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Sources of India's Post-reform Economic Growth: An Analysis based on India KLEMS Database

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Abstract: This paper analyses the sources of India's economic growth, in terms of industry origins, inputs, and productivity during 1994-2018, comparing the pre- and post- global financial crisis (GFC) periods. We apply a growth accounting methodology with five-input KLEMS framework, using the India KLEMS database, version 2020. The analysis reveals that market services have been the main contributor to the aggregate real gross value-added (GVA) growth in both the pre- and post-GFC periods. About one-third of the aggregate GVA growth in the post-GFC period came from total factor productivity (TFP) growth, with half of which stemmed from the reallocation of capital and labour inputs to more productive industries. The remaining part of aggregate TFP growth arose from productivity advances made within industries. Our analysis suggests a TFP momentum in manufacturing and agriculture and TFP erosion in the market services sector in the post-crisis period. Manufacturing was one of the main contributing sectors to aggregate TFP and GVA growth in the post-GFC period. The results stress the need for proactive policies to support agriculture, manufacturing, and market services sectors

Keywords: Indian economy, sources of growth, KLEMS framework, total factor productivity, Domar aggregation, market services, manufacturing, agriculture, India KLEMS

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Sources of India's Post-reform Economic Growth: An Analysis based on India KLEMS Database

1. Introduction

India's economic growth during 1994-95 to 2018-19 (hereafter written as 1994-2018)¹, i.e., the period since the liberal market reforms began in India in the early 1990s, was on average about six percent. This paper presents a supply-side analysis of this observed economic growth in the post-reform period, comparing growth performance between pre- and post- GFC (Global Financial Crisis) periods. Using disaggregated industry-level data, we look at the industry origins of growth – which industries are driving aggregate growth – with a focus on the roles of agriculture, manufacturing and services sectors. Furthermore, we study the contribution of factor accumulation and productivity advance to growth, taking a growth accounting approach based on the five-input KLEMS (capital-labour-energy-materials-services) framework.

For the analysis, we use the India KLEMS database, which is based on and is consistent with India's national accounts, and is available on the website of the Reserve Bank of India (<https://www.rbi.org.in/Scripts/KLEMS.aspx>).² This database

¹ For analyzing India's economic growth performance in the post-reform period, the growth rates since 1994-95 are considered. This leaves out 1991, the year of severe balance of payments crisis in India and the initiation of reforms, as also the next two years during which the process of reforms continued, making 1991 to 1993 a period of turbulence and transition in the economy.

² Some of the earlier studies based on the India KLEMS database include Das et al. (2016), Erumban and Das (2016), Goldar et al. (2017), Wu et al. (2017), Das et al. (2019), Erumban et al. (2019), Abraham (2019), Krishna et al. (2020), Bhadury et al. (2021).

provides annual time series data on output, inputs, factor income shares, and productivity from 1980-81 to 2018-19 for 27 industries that constitute the total economy (see Data manual; Das et al. 2020). The analysis in the paper is confined to the period 1993-94 to 2018-19 (1993-2018). We consider the average growth over the years 1994 to 2018, divided into two sub-periods, 1994-2007 (the pre-crisis period) and 2008-2018 (the post-crisis period), with the first sub-period sometimes being broken into 1994-2002 and 2003-2007.

The paper has three main parts. The first part (Section 2) briefly outlines the India KLEMS database. The second part (Section 3) analyzes sources of growth at the aggregate economy level and the industry origins of aggregate real gross value added (GVA) growth and total factor productivity (TFP). While tracing the industry origins of the aggregate GVA growth and TFP growth, we examine the specific roles of the manufacturing, services and agriculture & allied activities sectors.

The third part of the paper (Section 4) analyzes the trends in investment rates and the rates of return. Since the rate of investment has played a pivotal role in influencing India's economic growth, a disaggregated analysis of the trends in the investment rate and rate of return across industries of the manufacturing and services sectors is useful.

Finally, we summarize the main findings of the study in Section 5, along with a few concluding remarks.

2. India KLEMS Database

The basic approach used in this paper to understand the sources of growth is a standard growth accounting framework, using a KLEMS gross output production function for each of the 27 industries in the India KLEMS database. In this approach,

gross output (Y) growth for any given industry j is decomposed into contributions from factor inputs, capital (K) and labour (L), and intermediate inputs, energy (E), materials (M), and services (S), as:

$$\Delta \ln Y_j = \bar{s}_j^K \cdot \Delta \ln K_j + \bar{s}_j^L \cdot \Delta \ln L_j + \bar{s}_j^E \cdot \Delta \ln E_j + \bar{s}_j^M \cdot \Delta \ln M_j + \bar{s}_j^S \cdot \Delta \ln S_j + \Delta \ln TFP_j \quad (1)$$

where s_i is the income share of input i (i=K, L, E, M, and S) in the total nominal value of gross output, and $\Delta \ln TFP$ is the total factor productivity growth, measured as a residual after subtracting the observed input contributions from the observed output growth, all for industry j. Since the production function for the aggregate economy is a value-added function, a similar growth accounting may be performed, but using only two-factor inputs, capital and labor and aggregate value added, i.e.

$$\Delta \ln V = \bar{v}^K \cdot \Delta \ln K + \bar{v}^L \cdot \Delta \ln L + \Delta \ln TFP^v \quad (2)$$

where V is the aggregate economy real value added, \bar{v}^K and \bar{v}^L are respectively the income share of capital and labour in aggregate nominal value added, K and L are respectively the aggregate capital and labour inputs, and TFP^v is the total factor productivity using value added function.

For our analysis, we rely on the time-series data available from the **India KLEMS database, version 2020 (hereafter abbreviated as IKD_v2020)**.³ The database provides information on 27 individual industries that consist of the aggregate economy. The database is based primarily on *National Accounts Statistics* (NAS), published annually by the Central Statistics Office (CSO), Ministry of Statistics and Programme Implementation, Government of India. The NAS is

³Further details on the methodology of construction of variables and the details of industrial classifications used in the database are available in the India KLEMS Data Manual (Das et al. 2020) which can be accessed at the RBI website.

supplemented by Input-Output transactions tables (IOTTs), Supply-Use tables (SUTs), various rounds of *Annual Survey of Industries* (ASI), National Sample Survey Offices (NSSO)'s Employment & Unemployment Surveys (EUS), Periodic Labour Force Surveys (PLFS), and surveys on the unorganized manufacturing sector.

The database provides two output measures, the gross value of output (GVO) – Y in equation (1) – and gross value added (GVA) – V in equation (2) –, both in current and constant prices. The estimates of GVA at current and constant current prices are directly obtained from the NAS for certain sectors/industries of the economy.⁴ Since the NAS data are not available for all individual KLEMS industries belonging to manufacturing, it becomes necessary in some cases to split the aggregate into the KLEMS industry groups, which is done by using data from ASI and the NSSO surveys for unorganized manufacturing. A similar approach is followed to derive the estimates of GVO, except for service industries. For the service industries, additional information on the ratio of output to value added is obtained from the IOTTs and is applied to estimates of GVA from the NAS.

The database provides estimates of factor inputs labour and capital, including quantity (employment and capital stock) and composition measures (educational composition of workers and asset composition of capital stock) – the combination of these quantities and composition are called the labour and capital inputs. Employment data for the 27 industries are derived from the quinquennial rounds of EUS and, more recently, from PLFS, using the usual principal and subsidiary status (UPSS) concept.

⁴ All values in the database are consistent with the NAS 2011-12 base series, making use of the series from 2011-12 onward, and the back series.

Capital stock estimates for three individual assets, construction, machinery, and transport equipment, are constructed using real investment and asset-specific depreciation rates by applying a perpetual inventory method. Investment data for these assets are obtained from the NAS, supplemented by ASI and NSSO unorganized manufacturing surveys. Capital input is then measured as a rental share weighted growth rate of asset-specific capital stock, assuming differences in rental prices reflect productivity differences across assets. The rental shares are calculated as each asset's share in the total rental value, obtained using the rate of return and depreciation costs of each asset.

The database also provides information on three intermediate input categories, namely energy, materials, and services, at current and constant prices. Following Jorgenson et al. (2005) and Timmer et al. (2010), these measures are developed using IOTTs.

Finally, the labor income is obtained from the NAS data on the net domestic product, comprising compensation of employees, gross operating surplus, and mixed-income for the self-employed. As in the case of GVA and GVO, appropriate industry distributions are used to split the NAS data into 27 industry groups. Moreover, the labour income component of the mixed-income category has been separated to estimate the income attributable to workers accurately.

3. Sources of India's Economic Growth

3.1 Decomposition of the Aggregate Economy Value Added Growth

The decomposition of growth rate in real GVA at the aggregate economy level into the contributions of labour and capital input growth, and TFP growth (equation 2) are provided in Table 1. The results are averages for the period 1994-2018, and the

sub-periods 1994-2002, 2003-2007, 1994-2007, and 2008-2018. The aggregate economy TFP growth is broken up into an aggregation of industry-level TFP effect and the movement of resources from low productivity to high productivity industries – a factor reallocation effect, using a decomposition method suggested by Jorgenson et al. (2005). This approach separates estimates of the productivity gains from the reallocation of capital and labour inputs across industries.

Table 1: Sources of growth, Indian Economy, 1994-2018, by sub-periods
(Percent per annum; or percentage points per annum)

GVA growth and its components	1994-2002	2003-2007	1994-2007	2008-2018	1994-2018
<i>Real GVA growth (% per annum)</i>	5.50	8.29	6.49	6.41	6.46
<i>Contribution of labour input growth</i>	1.37	1.24	1.32	0.70	1.05
- Employment	0.81	0.62	0.74	0.16	0.49
- Labour composition	0.56	0.62	0.58	0.54	0.56
<i>Contribution of capital input growth</i>	2.78	3.95	3.19	3.62	3.38
- Capital stock	2.75	3.90	3.16	3.58	3.34
- Capital composition	0.03	0.04	0.03	0.04	0.04
<i>TFP growth</i>	1.35	3.11	1.98	2.09	2.03
- Domar aggregated industry-level TFP growth	0.57	1.82	1.02	0.88	0.95
- Factor reallocation effect on aggregate TFP growth	0.78	1.28	0.96	1.22	1.07
• Labour reallocation	0.04	0.41	0.18	0.42	0.28
• Capital reallocation	0.74	0.87	0.79	0.80	0.79

Note: Real GVA growth is the Tornqvist aggregate of industry GVA growth rates. Contributions of employment, labour composition (i.e., the changes in the composition of employment towards highly educated workers), capital stock, capital composition (i.e., the changes in the composition of capital stock towards equipment), and TFP growth to aggregate GVA growth are obtained using a growth accounting (equation 2). Industry-level TFP growth rates are the aggregates of industry TFP growth estimates obtained using the KLEMS production function (equation 1), weighted using Domar weights (the ratio of industry gross output to aggregate GVA); see Jorgenson et al. (2005).

Source: Authors' computations based on India KLEMS Database, version 2020 (IKD_v2020)

The average annual growth rate in real GVA during the entire period 1994-2018 was about 6.5 percent.⁵ The most important contributor to this growth was capital input (mostly driven by capital stock rather than changes in the asset composition of capital – i.e. capital composition effect), accounting for about half of the GVA growth. The TFP growth was the second dominant contributor, contributing about a little less than one-third of the real GVA growth. About one-half of the aggregate TFP growth came from industry-level productivity improvements. The reallocation of labour and capital inputs from low to high-productivity industries constituted the other half. The contribution of the labour input growth to the aggregate GVA growth was about one-sixth, divided somewhat equally between the quantity (employment growth) and composition (improvements in the educational composition of workers) components.

Contrasting the two pre-GFC periods, 1994-2002 and 2003-2007, it is found that in the later period, which is the high-growth phase of the Indian economy, the annual growth rate in GVA accelerated by about three percentage points. About two percentage points came from accelerated TFP growth, and the remaining from capital input.

The growth rates in real GVA in the post-GFC period (2008-2018) and the pre-GFC period (1994-2007) are quite comparable. This occurred despite a marked slowdown in employment growth and a consequent fall in the contribution of labour input in the post-GFC period. The growth rates in TFP in the two periods

⁵ This figure exceeds the NAS estimate of six percent mentioned in the introduction, as Table 1 implicitly involves double deflation of GVA.

were, by and large, the same. However, the roles of the two components, aggregated industry-level TFP and reallocation effects, changed, with the pace of improvement in the former declining and the role of factor reallocation improving. The sustenance of India's post-GFC GVA growth at a comparable rate as in the pre-GFC period is explained by an increase in the growth rate in capital input contribution, i.e., an enhanced rate of investment. This makes a study of the trends in the investment rate important, which is done in Section 4 of the paper.

3.2 Industry-level Disaggregated Analysis

The contributions of individual industries to the aggregate economy GVA growth and TFP growth are presented in Table 2. Based on the results, the following points emerge:

- (a) While aggregate GVA growth remained largely unaffected in the post-crisis period, there have been some important dynamics across industries. Three industries, namely (i) trade, (ii) agriculture & allied industries, and (iii) business services remained among the top contributing sectors to aggregate GVA growth in both periods. Together, these three industries contributed nearly one-third of total GVA growth in both periods. Five other industries (i) construction, (ii) transport & storage, (iii) financial services, (iv) post & telecommunications, and (v) public administration & defense were relatively important contributors in the pre-crisis period, each contributing about 5 to 8 percent of the total growth. However, all these sectors except public administration & defense lost their relative importance for aggregate growth in the post-crisis period. Three industries that joined the relatively bigger contributing group in the post-crisis period are (i) coke & petroleum products, (ii) education, and (iii) other services,

contributing about one-fifth of the total GVA growth in the post-crisis period, compared to a mere 8 percent in the pre-crisis period.

(b) The industries that made largest contribution to aggregate economy TFP growth in the pre-GFC period are: (i) public administration & defense, (ii) post & telecommunications, (iii) transport & storage, and (iv) agriculture & allied activities.⁶ While public administration & defense and agriculture & allied activities made subsequent productivity gains in the post-crisis periods, the other two industries had a significant setback with contracting TFP. Other industries that improved their relative contributions to aggregate productivity growth are prominently manufacturing industries, including coke & petroleum products, textiles, textile products, leather & footwear, and rubber & plastic products. Among the services industries, financial services and education improved their TFP growth in the post-GFC period. On the contrary, many other sectors, including post & telecommunications, transport & storage, utilities, trade, chemicals & chemical products, mining & quarrying, and construction, had an erosions in TFP. In particular, construction and mining & quarrying industries saw substantial deterioration in their already decreasing TFP.

⁶ Note here that the contributions shown in the last two columns of Table 2 are obtained by using Domar aggregated industry-level TFP growth rates. It does not take into account the gains from inter-industry resources reallocation.

Table 2: Industry contributions to aggregate economy GVA growth and TFP growth, pre- and post-GFC periods (Percentage points per annum)

KLEMS industries	Contribution to aggregate GVA growth		Contribution to aggregate TFP growth	
	1994-2007	2008-2018	1994-2007	2008-2018
Trade	0.71	0.84	0.12	-0.24
Business services	0.55	0.66	-0.07	-0.06
Agriculture & allied	0.68	0.60	0.20	0.34
Coke & petroleum pdts.	0.05	0.47	-0.10	0.28
Other services	0.27	0.44	-0.15	0.02
Public administration	0.31	0.41	0.28	0.35
Education	0.20	0.36	-0.02	0.14
Financial services	0.40	0.33	0.05	0.08
Construction	0.50	0.32	-0.13	-0.25
Transport & Storage	0.48	0.28	0.23	-0.01
Basic metals & metal pdts.	0.22	0.24	0.02	0.08
Textiles & leather	0.17	0.20	0.01	0.16
Transport eqpt.	0.21	0.18	0.07	0.06
Machinery, nec.	0.15	0.17	0.03	0.07
Electrical & optical eqpt.	0.14	0.15	0.08	0.09
Rubber & plastic pdts.	0.04	0.14	-0.03	0.10
Non-metallic mineral pdts.	0.04	0.13	-0.06	0.08
Post & telecom	0.39	0.11	0.24	-0.07
Utilities	0.30	0.11	0.18	-0.04
Health & social work	0.14	0.10	0.02	0.004
Other manufacturing	0.03	0.07	0.002	0.06
Food pdts., beverages & tobacco	0.19	0.07	0.08	-0.004
Hotels & restaurants	0.09	0.06	0.02	-0.01
Wood & wood pdts.	-0.01	0.02	-0.05	0.02
Pulp & paper pdts.	0.04	-0.002	0.01	-0.01
Mining & quarrying	0.08	-0.003	-0.05	-0.17
Chemicals & chemical pdts.	0.16	-0.04	0.04	-0.18
<i>Total Economy</i>	6.49	6.41	1.02	0.88

Note: Industry contributions are obtained as the product of industry GVA growth rate and the industry share in aggregate nominal value added. Industry contributions are obtained as the product of industry TFP growth rate based on the gross output production function and the Domar weights. The industries are ordered according to the contribution to aggregate GVA growth in the post-GFC period.

Source: Same as Table 1.

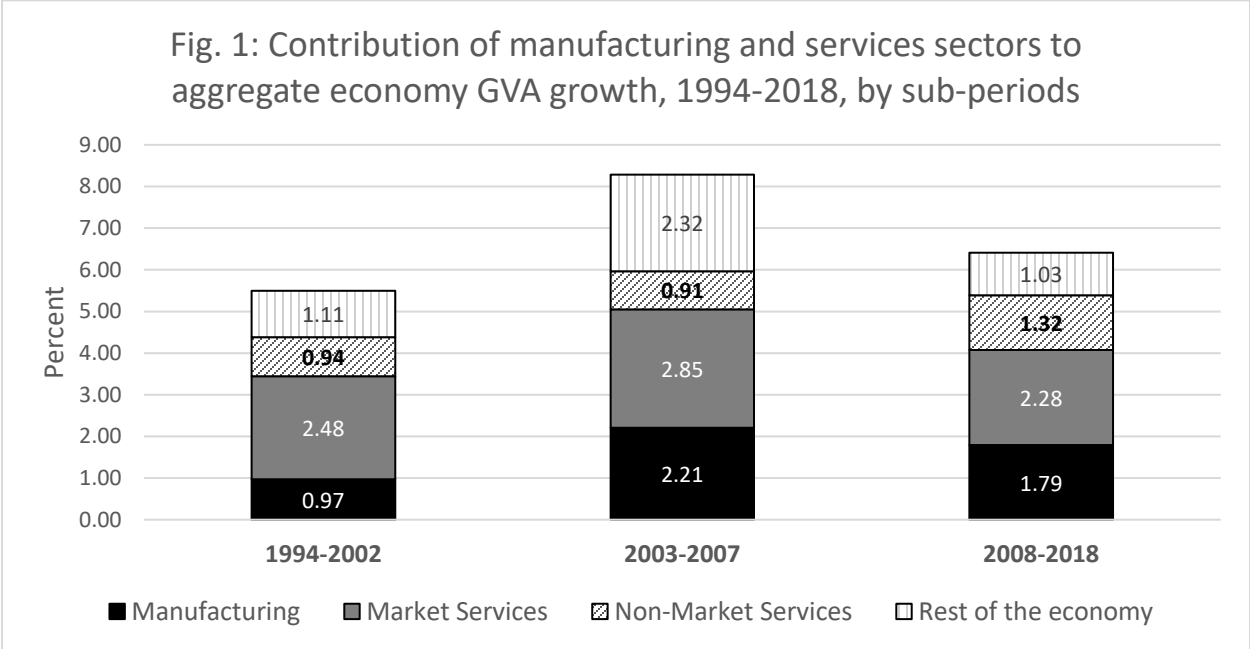
One important feature of India's economic growth over the last three decades is the role of agriculture & allied activities in supporting aggregate GVA and TFP growth in both pre- and post-GFC periods. The high TFP growth in agriculture observed in the India KLEMS dataset has been confirmed by a recent study by Krishna and Meenakshi (2022, forthcoming) in their comparison of the KLEMS estimates with estimates from USDA dataset. They have underscored the need for considering water input while computing productivity in the agricultural sector, and the possible role of changing composition of the agriculture sector in driving much of the observed productivity growth.⁷ We conclude that, although the share of agriculture in the aggregate GVA declined significantly over time, it still had a significant impact on the economy's overall performance in the post-GFC period, suggesting the need for focusing on the sector. Chand (2021) has recently drawn attention to the importance of agriculture in formulating a strategy for India's future economic growth. He notes that in the context of rising concerns over employment, sustainability, environmental services, poverty, nutrition, and health, agriculture ought to play a larger and different role in the process of development than merely serving to meet the requirements of industrialization.

3.3 Sectoral Contributions: Manufacturing and Services

The growth in real GVA obtained by applying the double deflation procedure has been faster in the manufacturing sector (10.3 percent per annum) than in the services sector in the post-GFC period (7.1 percent per annum). However, the services sector continued to play a lead role in the economy - because its

⁷ Hence, Krishna and Meenakshi (2022) further argue that devising appropriate strategies for agricultural productivity enhancement would require a more detailed sub-sectoral analysis of agricultural productivity, which is not yet part of the KLEMS dataset.

contribution to aggregate economy real GVA growth was far greater than that of the manufacturing sector thanks to the relatively bigger size of the services sector vis-à-vis the manufacturing sector in terms of GVA. This is depicted in Figure 1. The figure distinguishes between non-market services, consisting of public administration & defense, education, health & social work, and other services (which includes real estate activities), and market services, consisting of all other service industries.



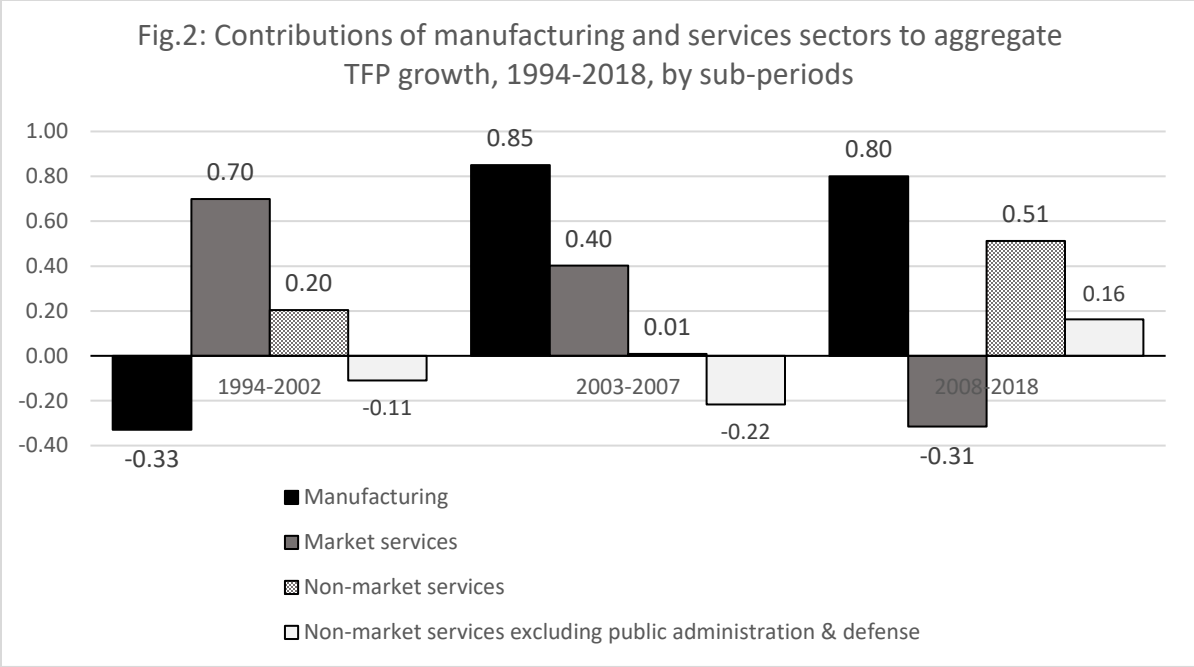
Note: See Table 2.

Source: Same as Table 1.

Figure 1 depicts three major trends: 1) the sustained role of market services in driving aggregate growth throughout; 2) the rising role of manufacturing – taking the two pre-crisis periods together and comparing them with the post-crisis period, the average contribution of manufacturing was higher in the post-crisis period,

primarily due to better productivity growth; and 3) a shift in the relative roles of market and non-market services, with a shift from market services to non-market services in the recent period. Important to note that market services has remained the single largest contributor in all the three sub-periods.

At the aggregate economy level, the growth rates in TFP in the periods 1994-2002, 2003-2007 and 2008-2018 were 1.35, 3.11 and 2.09 percent per annum respectively (refer to Table 1). Figure 2 suggests that manufacturing drove the aggregate TFP growth to a considerable extent in the period since 2003. While the market services sector was the second-largest contributor in the 2003-2007 period, non-market services assumed that position in the post-crisis period. However, it is important to note that the non-market services' contribution was mainly driven by public administration & defense (Table 2), without which its contribution was much smaller in the post-crisis period, and negative in the pre-crisis periods. The market services sector, which includes dynamic industries such as financial services, business services, and information technology services, was the main contributor to the aggregate TFP growth during 1994-2002 and an important contributor during 2003-2007, but contributed negatively in the post-crisis period.



Note: See Table 2.

Source: Same as Table 1.

To sum up the above discussion, India's economic growth in the post-reform-pre-crisis period was driven heavily by capital accumulation and productivity improvements, with the 2000s seeing more rapid productivity improvements than the 1990s. The sustenance of pre-crisis GVA growth rates in the post-crisis period was largely possible due to moderate improvements in capital contribution and stable TFP growth, even when the labour input contribution decelerated. In the following section, we further delve into the factors underlying the growth in capital input, viz., investment rates and the rate of return, in the agriculture, manufacturing, and services sectors of the economy.

4. Trends in Investment and Rate of Return

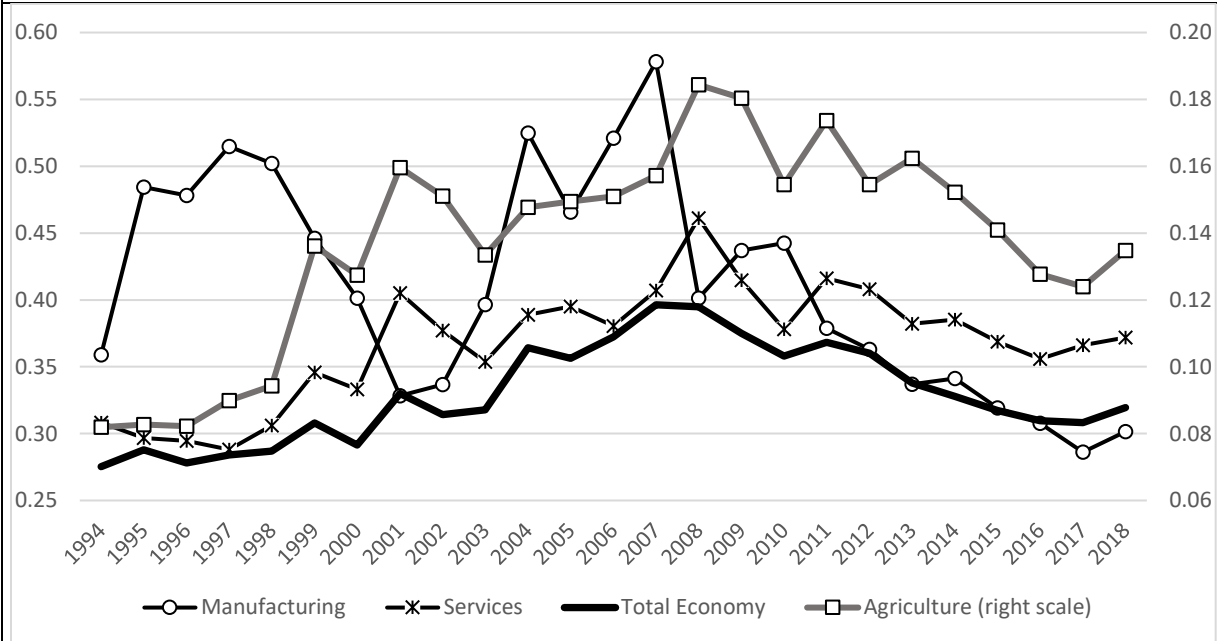
This section compares the trends in investment rate (investment to GDP ratio) and internal rate of return in the pre- and post-crisis periods. First, we document the

trends in investment rates in services (distinguishing between market and non-market services), manufacturing, and agriculture in comparison with the aggregate economy. These ratios are calculated in current prices, using total investment (i.e., the sum of investments in three assets machinery, transport equipment, and construction) and GVA. Subsequently, we analyze the trends in the average internal rate of return in these sectors. The internal rate of return is measured as the ratio of the sum of gross operating surplus and the total capital gain (aggregated over three asset types, see Section 2) net of total depreciation costs, over total capital stock, all in nominal terms (see Erumban 2008).

4.1. Investment rates

We document three important observations from Figure 3, which depicts the investment rates. The first is a rising aggregate investment rate during the pre-crisis period, mostly consistent with the services sector and agricultural sector trends. The second is a consistently falling trend in the post-crisis years, except for a minor uptick in 2018, visible in all three sectors. However, the fall is more intense in manufacturing. The third is the fierce volatility of investment rates in the manufacturing sector than in services, especially in the pre-crisis years. We see episodes of rapid rise between 1994-1997 and 2001-2006 and rapid fall from 1997-2000 and after 2006. While the fall in the post-crisis years is a common phenomenon in both sectors, the same is not true in the case of the 1997-2000 period.

Fig. 3: Total investment rate, agriculture, manufacturing, services and total economy – 1994-2018



Note: Total investment rate is the ratio of total nominal investment (i.e., the sum of investment in three assets, machinery & equipment, transport equipment, and construction) to nominal value added.

Source: See Table 1.

Although 1997-2000 period coincides with the Asian financial crisis (AFC), it is argued that India was largely unaffected as it was not directly linked with the ASEAN markets until recently (Chowdhury et al. 2019; Ghosh and Chandrasekhar 2009). However, external factors such as a fall in FDI inflow and domestic financial constraints during this period (Reserve Bank of India 2006) may have affected investment activity. Moreover, following the substantial liberal reforms in the early 1990s, many domestic firms were still restructuring and equipping themselves to operate in a competitive environment.

Figure 4: Average investment rates by asset – pre- and post-crisis periods, agriculture, manufacturing, services and total economy

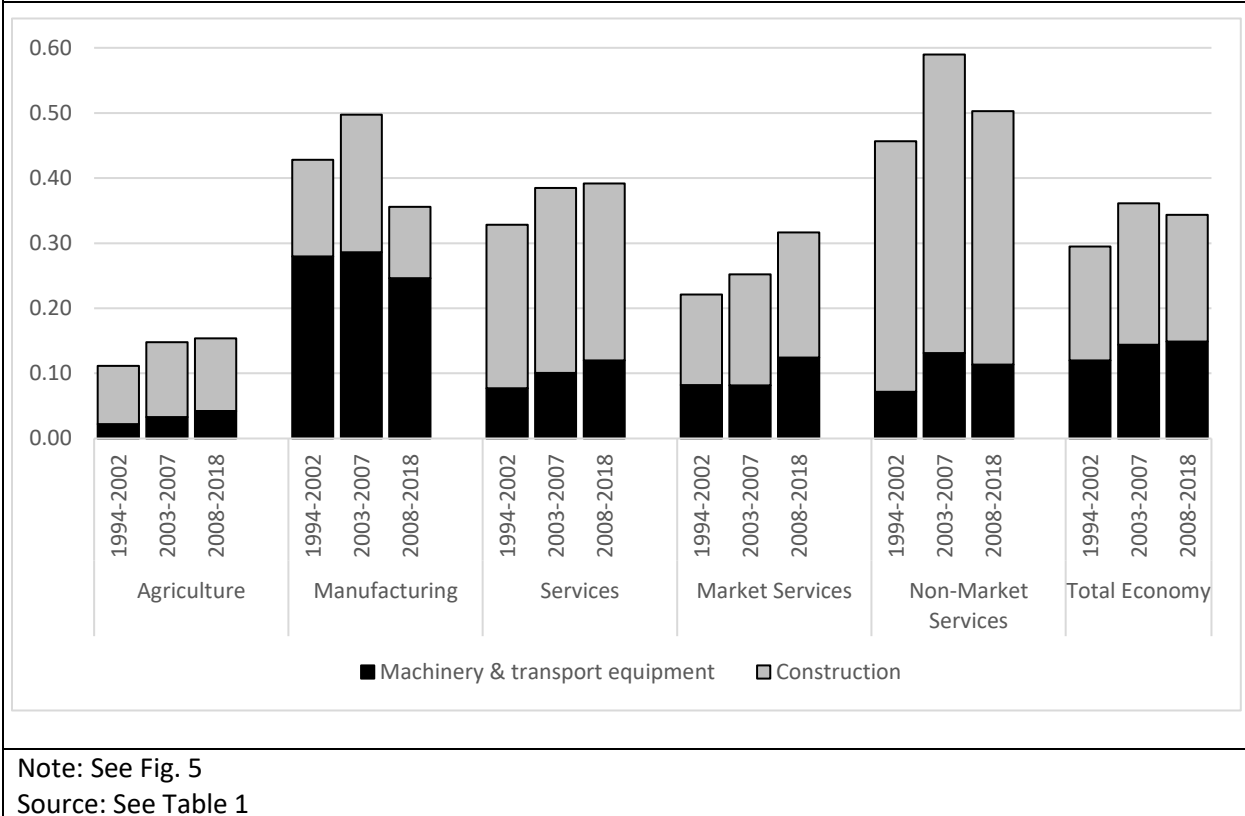


Figure 4 provides an asset break-up of the total investment rate. In general, while investment rates in machinery and transport equipment (hereafter equipment) dominate in the manufacturing sector, it is the investment in construction (hereafter non-equipment) that dominates in the services sector. The post-crisis falls in the total manufacturing investment rates resulted from the decline in both equipment and non-equipment assets, although the magnitude of the fall was higher in the latter. In contrast, in the post-GFC rise in market services investment rates was more from the equipment than non-equipment. The investment rates in the agriculture sector are generally lower than in the other two

and the aggregate economy, with the non-equipment component dominating the investment composition. Despite the falling trend in investment rate in the agricultural sector, the average investment ratio in the post-crisis period remains slightly higher than in the pre-crisis periods - thanks to slightly improving equipment investment.

Table 3 provides the average investment rates in agriculture along with 13 manufacturing and 10 services industries. The investment rate improved in most industries in the 2003-2007 period over 1994-2002, including in agriculture, where it generally remains lower than most manufacturing and services industries. A few exceptions to this rising trend include three manufacturing industries (coke & petroleum products, chemicals & chemical products, and pulp & paper products - with bigger falls in the first two) and two market services industries (post & telecommunications, and financial services).

Table 3: Average investment rates in agriculture, manufacturing and services industries			
	1994-2002	2003-2007	2008-2018
Agriculture & allied	0.11	0.15	0.15
Manufacturing			
Food pdts., beverages & tobacco	0.48	0.55	0.43
Textiles & leather	0.41	0.69	0.38
Wood & wood pdts.	0.15	0.33	0.18
Pulp & paper pdts.	0.90	0.85	0.42
Coke & petroleum pdts.	0.47	0.23	0.39
Chemicals & chemical pdts.	0.53	0.39	0.30
Rubber & plastic pdts.	0.36	0.52	0.35
Non-metallic mineral pdts.	0.61	0.66	0.36
Basic metals & metal pdts.	0.40	0.52	0.47
Machinery, nec.	0.20	0.41	0.20
Electrical & optical eqpt.	0.51	0.52	0.23
Transport eqpt.	0.31	0.40	0.36
Other manufacturing	0.53	0.83	0.30
Services			
Trade	0.05	0.08	0.21
Hotels & restaurants	0.14	0.20	0.31
Transport & Storage	0.37	0.40	0.42
Post & telecom	0.29	0.18	0.61
Financial services	0.20	0.13	0.07
Business services	0.43	0.54	0.54
Public administration	0.42	0.59	0.52
Education	0.09	0.18	0.20
Health & social work	0.14	0.28	0.27
Other services	0.63	0.77	0.64
Total economy	0.30	0.36	0.34
Note: See Fig. 5			
Source: See Table 1			

In the post-GFC period, all manufacturing industries had a retreat except for coke & petroleum products. The investment rates remained largely unchanged from the previous period in agriculture, two market services industries - transport & storage, and business services - and two non-market service industries - health

& social work and education, whereas it relapsed in the financial services industry and the remaining non-market services industries. Only three market services industries – post & telecommunication, hotels & restaurants, and trade – have seen a notable improvement in the post-crisis period.

Overall, the data suggest a rapid increase in the investment rate in the post-2000 years until the global financial crisis, driven by both the manufacturing and the services sectors. The investment rate fell in the post-crisis years, primarily due to weakening in manufacturing and non-market services – the two key drivers of aggregate productivity growth in the post-crisis period.

4.2. Internal rate of return

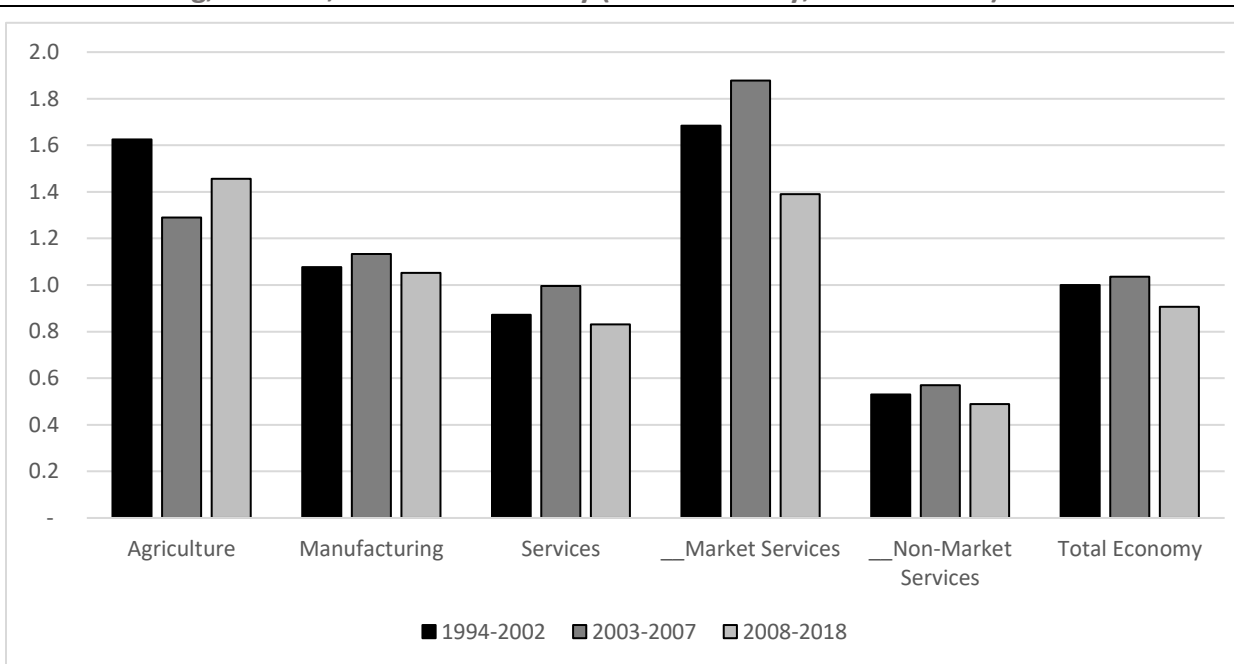
This section compares our estimates of the internal rate of return, which has a bearing on the decision of enterprises to invest in new capital assets. The internal rate of return on capital investment, which reflects realized marginal products of capital (Berndt 1990), is calculated using the neoclassical approach, setting pure profits to zero under the assumption of perfect competition (see Hall and Jorgenson 1967). In this framework, the internal return, or the *ex-post* rate of return, is a ratio of the compensation accrued to the capital assets after allowing for any depreciation costs over the nominal value of the capital stock. This approach accounts for the differences in the asset composition of capital stock. Figure 7 provides the average internal rate of return for the manufacturing and services sectors, along with the total economy for the three time periods. The estimates are indexed to total economy rates in 1994-2002 period.

Similar to aggregate investment rates, rate of return also improved in the 2003-2007 period over the 1994-2002 period, albeit marginally. However, both in

the manufacturing and services sectors, 60 percent of industries had a fall in the rate of return during this period (Table 3). Capital-intensive manufacturing industries such as basic metals & metal products, chemicals & chemical products, and electrical & optical equipment were among the industries with improved rates of return. In the service sector, market services industries such as financial services, hotels & restaurants, and transport & storage showed a similar trend.

While the manufacturing sector has shown relatively little variance in the rate of return over the three time periods, a substantial difference is observed in the services sector, particularly in the market services (Figure 5). The market services sector has shown a rapid rise – much higher than manufacturing and non-market services – in the rate of return in the 2003-2007 period.

Fig. 5: Indices of the average internal rate of return – pre and post-crisis years, agriculture, manufacturing, services, and total economy (total economy, 1994-2002=1)



Notes: Internal nominal rate of return is measured as $(M_t - \sum_i [\delta_i \cdot p_{i,t}^I \cdot K_{i,t} - (p_{i,t}^I - p_{i,t-1}^I) \cdot K_{i,t}]) / \sum_i p_{i,t-1}^I \cdot K_{i,t}$, where M is capital compensation measured as value added minus labour compensation, δ is depreciation rate, P^I is investment price, and K is capital stock. The subscripts i and t stand respectively for asset and year. We consider three asset types, machinery, transport equipment and construction.

Source: See Table 1

In the post-crisis years, the aggregate economy rate of return declined to a level below the 1994-2002 levels. The decline was more intense in the market services sector, but the trend was not unique to the sector. Although more than half of the manufacturing industries showed an improvement in the 2008-2018 period compared to 2003-2007 (Table 4), it was insufficient to offset the larger fall in other industries. Only three industries, chemicals & chemical products, electrical & optical equipment, and pulp & paper products, had a higher rate of return in the post-crisis period than the 1994-2002 period. Of these, chemicals & chemical

products and pulp & paper products had a retreat in investment rates, as we observed in the previous section.

The rate of return in agriculture improved in the post-GFC period from the 2003 to 2007 period, although it still remained lower than the 1994-2002 average. Moreover, it is relatively higher than in manufacturing and services. It was lower than market services in the pre-crisis years, but the rapid fall in market services in the post-GFC period from the 2003-to 2007 period and the rise in the agriculture sector keeps the latter above even market services.

Except for financial services, all services industries had a retreat in the rate of return in the post-crisis period. The financial services had a boom, reaching far above its own rate of return in the 1994-2002 period. Other market services industries, primarily trade, hotels & restaurants, post & telecom, and business services, all had a falling rate of return. Among the non-market services, public administration and other services had a moderate fall, whereas education and health & social work industries had larger declines. Moreover, except for trade, financial services, hotels & restaurants, education, and health & social work, all other service industries had a level below or similar to the aggregate economy rate of return.

Table 4: Indices of the average internal nominal rate of return in agriculture, manufacturing and services industries (Total economy, 1994-2002=1)

	1994-2002	2003-2007	2008-2018
Agriculture & allied	1.63	1.29	1.45
Manufacturing			
Food pdts., beverages & tobacco	0.80	0.93	0.81
Textiles & leather	1.08	0.79	0.73
Wood & wood pdts.	4.15	1.23	1.35
Pulp & paper pdts.	0.27	0.37	0.41
Coke & petroleum pdts.	2.77	2.76	2.27
Chemicals & chemical pdts.	0.90	1.25	1.59
Rubber & plastic pdts.	1.76	1.12	1.20
Non-metallic mineral pdts.	1.18	0.90	1.00
Basic metals & metal pdts.	1.03	1.35	0.81
Machinery, nec.	2.42	1.86	1.67
Electrical & optical eqpt.	0.84	1.06	1.26
Transport eqpt.	1.83	1.75	1.56
Other manufacturing	0.77	0.49	0.68
Services			
Trade	5.77	5.62	2.99
Hotels & restaurants	1.73	2.25	1.23
Transport & Storage	0.58	0.92	0.63
Post & telecom	1.94	1.82	0.93
Financial services	2.51	2.87	3.85
Business services	1.83	1.47	0.91
Public administration	0.35	0.27	0.25
Education	3.24	2.19	1.58
Health & social work	2.79	1.89	1.12
Other services	0.51	0.60	0.51
Total economy	1.00	1.04	0.91
Note: See Fig. 6.			
Source: See Table 1.			

Thus, the story here is that of a moderate rise in the rate of return in the total economy in the pre-crisis years after 2002 and a fall in the post-crisis years, both driven mainly by the market services sector. On the contrary, this sector has seen a rise in investment rates in the post-crisis years. Although the agricultural sector sustained relatively higher rates of return, albeit a fall from the pre-crisis period, its

relatively low investment rates keep its effect on the aggregate rate of return minimal.

5. Concluding Remarks

Four points emerge from the analysis presented above. First, the manufacturing sector contributed significantly to India's economic growth in the high-growth phase of 2003-2007, and in the post-GFC period. It has been the main contributor to TFP growth in the Indian economy since 2003.

Second, despite its relatively better productivity performance in recent years, the manufacturing sector has substantial challenges. These are evidenced by a fall in employment and investment rate and a decline in the rate of return on investment in the post-GFC period. Thus, it may be argued that while the manufacturing sector continues to contribute to India's economic growth, to attain sustainable acceleration in future growth, it will have to play an even larger role, addressing its structural challenges.

Third, the falling return on capital and the retreat in productivity and employment growth rates may challenge the outlook of the market services sector. One advantage this sector is its relatively low capital-output ratio. It may be noted that, despite the fall in the rate of return in this sector in the post-GFC period, the rate of investment has been somewhat improved. Moreover, the market services sector has been the main contributor to the aggregate real GVA growth in the three sub-periods 1994-2002 and 2003-2007 and in the post-GFC period 2008-2018. It seems that to maintain and step up the growth momentum in the aggregate economy, the market services sector needs to grow fast. A part of the growth of

this sector may come from the domestic economy. But attention needs to be paid to fuller exploitation of the growth potential from exports.

The final point is about the role of agriculture. Because of the declining share of agriculture in aggregate GVA and the fall in the absolute size of its employment reflecting the shift of workers from agriculture to other sectors of the economy, attention has shifted away from agriculture in discussions on the future potential for economic growth in India. Yet, the experience of the post-GFC period suggests that the sector is an important contributor to aggregate economy real GVA and TFP growth. While the sector possesses a relatively low investment rate compared to the manufacturing and services sectors, the rate of return is relatively high in the sector and has even improved in the post-GFC period. It appears that policy actions for raising TFP growth in agriculture would help improve the aggregate economy TFP growth, without which a step-up in India's economic growth would be hard to attain. Moreover, existing evidence suggests that the acceleration in growth in the sector per se does not translate into farmer incomes (Krishna and Meenakshi 2022). This further reiterates the importance of enhancing productivity as an essential pathway to facilitate translating growth into welfare. The increases in productivity in agriculture need to be accompanied by the creation of ample productive employment opportunities in manufacturing and services to make the development process more rapid and, at the same time, more inclusive.

To recap, our analysis reiterates the need to strengthen the three main sectors of the economy – agriculture, manufacturing, and market services – realizing their productivity and input (employment and investment) potential, along with facilitating growth-enhancing resource reallocation. This tends to

support Dev (2021)'s suggestion to have a broad policy agenda to address a broad range of India's developmental issues, such as reducing inequality, improving social indicators and human development, creating better quality jobs, improving health and education, and addressing sustainability issues. Many of the suggestions made by Dev (2021) for policy action for raising the growth rate of the Indian economy are predominantly directed at building up the supply-side of the economy, e.g., raising the rate of investment, ensuring sufficient credit supply, bringing in new technology, enhance the quality of labour through betterment of health and education. These recommendations are in harmony with analysis in the paper and policy suggestions emerging therefrom.

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