 percentage points of 0.44 point contribution from the overall manufacturing to aggregate TFPG. Within the services sector, 70 percent (0.32 out of 0.46) of TFPG contribution came from market services, despite seeing negative TFPG contributions from trade and distribution services and no productivity gain in business services.

During the 1994–2003 period, aggregate Domar weighted TFPG lowered marginally from 0.77 percent to 0.61 percent, due to the declines in agriculture and goods production including manufacturing, even when productivity contributions from the service sector doubled. TFPG in manufacturing sector decelerated significantly, with its relative contribution declining to about –16 percent, i.e., the aggregate TFPG would have been 16 percent higher even without any productivity growth in the manufacturing sector.²³

Even though manufacturing as a whole did see a shrinking TFPG, this was driven mainly by a fall in consumer goods-producing sector. Investment goods sector maintained its absolute contribution at 0.08 percentage point (nearly 13 percent of total within TFPG) and the drop in the intermediate goods sector was trivial. The agricultural sector also witnessed a deceleration in TFPG (–0.01 percentage point contribution). The improving contribution of the services sector was primarily driven by trade and distribution, which increased its relative contribution from –5 percent (–0.04 percentage point out of 0.77 percent aggregate within TFPG) during 1981–1993 to 66 percent during 1994–2002. The market services consist of 64 percent (0.54 percentage point) and nonmarket services consist of the remaining 36 percent of total service sector TFPG contribution.

²³ The finding of weak productivity growth in manufacturing is consistent with previous studies – both in the extensive literature in the context of formal manufacturing (e.g., Goldar, 2004; Goldar, 2014; Kathuria et al., 2010) and limited evidence on the unorganized sector (Kathuria et al., 2010).

In the last period, 2003–2011, the economy had a significant productivity growth surge. This was achieved mainly because of the remarkable rebound in the contribution of agriculture and manufacturing sectors whereas services contribution did see a decline. Agriculture contributed more than 20 percent (0.37 percentage point) of aggregate within TFPG during this period. Nearly 60 percent of aggregate within sector TFPG was from the manufacturing sector (0.96 percentage point out of 1.63 percent within TFPG), whereas the contribution of services shrunk to 36 percent (0.58 percentage point) – a decline of more than 100 percent from the previous period. All the three manufacturing industry groups – consumer, intermediate and investment goods – improved their contribution to overall TFPG during this period. However, the relative importance of consumer goods was much lower than the other two. The contribution of both market and non-market services declined. Yet, the market services still maintained its overall dominance over the non-market services. Much of the decline in the market services came from trade and distribution services, whereas financial and business services improved, though not enough to offset the decline in trade and distribution sector.

Overall, our TFPG results seem to suggest a continuing role of the agricultural sector in driving aggregate TFPG, a falling role of services – both market and non-market services – and an improving role of manufacturing, particularly intermediate goods and investment goods manufacturing. It may also be noted that the period of the early 2000s also coincides with the rapid fragmentation of global production and the acceleration of trade in intermediate goods (Timmer et al., 2015). It would be interesting to examine the participation of India's manufacturing sector in the global value chain, and the trade of intermediate goods, to understand whether these factors were important in driving the productivity momentum in the manufacturing sector.

7.5. Structural change with no industrialization – India is not unique

From our analysis, it appears that even though the structural change effect of labor reallocation in India has been positive overall, it has been limited. Moreover, our labor productivity decomposition observes no dynamic reallocation effects – no aggregate productivity gain through worker movement to fast-growing sectors. Capital, which was moving more toward less productive sectors in the 1980s, however, has changed its direction in the post-reform period, especially in the 2000s.

An important feature of the structural change process and a possible reason for the limited structural change bonus is the lack of expansion of jobs and investment in the manufacturing sector, which defies conventional logic, and also the experience of many advanced countries. Most advanced economies in the west and high-income countries in East Asia have achieved a high per capita income before moving away from manufacturing to the services sector. For instance, in East Asian countries like South Korea, the manufacturing sector in general, and technology and intensive trade sectors in particular, were important in driving structural transformation. In the 1960s and 1980s, the manufacturing sector

Table 7

Sectoral contribution to aggregate Domar-weighted TFPG, 1986–2011: 5 subperiods.

Industry group/sector	1981–1993	1994–2002	2003–2011	1981–2011
Aggregate TFPG (aggregate production possibility frontier)	0.68	0.98	2.31	1.24
Capital reallocation	–0.20	0.43	0.42	0.17
Labor reallocation	0.11	–0.06	0.26	0.10
Domar-weighted TFPG	0.77	0.61	1.63	0.97
Contribution from:				
Agriculture & allied activities	0.17	–0.01	0.37	0.17
Goods production	0.14	–0.23	0.68	0.19
Manufacturing	0.44	–0.10	0.96	0.43
Consumer & intermediate goods	0.36	–0.18	0.64	0.28
Consumer goods	0.21	–0.14	0.24	0.12
Intermediate goods	0.15	–0.04	0.40	0.17
Investment goods	0.08	0.08	0.32	0.15
Other goods	–0.29	–0.13	–0.28	–0.24
Services	0.46	0.85	0.58	0.61
Market services	0.32	0.54	0.38	0.40
Trade & distribution	–0.04	0.40	–0.01	0.10
Financial services	0.08	0.00	0.35	0.14
Business services	0.00	–0.04	0.00	–0.01
Other services	0.28	0.17	0.04	0.18
Non-market services	0.14	0.31	0.20	0.21

Notes: All growth rates are the average of annual log differences. The sum of Domar-weighted TFPG and reallocation term will result in aggregate PPF TFPG. Aggregates may not add up due to rounding.

Source: Authors' calculation using India KLEMS database, version 2015.

Fig. A1. Relative levels of labor productivity in construction and agricultural sectors (Aggregate economy labor productivity = 100), 1980–2011.

Note: Productivity level is defined as the ratio of output per worker in the given sector to the level of output per worker in the aggregate economy.

Source: India KLEMS.

in these economies absorbed a large number of unskilled workers. At the same time, faster absorption of technology developed in the advanced economies, through diffusion and catch-up process, the sector also generated high productivity jobs (Rodrik, 2013). While the tradability of the sector further helped expand the market reach, efforts by governments and firms to improve worker skills helped develop innovative capabilities. We do not see such a pattern of structural transformation in India. Instead, the manufacturing job creation remains dismal (see Section 6.1).

However, the process of structural change without industrialization is not unique to India and has been documented in the context of other developing economies (de Vries et al., 2015; Diao et al., 2017). For instance, de Vries et al. (2015) shows that jobs shifted to market services sectors in several low-income African economies in the 1990s, and the manufacturing-oriented structural change stalled in the mid-1970s and 1980s. Diao et al. (2017) also find supportive evidence and shows the presence of a

growth-enhancing structural change in several low-income African economies but driven by a movement of workers to services rather than manufacturing. However, a nearly absent industrialization stage in India's structural change process is a concern because it might eventually reduce the overall productivity growth, as the potential for productivity expansion and technological change in the services and construction sectors are limited. Adding more workers to construction or services, without expanding the market, may reduce the marginal productivity of workers. Diao et al. (2017) show that the worker reallocation to services in African economies led to a productivity enhancement initially, but that eventually led to a productivity growth decline. However, from a policy perspective, it would also be hard to imagine India to replicate the structural change experience of East Asian economies or several advanced economies. Because manufacturing technology has changed rapidly during the last decade, and has become highly skill-intensive, making it less feasible to absorb less-skilled

Table A1
Industries and industry groups in India KLEMS database, version 2015.

	Industry	ISIC	Industry group
1	Agriculture, Hunting, Forestry & Fishing	AtB	Agriculture
2	Mining & Quarrying	C	Other goods production
3	Food Products, Beverages & Tobacco	15t16	Consumer Mfg.
4	Textiles, Leather & Footwear	17t19	Consumer Mfg.
5	Wood & Products of Wood	20	Consumer Mfg.
6	Pulp, Paper, Printing & Publishing	21t22	Consumer Mfg.
7	Coke, Ref. Petroleum & Nuclear Fuel	23	Intermediate Mfg.
8	Chemicals & Chemical Products	24	Intermediate Mfg.
9	Rubber & Plastic Products	25	Intermediate Mfg.
10	Other Non-Metallic Mineral Products	26	Intermediate Mfg.
11	Basic Metals & Metal Products	27t28	Intermediate Mfg.
12	Machinery, nec.	29	Investment goods Mfg.
13	Electrical & Optical Equipment	30t33	Investment goods Mfg.
14	Transport Equipment	34t35	Investment goods Mfg.
15	Mfg., nec. recycling	36t37	Consumer Mfg.
16	Electricity, Gas & Water Supply	E	Other goods production
17	Construction	F	Other goods production
18	Trade	G	Trade & distribution
19	Hotels & Restaurants	H	Other market services
20	Transport & Storage	60t63	Trade & distribution
21	Post & Telecommunication	64	Other market services
22	Financial Services	J	Finance services
23	Renting of Mach. & Business services	71t74	Business Services
24	Public Administration & Defense etc.	L	Non-market services
25	Education	M	Non-market services
26	Health & Social Work	N	Non-market services
27	Other Services	70 + O + P	Other market services

workers. Increased focus on skill development to prepare the younger generation employable in skill-intensive sectors – including skill-intensive service sectors with productivity potential such as computer, business, and financial services – as well as accelerating the participation in the global value chain, where agriculture and services can also participate, are important for India to boost its productivity.

8. Concluding remarks

The importance of structural change for attaining higher levels of economic development was stressed in the development economics literature as early as in the 1940s. The recent developments in this literature reiterate the importance of workers and capital moving from less productive to more productive sectors, in determining the speed of economic growth. This paper is an attempt to document the evolution of India's aggregate productivity growth, decomposed into the contributions of detailed industrial sectors and structural change since the 1980s. Using the India KLEMS database, version 2015, which provides comprehensive and consistent industry-level data on the Indian economy, we trace the industry origins of labor productivity and total factor productivity growth (TFPG), along with the contribution of factor reallocation. In the labor productivity decomposition, we examine both static—movement of workers from low productive to high productive sectors—and dynamic—the movement of workers from slow-growing to fast-growing sectors—reallocation effects, in comparison with within industry productivity growth.

Even though the relative shares of agriculture in total employment and output have diminished substantially over time, agriculture remains the major employment provider in India. The gradual job declines in agriculture are largely offset by jobs creation in the construction sector, followed by some increases in the employment share of market services, in particular, trade and distributive services, financial services and business services. Manufacturing job creation has been very low. Given the relatively higher productivity levels in these non-manufacturing sectors compared to agriculture, the static structural change—the movement

of workers to industries with higher productivity levels—has been positive, whereas as the dynamic productivity gains—the movement of workers to fast-growing sectors—has been limited or absent. Productivity growth in the construction sector, where job growth has been improving rapidly, has been consistently negative. Yet, the expansion of jobs in the construction sector is due to its less skill requirement, compare to manufacturing or services, the informality of the sector which helps evade some of the rigidities in the formal labor market, and relatively higher wages.

The capital reallocation term in our TFP decomposition has been positive since 1994, suggesting an expansion of investment in sectors with high returns from capital. Labor reallocation has, however, been negative during the 1994–2002 period; employment does not seem to have expanded in sectors with relatively higher levels of wages during this period. This, which is in contrast with our static reallocation effect, seems to suggest that wages and productivity does not go hand in hand. The positive and high reallocation of both labor and capital in the post-2003 period might imply a complementarity between labor and capital inputs. This aspect, however, requires further research, taking account of the differences in skilled worker share and skill premium across sectors. It is likely that job growth was high in skill-intensive sectors, where the capital and technology requirements and wage levels are relatively higher than in other sectors.

In general, the observed TFP is not broad-based. If the pattern of productivity was more broad-based the aggregate productivity gain would have been much larger. There are many industries that contributed negatively to aggregate productivity growth. While some industries lost their relative importance as contributors to aggregate productivity, some other industries emerged as important contributors. While manufacturing had a notable contribution to aggregate TFP in the 1980s, services sector dominated in the mid-1990s. Yet, manufacturing did witness a diversification during this period, with a shift in productivity contribution toward investment goods from consumer and intermediate goods production. In the 2000s, however, manufacturing revived significantly, breaking its own past record, and services lost its relative importance in contributing to aggregate TFP.

Table A2

Industry contribution to aggregate Domar-weighted TFP, 1980–2011: 3 subperiods.

	1981–1993	1994–2002	2003–2011	1981–2011
Agriculture, Forestry & Fishing	0.17	−0.01	0.37	0.17
Mining & Quarrying	−0.05	0.07	−0.16	−0.05
Food Products, Beverages & Tobacco	0.11	−0.01	0.08	0.07
Textiles, Leather & Footwear	0.05	−0.01	0.15	0.06
Wood & Products of Wood	−0.06	−0.10	0.00	−0.05
Pulp, Paper, Printing & Publishing	0.02	−0.02	0.04	0.01
Coke, Ref. Petroleum & Nuclear Fuel	0.03	−0.12	0.29	0.06
Chemicals & Chemical Products	0.09	−0.05	0.19	0.08
Rubber & Plastic Products	0.02	0.00	0.06	0.03
Other Non-Metallic Mineral Products	0.00	0.02	0.01	0.01
Basic Metals & Metal Products	0.01	0.11	−0.16	−0.01
Machinery, nec.	0.00	0.03	0.09	0.03
Electrical & Optical Equipment	0.06	0.04	0.12	0.07
Transport Equipment	0.02	0.01	0.11	0.05
Mfg., nec. recycling	0.09	0.00	−0.02	0.03
Electricity, Gas & Water Supply	0.06	0.11	0.10	0.09
Construction	−0.30	−0.31	−0.22	−0.28
Trade	0.03	0.32	−0.18	0.05
Hotels & Restaurants	−0.03	0.05	−0.04	−0.01
Transport & Storage	−0.07	0.08	0.17	0.05
Post & Telecommunication	−0.01	0.14	0.26	0.11
Financial Services	0.08	0.00	0.35	0.14
Renting of Mach. & Business services	0.00	−0.04	0.00	−0.01
Public Administration & Defense etc.	0.13	0.32	0.35	0.25
Education	0.02	−0.01	−0.07	−0.01
Health & Social Work	−0.02	0.00	−0.08	−0.03
Other Services	0.31	−0.02	−0.17	0.07
Aggregate Domar Weighted TFP	0.77	0.61	1.63	0.97
Capital Reallocation	−0.20	0.43	0.42	0.17
Labor Reallocation	0.11	−0.06	0.26	0.10

Source: Authors' calculations using India KLEMS dataset, version 2015.

Yet, India's structural change, which contradicts with the success story of several advanced economies, poses major challenges. Evidence from several of today's advanced economies both in Asia and elsewhere suggests that no country has achieved a higher level of development without a solid manufacturing sector. Even today, with the GDP growth being driven primarily by the services sector, nearly half of India's workers are employed in the primary sector, suggesting a further potential for structural change. It is hard to argue, particularly given the fact that the pace of job creation in high productive services has been slow, that India can sustain higher long-term growth rates without a solid manufacturing sector. Indeed, India still has substantial catch-up potential in the manufacturing, and given its large pool of young population and underdeveloped infrastructure, it can excel in manufacturing only if it focuses on improving its human capital and infrastructure.

The methodology followed in this paper is built on Jorgenson et al. (2007)'s growth accounting framework. As Maddison (1987) observed, growth accounting does not provide any insights into a causal relationship. Rather it helps to understand the 'proximate' sources of growth, and more importantly which factors need attention, while it does not explain the elements of policy or circumstances that underline those sources. As the TFP in this approach is calculated as a residual, the precision of the estimate crucially depends upon the accuracy of labor and capital input measures. The India KLEMS database attempts to provide relatively better measures of labor and capital inputs, yet it is subject to limitations, primarily driven by a lack of enough data. Moreover, this kind of approach is less insightful in understanding the nature of productivity growth – more precisely, whether the changes in TFP is due to technological change or structural change, or simply a measurement error, caused by a violation of the assumptions underlying the production function. Indeed, these caveats invite the importance of being cautious while interpreting the TFP results. Yet, our results are insightful in understanding the changes in factor

reallocation and industry origins of the measured residual TFP estimates. Future research should further examine the determinants of the observed reallocation effects, using an appropriate methodological approach. Potential factors that limit a pro-growth factor re-allocation may include labor market rigidities which impede the expansion of manufacturing sector, the poor quality of and accessibility to education which hinders its human capital development, weak infrastructure which increases cost inefficiency, the existence of a large informal sector which drags aggregate productivity and above all a slow pace of reforms particularly to ease the supply side constraints. Achieving growth-enhancing structural change requires adequate policies that would ease the reallocation of resources from less productive to high productivity sectors.

Appendix A

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