What is New about India's Economic Growth 1980-2012: The Industry Perspective using KLEMS dataset

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Abstract

The dynamics of Economic Growth in India continues to engage economists and still remains an enigma. The trends and patterns of growth observed in India have seen acceleration in growth in Indian economy in the period following macroeconomic reforms and policy changes in investment and trade regimes. However, when and how did India transformation from itself Hindu rate of growth to the present growth regime continues to be debated. The present study using INDIA KLEMS dataset provides a highly novel, very valuable, and quite distinctive perspective on India's economic growth. A unique dataset comprising 27 sectors of Indian economy at a disaggregate industry level for a period of 30 years attempts to understand the dynamics of India's growth from the contribution of industries that comprise the Indian economy. This DATA SET offers a new way of analyzing the dynamics of growth including the sources of growth. Our growth empirics allow evaluation of the relative significance of multi factor productivity growth *Vis-a-Vis* input accumulation in accounting for output growth. In addition, we are able to document the industry contributions to aggregate growth. In this way, we are able to analyze how important are different sectors of the economy- agriculture, manufacturing, construction, market as well as non-market services in accounting for the observed growth in India. In conclusion, the industry perspective offers a fresh and novel way of discerning new aspects of India's march to higher growth regimes in post 1990s era.

Key words- Industry origins of growth, KLEMS dataset, TFP versus input accumulation
JEL classification- D24, L6, F43, O47, O53

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1. Introduction

India's 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 has been many studies discussing various aspects of this growth process (Das et al, 2015; Bhagwati and Panagariya, 2013; Verma, 2012; Balakrishnan, 2010; Eichengreen, Gupta and Kumar, 2010; Bosworth and Collins, 2008; Panagariya, 2008; Kochar et al, 2006; Vaidyanathan and Krishna, 2007). In particular, several interesting dimensions of India's growth story are already documented in the literature. First, there have been several debates centering on when and how did India transform from a country with a Hindu rate of growth to one which is high and being driven by services sector- "The turn-around controversy" (Rodrik and Subramanian, Bradford de Long, Williamson and Zagha). Second, the determinants of economic growth- attitudinal change (Subramanian 2007) versus economic policies (Bhagwati and Panagariya) have been argued. Third, the political economy dimension on whether Nehruvian era and resultant economic growth – christened the *Hindu growth rate* have actually been periods of no return have been intensely researched (Kohli, Corbridge, and Rajiv Kumar). Scholars have also examined issues of savings-investment puzzle to track India's growth performance (Rakesh Mohan, SL Shetty). Last but not the least, international dimensions of India's growth path and romanticizing India-China growth comparisons have been discussed (Bosworth, Collins and Virmani). Finally, we have revised estimates of GDP growth following new methodology adopted by the National Accounts of India. Therefore it becomes imperative to ask - *What's new about India's economic growth?*

It is well known that India is now more than two decades into economic reforms (1991-2015). Further reforms have encompassed all segments of Indian economy including manufacturing and services. From a major overhauling of industrial policy, lowering of tariff as well as non-tariff barriers, there has been a lagged but positive impact of reforms (Das 2015). Indian Economy has grown at an average annual rate of 7 percent since 1996 for a period of 15 years, with not so much annual deviation from the mean growth rate. Even when the global economy was suffering from recession in 2008 and 2009, Indian economy grew at about 6 to 8 percent, though the rate of growth has slowed down significantly to an average of 5 percent in the last three years. Obviously, the growth in the late 1990s until 2010 was way higher than the average growth rates India had achieved before the 1980s (Das et.al 2015). One important aspect of the observed growth process in India that needs to be raised here concerns India's total factor productivity growth - how has India fared with respect to overall efficiency of resources (TFP). It is often argued that in emerging economies, growth is attributed to input accumulation and not resource efficiency. Further, it is also important to go beyond the numbers and analyze the sectors that contributed to the growth momentum. It is well known by now that services have driven the outstanding growth achieved by India in much of 1990s and 2000s; however what is not known is that how have different industries which constitute the aggregate economy fared in this growth story? Can we say what has been the contribution of construction, energy, market services - in particular, business and financial services, manufacturing of investment goods versus consumer goods in driving the overall economic growth?

The paper provides a novel as well as a very valuable and distinctive perspective of India's economic growth. Using a new dataset - INDIA KLEMS DATASET**,** we are able to trace the aggregate economy level growth to the industry of origin. The paper presents a new dataset for the Indian economy as a whole and a new way of looking at the growth numbers. Using output, input and total factor productivity data for 27 component industries of Indian economy for the

period 1980-2012, we examine the sources behind the aggregate GPD growth number and to industry origins of India's economic growth. The paper covers the crucial period of the acceleration of economic growth when a lot of policy changes were introduced in several of these disaggregated sectors of Indian economy. Consequently, an industry level analysis allows for new perspective on growth trends in the India to capture the impact of policy changes at the sectoral level

Both growth skeptics and others may question the need to engage with a new dataset – India KLEMS dataset. There are several strong reasons as to why this may be fruitful. An overview of India's growth rate based on aggregate data could be worrisome as it may often mask the vast heterogeneity underlying the aggregate data. Few industries could dominate the growth process at the expense of other industries and the contribution of these industries could change over a period of time. Further aggregate results often are misleading as it does not reflect the variations across industries in assessing the overall growth. It is also important to understand that variations within a particular sector are important- for example, it is well established by now that post 1991 reforms, services have been the engine of growth in India. But what is not known is that it is market services that contribute more to overall service sector growth than does non-market services. A disaggregated growth accounting makes it possible to dig deeper insights into India's growth transition story.

The paper is structured as follows. We document an overview of India's economic growth story in the context of review of Indian economic growth experience during the period 1980-2011 in section 2. The new dataset is explained in section 3. The methodology underlying the growth empirics is outlined in section 4. The next section analyzes what's new about India's growth providing an industry level perspective. The final section concludes our findings and ends the paper.

2. **India's Growth Story- What we already know!**

India provides a fascinating case study in the realm of growth literature. Although India's growth performance seems to have been propelled by the traditional prescriptions of deregulation and ease of entrepreneurship, it has little in common with the so-called "East Asian" model of growth. In what follows, we first discuss the broad trends and structural breaks that characterize GDP growth in India. We follow it up with an overview of reforms underlying the breaks in GDP growth. This is corroborated with studies showing trends among broad sectors, and the role of TFP in India's growth performance.

India's growth story is generally considered to start from 1950-51, the year from which regular data on national income for the country is available. This post World War II phase in India's economic history is characterized by a move to Fabian socialism, central planning and "inward" looking policies initiated by the Nehruvian governments. The plethora of bureaucratic red tape and license controls caused the national income to grow at a modest rate of 3.5 percent per annum. The country remained stuck at this low level steady state growth path for at least the next three decades – the so called 'Hindu rate of growth', a term popularized by Prof. Raj Krishna in the seventies. This

was broken in the decade of the 1980s when the growth rate of GDP surged to 5 percent per annum and further increased to 6 percent per annum in the 1990s (Kotwal, 2010). The year 1990-91 is considered to be a watershed in the history of India's economic growth and development – a series of extensive liberalization policies in the wake of the BOP crisis saw India embark as one of the fastest growing countries along with China and Vietnam. However after growing at the impressive average GDP growth rate of around 6 percent per annum between 1980 to 2011, the growth rate declined from a high of 9 percent in 2011 to 6.7 percent in 2012 to a low of 4.5 percent in 2013 (Patnaik and Pandit, 2014). Some studies show that this decline in growth rate is a decline in trend, having reached the peak growth rate of around 8 percent in the period between 2002-07/08 (Anand, Cheng and Rehman, 2014; Acharya, 2006). On the contrary, estimates for the next twenty years show that India's current growth rate is well below its potential and modest reforms can see India sustain a GDP growth rate of around 7 percent (Rodrik and Subramanian, 2004).

While the preceding analysis of the GDP growth rate trends is insightful in its own accord, there have been suggestions in some sections that it is more interesting to study sudden changes in the GDP growth rate of a country. This led to an extensive body of literature trying to identify the structural breaks in the growth rate of GDP for India. However, evidence on this account is at best controversial. Conventional wisdom points out to the watershed year of 1991 as the primary structural break in India's GDP growth rate. This strand of literature argues that the large scale reforms that led to deregulation and liberalisation of the Indian economy was primarily responsible for the high growth rate of the 1990s (Basu and Maertens, 2007; Panagariya, 2008; Virmani, 2004, 2006). The other view counters the conventional wisdom by pointing to the fact that the growth rates between the 1980s and 1990s were not significantly different. Instead they find two structural breaks in the GDP growth rates – one in 1980, when the growth rate surged to 5 percent from the 'Hindu Rate of Growth' of 3 percent per annum. For instance, Virmani (2005) controls for variations in rainfall and finds a breakpoint in the GDP growth rate of India in 1980. The other breakpoint is found, instead of 1990, to be around 2003 (Bindal, 2011). This controversy sparked a debate among economists and policy makers regarding the effectiveness of reforms and thus the source of the surge in GDP growth rate.

It is clear that there is some consensus that the surge in India's GDP growth began with piecemeal reforms introduced in the 1980s by the Rajiv Gandhi government. However, it is generally difficult to pinpoint to particular subset of reforms that triggered the growth of the economy and different studies have shown different policies as the key factor behind the structural break. While some studies focus on the "pro-business" attitude of the Rajiv Gandhi government, others have focused on greater access to credit available to the industries. The "inward" looking strategies of the post World War II period (when India suffered from the "Hindu Rate of Growth") came in contrast to the "pro-business" attitude that was brought about by the Rajiv Gandhi government in the 1980s. Corporate tax restructuring and deregulations undertaken during this time pushed the economy towards the production possibility frontier, pushing the steady state growth rate to above 5 percent per annum in this decade (Rodrik and Subramanian, 2004;

Kohli, 2006). The modest change in outlook of the government, along with oil price rise during the Gulf War deepened the financial crisis in the 1980s and ultimately culminated in the BOP crisis of 1990. The proponents of the saving-investment line of reasoning point to the large scale nationalisation of banks undertaken during the Indira Gandhi reign and an amoebic growth of bank branches all over India. This propelled the economy by channeling large amounts of savings to investment (Basu and Maertens, 2007). The rate of investments improved, fuelled by an increase in public and corporate investment, from the second half of the 1970s and remained at around 22-23 percent per annum. These policies formed part of the broader goal envisaged by the then government – prioritising economic growth and supporting big business to achieve this goal (Kohli, 2006; Kochar, 2006). The greater access to credit, along with "pro-business" policies, helped the incumbent industries to maximize production and enhance their efficiencies. The Narsimha Rao government came to power in 1991 and embarked on opening India to the world economy. Extensive policies included devaluation, fiscal contraction and freeing the controlled investment regime. This outlook of reforms gradually expanded into other areas of the economy over the next ten years-agriculture, insurance, capital market and full-blown privatisation (Williamson and Zagha, 2002; Kohli, 2006). Despite the extent of these reforms, it has generally been recognized that the average growth rate in this decade has not been significantly higher than the 1980s (Rodrik and Suramanian, 2004; Balakrishnan, 2005; Kohli, 2006; DeLong, 2001; Bindal, 2011). A general lack of macroeconomic policy like declining budgetary support to capital formation and lacking monetary policy prevented the economy from reaching its potential in the post reform period (Balakrishnan, 2005). Consequently the sustained period of high growth did not last beyond 2010-11. Some studies find this decline part of a cyclical downturn, propelled partly by a fall in investment due to subdued external demands and partly due to policy uncertainty (Patnaik and Pandit, 2014; Acharya, 2006).

Although the analysis of GDP growth rates and the political economy factors that affected it shed light on the growth process itself, a disaggregated picture often reveals interesting dynamics occurring in the economy. In broad terms, some studies have analysed the effect of the GDP growth rate on the broad determinants of development like geography and political institutions. It has been shown that given the level of development, India has yet to reach its potential growth rate (Rodrik and Suramanian, 2004; DeLong, 2001). Breaking up the overall GDP into its sectoral components, there have been a few studies that look into the sectoral origins of GDP growth in India. Services have outperformed the other sectors in the period of study – through rising demands in 1980-90 and through reforms allowing FDI in the service sector from the 1990s. However its contribution to employment has been modest, mostly feeding off the skilled labour that was created due to prior emphasis on tertiary education in the 1980s. Similar conclusions have been reached by other studies attempting to analyse the structural breaks in the major sectors of the economy (Bindal, 2011). Agriculture series' break point of 1965 does not coincide with that of the GDP break points. It was most likely induced by the onset of the Green Revolution. Service sector is shown to have significant breakpoints that coincide with the first aggregate breakpoint of 1982. In another study, Virmani (2005) shows that the acceleration brought about in the

manufacturing sector since 1980 had played a major role in the surge of growth rate from that year onward (again controlling for variations in rainfall). A similar analysis on the service sector showed that beginning from a modest contribution to GDP growth in 1980-1985, this sector played a major part in the growth story post-1985. The trend of improving service sector and stagnant industrial sector has continued into the decade of the 2000s. There was a marked shift in the pattern of growth towards non-tradable sectors like banking, mining and insurance (Sen and Kar, 2014). There have been some studies which show that the policies discussed above culminated into better growth performance through improvements in TFP. Basu and Maertens (2007) have shown that TFP was a major contributor of post-1980 growth in India- with services playing a predominant role over agriculture in this period. The trend of TFP growth in India seems to mirror that of GDP – very stable during 1980-90 with a large upsurge in 1980. This suggests that India has relied less on deferred gratification and more on productivity to motor its growth even compared to East Asia (Rodrik and Subramanian, 2005). However rigid laws and other constraints did not allow this high productivity channel into exports of labour intensive goods. Following the initial reforms of the 1980s, the authors find that manufacturing in India has failed to keep up with the world average, while services surged ahead. Movement of labour from low to high productivity activities has been void in India since the 2000s.

Although India provides a fascinating subject from a growth perspective – its growth performance corroborated with the predominance of services, there has hardly been any study of India's growth experience at the industrial level. A detailed analysis of individual industries would provide information about which industries have been behind India's growth performance, something masked by the traditional broad perspective studies. This may pinpoint to more accurate policy prescriptions to enable India to achieve the proposed 8-9 percent per annum growth rate of GDP over the next years (Rodrik and Subramanian, 2005; Acharya, 2007)

3. A New Way of understanding India's Growth Dynamics: The India KLEMS Dataset

The India KLEMS dataset is a unique dataset based on EU KLEMS dataset and consists of a panel of 27 industries for the period 1980-2012 for the Indian economy. In particular, data on output, input and measures of total factor productivity and labor productivity are available at the industry level for undertaking research and quantitative analysis on growth and productivity aspects of Indian economy. The India KLEMS data offers new ways of addressing issues connected with the development agenda of an emerging country's growth – aspects like productivity, employment creation, capital formation and technological change at the disaggregate industry level for industries which comprise the Indian economy. It also provides a sectoral dimension – agriculture, manufacturing, energy, construction, electricity, gas and water and services – both market services and non-market ones. The input measures include various categories of capital (K), labour (L), energy (E), material (M) and service inputs (S). The variables which comprise the dataset are based on the growth accounting methodology. A major advantage of growth accounts is that it is embedded in a clear analytical framework rooted in production functions and the theory of economic growth. It provides a conceptual framework

within which the interaction between variables can be analysed, which is of fundamental importance for policy evaluation.

The distinguishing features of this dataset are manifold. A key objective of the database is to move beneath the aggregate economy level and examine the performance as well as contribution of individual industries to the observed aggregate growth. The database has been constructed on the basis of data available in public domain (Central Statistical organization (CSO), Government of India, Ministry of Statistics and Program Implementation, India), Annual Survey of Industries covering India's formal manufacturing industry sub-groups and National Sample Survey Organization (NSSO) rounds to cover the informal manufacturing industry sub-groups. Several benchmark Input-output (IO) tables were used to measure important variables. Further, it also utilizes data not available in public domain, but available with the cooperation of national statistical offices. In addition, several information especially on asset structure of manufacturing industries, collected but not disseminated publicly were made available. Further, the dataset is deeply rooted in the National Accounts Statistics of India (NAS) and has the followed the several harmonizations followed in the EU KELMS dataset, which in turn was based on the European system of national and regional accounts (abbreviated as ESA95) to make it comparable across countries.

The database covering the period 1980-81 to 2011-12 has been constructed on the basis of data collected from CSO, NSSO, ASI, Input-Output tables (IO tables) and processed according to the procedures prescribed below. These procedures were developed to ensure harmonization of the basic data, and to generate growth accounts in a consistent and uniform way. Harmonization of the basic data has focused on a number of areas such as industrial classification and aggregation levels. There are also various gaps at industry level, for which data are not available. The dataset currently covers 27 industries comprising the entire Indian economy. Following are the main sources of growth measured in the India KLEMS dataset which are relevant for this paper:

- *Labor input:* various concepts of labor input (employees, self-employed) and harmonized measures of persons engaged have been developed.
- *Capital services input:* capital service input has been measured in a standard way, using harmonized depreciation rates and common rules to deal with a variety of practical problems, such as weighting and rental rates.
- *Intermediate inputs [Energy (E), Material (M) and Services(S)]* have been measured using IO tables and interpolated to arrive at the time series of intermediate inputs.
- *Total Factor productivity or Multi Factor Productivity measures:* TFP has been generated on the basis of a gross output production according to a standard methodology of growth accounting. We have also generated TFP based on a gross value added production function.

3.1 Coverage: Industries and Variables

In this section we describe the coverage of the India KLEMS dataset in terms of industries and variables. In principle, the 30 year period covered is from 1980-81 to 2011-12. At a disaggregated level, dataset is created for 27 industries. The industrial classification is constructed by building concordance between NIC 2008, NIC 2004, NIC 1998, NIC 1987 and

NIC 1970 so as to ensure continuous time series from 1980 to 2011. This classification is very close to the International Standard Industrial Classification (ISIC) revision 3. The 27 industries are aggregated to form nine broad sectors namely:

- Agricultural, Hunting, Forestry and Fishing
- Mining and Quarrying
- Manufacturing- consumer goods
- Manufacturing- intermediate goods
- Manufacturing- investment goods
- Electricity, Gas and Water supply
- Construction
- Services- Market services
- Services- Non Market services

The main variables in the dataset are two indicators of economic growth at the industry level – value added based measure of growth and a measure of growth based on gross output specification of a production function. For an individual firm or industry, productivity measure can be based on a value added concept where value added is considered as an industry's output and only primary inputs such as labour and capital are considered as industry input. Value added based productivity measures reflect an industry's capacity to contribute to economy-wide income and final demand. In this sense they are valid complements to gross output based measures. The gross output of an industry is defined as the value of industry production using primary factors like labour, capital and intermediate inputs purchased from other industries. The gross output production function is separable in inputs and technology. An important advantage of gross output approach is that it provides a complete measure of production and treats all inputs - labour, capital and intermediate inputs symmetrically. In contrast, the value added measure of output does not explicitly account for the flow of intermediate inputs which may be the primary component of an industry's output. We use the more restrictive value added concept primarily because it is useful for aggregation purposes.

The National Accounts Statistics (NAS) brought out by the CSO (Central Statistic Office, Government of India) is the basic source of data for the construction of series on gross value added for KLEMS industries. NAS provides estimates of GDP (i.e. gross value added) for Indian economy at a disaggregate industry level at both current and constant (1999-2000) prices since 1950-51. To construct the gross output series at industry level we use multiple data sources namely National Accounts Statistics, Annual Survey of Industries, NSSO rounds for unorganized manufacturing and Input Output Transaction tables.

Out of the five variables in the India KLEMS dataset, the labor input series and capital input series are considered as the two primary inputs**.** Labour input is measured by combining data on labour persons and data on education. In the KLEMS framework it is desirable to estimate changes in labour composition by industries on the basis of age, gender and education. The measurement of labour composition is essentially an attempt to distinguish one labour type from the other taking into account the embodied human capital in each person. The source of human capital could be through investment in education, experience, training, etc. The contribution to output by each person also comes from this embodied capital and the reward (wages and earnings) to each person includes the reward for investment in human capital. Therefore, it is essential to separate out these differences in labour to clearly understand the underlying

differences in labour characteristics. It is in this context that an endeavor has been made to estimate a labour composition index. Therefore to build a time series of employment series for 27 industrial sectors is a challenge as there does not exists time-series data on Indian economy, except for the organized segment. Therefore, it was essential to make certain assumptions regarding the annual changes in the employment series using available information. The large scale Employment and Unemployment Surveys (EUS) by National Sample Survey Organization (NSSO) and the estimated population series based on the decennial population census are the main data sources for estimating the workforce by industry groups, as per the National Industrial Classification (NIC). Population for the intervening years is calculated by interpolation.

The technique employed to estimate capital services by asset type draws on the theoretical aspects developed by Dale Jorgenson et al (as developed by Jorgenson and Griliches, 1967, and outlined in Jorgenson, Gollop and Fraumeni, (JGF), 1987, Chapter 4). For the measurement of capital services we need capital stock estimates for detailed assets and the shares of capital remuneration in total output value. Therefore to take account of asset heterogeneity, it was essential to obtain investment data by asset type. We distinguish between 4 different asset types – construction, transport equipment, non-ICT machinery, ICT equipments (hardware, software and communication equipment). Though India is a leading ICT software producing country, there is little information about the use of ICT as an input in the production process across different industries. Therefore, we exploit multiple sources of information for the construction of our database on capital services. This includes the National Accounts Statistics (NAS) that provide information on broad sectors of the economy, the Annual Survey of Industries (ASI) covering the formal manufacturing sector, the National Sample Survey Organizations (NSSO) rounds for unorganized manufacturing, Input-Output tables and CMIE's Prowess firm level database. Even though we use multiple sources of data, our final estimates are fully consistent with the aggregate data obtained from the NAS.

The methodology for measuring intermediate inputs was developed by Jorgenson, Gallop and Fraumeni (1987) and extended by Jorgenson (1990 a). The cornerstone of this approach is a time series of input output (IO) tables which gives the flows of all commodities in the economy, as well as payments to primary factors. Every commodity is accounted for, whether produced by a domestic source or imported, and every use is noted - whether purchased by an industry or by a final demand element. All payments to factors of production i.e. labour and capital is accounted for so that all income elements of GDP are included. The methodology of constructing time series on energy, material and services input for the European economy has been elucidated in Timmer et al. (2010, Chapter 3). Following a similar approach as explained in Jorgenson et al. (2005, Chapter 4) and Timmer et al. (2010, Chapter 3), the time series on intermediate inputs for the Indian economy has been constructed.

The key building block for constructing time series on Intermediate Inputs at current prices, as explained in Jorgenson et al. (2005, Chapter 4), is the input-output transaction tables, that is, the inter industry transaction tables that provide a description of which industries produce each product and which industries use them. The input-output table gives the inter-industry transactions in value terms at factor cost presented in the form of (commodity X industry) matrix where the columns represent the industries and the rows as group of commodities, which are the

principal products of the corresponding industries. Each row of the matrix shows in the relevant columns, the deliveries of the total output of the commodities to the different industries for intermediate consumption and final use. The entries read down industry columns give the commodity inputs of raw-materials and services, which are used to produce outputs of particular industries. The column entries at the bottom of the table give net indirect taxes (NIT) (indirect taxes – subsidies) on the inputs and the primary inputs (income from use of labour and capital), i.e., Gross Value Added (GVA). As the IOTT is in the form of (commodity X industry) matrix, the row totals do not tally with the column totals. The difference between each column and the corresponding row totals is due to the inclusion of the secondary products, which appear particularly in the case of manufacturing industries. This is so because by-products are also manufactured by industries in addition to their main products. Thus, while determining the entries in the rows, a by-product of an industry is transferred to the sector (commodity row), whose principal product is the same as the by-product under reference. The columns, however, show the total of principal products and by-products of each industry. All the entries in the IOTT are at factor cost, i.e. excluding trade and transport charges and NIT.

Finally, the distribution of income between capital, labour and intermediate inputs, is an important element in growth accounting because income shares, under conditions of competitive markets, can be used to measure the contributions each factor makes towards output growth. There are no published data on factor income shares in Indian economy at a detailed disaggregate level. *National Accounts Statistics* (NAS) of the CSO publishes the NDP series comprising of compensation of employees (CE), operating surplus (OS) and mixed income (MI) for the NAS industries. The income of the self employed persons, i.e. mixed income (MI) is not separated into the labour component and capital component of the income. Therefore, to compute the labour income share out of value added, one has to take the sum of the compensation of employees and that part of the mixed income which are wages for labour.

The last measure is that of total factor productivity (TFP) growth for individual industries in the KLEMS framework and the aggregation from industry level productivity measures to measures for broad sectors and the economy as a whole. The methodology of analysis of sources of gross output growth at the individual industry level and sources of GVA (Gross Value Added) or GDP growth at the broad sector level and economy level are based on Jorgenson et al (1987) and discussed in details at the India KLEMS data manual.

We end with the assertion that there are several outstanding issues in the database creation – which form the area of further research to update the dataset and also correct for any data discrepancies that may exist. It may be important to point out that wherever there is lack of consistent time series data - especially in use of NSSO rounds or IO tables, several assumptions have been made in order to interpolate the end point data to generate a continuous series and hence robustness checks have been done at appropriate steps. Similarly in case of capital services measurement, there are issues with investment in ICT assets, rate of depreciation, and rate of return which need scrutiny. Finally for variables like gross output, intermediate inputs and capital inputs, issues remain with base revisions to 2004-05 and subsequently to 2011-12 base years as India statistical agencies are shifting the base year to 2011-12.

In the end, the India KLEMS dataset belongs to the World KLEMS data initiative of making possible comparative studies on sources of growth and decomposition of growth into input accumulation or productivity enhancements. The richness of the India KLEMS database stems from the fact that comparisons with several countries of similar size- Brazil, China, Russia is possible. Further the dataset

allows useful analysis both at the aggregate and industry level of issues like energy efficiency, services out sourcing, skill formation and investment in ICT assets. The dataset is publicly available for researchers as well as policy makers etc and is based on the National Accounts system (NAS) of India, which lends credibility as well as quality to the dataset.

4. Methodology of the Study: Overall Growth and its source

In this section, we discuss the methodology used to construct aggregate estimates of productivity growth and the sources of aggregate value added growth. The methodology is heavily drawn from Jorgenson et al (2012). We use the direct aggregation method suggested by Jorgenson et al (2012), which is explained in detail below. Estimates of productivity and output growth using the below-mentioned methodology are constructed for 27 industries that cover the entire Indian economy during the time period 1980-2012. 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 sectoral productivity growth, using the approach suggested by Harberger (1998), and employed in Timmer et al (2010).

The most common approach to measure aggregate economic growth and its sources is to assume an aggregate production function. In this setting inputs and value added are aggregated across industries to obtain aggregate volume indices under strict assumptions on the nature of production function and industry detail (Jorgenson et al, 2012)6. Jorgenson et al (2005) employ a less restricted production possibility frontier approach that relaxes the restrictions on industry value added functions, that value added prices are identical across industries. In this setting, the aggregate value added is not aggregated across industries; rather it is a translog index of industry value added. The production possibility frontier, however, does not relax the assumptions on input measurement. In this paper, we use another approach, suggested by Jorgenson et al (2012). This is the direct aggregation across industries that relax many assumptions on input and output measurement. The difference between the production frontier and direct aggregation will give us indication on resource reallocation across sectors. In what follows we discuss the production possibility frontier and direct aggregation approaches in detail.
We define aggregate value added as a translog index of industry value added as:

1

where V_i is the industry value added and s_i is the share of industry *i* in aggregate nominal value added, measured as:

2 where P_{vi} is the price of industry value added. is the two-period average share defined as:

3 Following the standard growth accounting methodology, the aggregate value added growth under production possibility frontier approach can be decomposed into contributions from aggregate capital inputs (K), aggregate labor inputs (L) and aggregate MFPG (A) as:

4 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. Aggregate capital and labor

compensation are derived from the identity that total nominal value added is the sum of aggregate labor and capital compensation. Aggregate capital and labor inputs are measured as the flow of services from these inputs to the production process. Since aggregate capital and aggregate labor inputs consists of different types of capital assets (e.g. machinery, computers, buildings) and labor types (low skilled, high skilled etc.), it is important to account for the possible heterogeneity while measuring these inputs, as their marginal productivities may differ. Therefore following Jorgenson (1963), we define aggregate capital services and labor input as translog aggregates of heterogeneous type of capital and labor,

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:

6 As before is the two-period average of these shares.

Sectoral TFP growth is measured using the standard growth accounting approach (see Jorgenson et al, 2005) using both value added functions – using K and L only and gross output – using factor inputs capital (K), labor (L), energy (E), material (M) and services (S). We can compute TFP and factor contribution using a value added function as:

7 where is the growth rate of factor productivity and are respectively the compensation shares of capital and labor in nominal value added, so that the sum of the two is unity, under constant returns to scale assumption.

In the case of sectoral TFP growth based on five factor inputs, it is assumed that gross output production is separable in capital, labour and technology. Let the production function for industry i be denoted as:

8 where Y is industry gross output, K is capital input, L is labour input, E is energy input, M is material input S is services input, and A is an indicator of technology in any industry i. All variables vary over time t, but the t subscript is not shown explicitly, for the sake of simplicity. Assuming constant returns to scale, and perfect competition, industry output can be decomposed into the contribution of factor inputs and TFP using a Tornvqvist aggregation:

9 and the gross output based TFPG is obtained as a residual:

10 Or equivalently as:

11 where $s_{K,i}$, $s_{L,i}$, and $s_{X.i}$ are respectively the share of capital, labor and intermediate input in total nominal output in industry i. The relationship between industry output and industry value added can be written as:

12 where V_i is the industry value added, and $s_{v,i}$ is the share of industry value added in industry gross output. Re-arranging equations (11) and (12), and assuming that aggregate value added is a translog sum of industry value added (equation (1)), we can re-write aggregate value added in equation (4) as:

13 In equation (13), aggregate value added growth is the weighted contribution of industry capital input, industry labor input and industry MFPG. The weights on capital and labor consists of s_i, the share of industry value added in aggregate value added, $s_{K,i}$ and $s_{L,i}$, the share of industry capital and labor compensation in industry gross output and s_{vi}, the share of industry value added in industry gross output. The first and last components of the input weights (s_i and s_{vi}) also reflect in the MFPG weights. In

equation (4), we had aggregate MFPG, defined as:

14 Subtracting equation (13) from (14), and rearranging, we obtain

15 Equation (15) suggests that aggregate MFPG can be decomposed into weighted average of industry MFPG and the capital and labor reallocation across industries. Note that the weights attributed to industry MFPG in this setting is equivalent to the well-known Domar weight (Domar, 1961). The weight in equation (15) is the ratio of s_i, or industry share in aggregate value added and s_{vi} or the industry value added share in aggregate output, which approximates to the Domar weight, which is the ratio of industry gross output to aggregate value added. These weights will be greater than one, as industry MFP improvement can have a direct effect through industry output, but also an indirect effect through output in other industries, by means of intermediate input sold to other industries (Jorgenson et al, 2012).The difference between Domar weighted MFPG and the aggregate MFPG is the sum of labor and capital reallocation effects, which reflects the movement of these resources across industries. For instance, a positive reallocation term would indicate a movement of resources from less productive to more productive industries.

5. The Empirics of India's Economic Growth: An Industry Level perspective

We have outlined the methodology of computing growth and analyzing both sources of growth as well as industry contributions to aggregate growth in the previous section. As indicated in our review of empirics for growth, we need some fresh way of looking at India's economic growth – "Who drives India's growth and how" needs to be extended beyond the savings–investment story and also extend the discussions beyond 'turn around' structural breaks and even timings of reforms when analyzing growth numbers. In the following paragraphs we present a new way of discerning about India's economic growth during the period 1980-2011 by providing an industry perspective.

The simplest and traditional way of analyzing growth in India has been to explore the structural changes brought about by growth in terms of broad sectors- agriculture, industry and services, however as we enter almost two decades of economic openness, several new policy directives to address investment and trade regimes have seen the light of the day making it important to understand what has been the outcome of such sectoral policies? Can we infer which of the disaggregated sectors are contributing to the GDP numbers and why? The Jorgenson, Gollop and Fraumeni et al (1987) pioneering work on economics of total factor productivity at the industry level allows us to break down the contribution of inputs as well as productivity in explaining industry output growth one hand and about industry contributions to aggregate GDP (as well as TFP).

The KLEMS dataset allows us to undertake this kind of analysis with the major variables at industry level – outputs and inputs [capital (K), Labor (L), Energy (E), Material (M) and Services (S)]. The variables constructed as part of the KLEMS dataset allowing calculating TFP as well as Decomposing TFP in output growth and others using disaggregated growth accounting techniques. In this paper, Indian economy is analyzed at the level of macro aggregates. Moreover to provide an industry level examination of the Indian economy, we categorize the Indian economy in terms of 27 industries encompassing the above categories.

As regards periodization of the study, the period covers the Indian economy from 1980-2011. This period has been analysed by various scholars of Indian economy using different yardsticks of Indian economy. We refrain from any particular kind of periodization and hence accordingly divide the whole period into

three sub periods to cover the decades of 1980s, 1990s and 2000s.

5.1 India's Economic Growth - A broad sector perspective

We start with the value added shares of different broad sectors to understand how has different sectors behaved over the 30 year period (including the watershed 1990 year) in order to document the importance of these sectors in our assessment of overall economic growth. We divide the economy into 9 broad sectors – Agriculture, Mining, Consumer Goods Manufacturing, Intermediate Goods Manufacturing, Investment Good manufacturing, Electricity, Construction, Market Services and Non-Market Services. Figure 5.1.1 provides a broad outline of the importance of each of the sectors over the entire time period of our study.

Figure 5.1.1: Share of different broad sectors in GVA: Source: India KLEMS dataset version, 2015.

We find that the share of the Agriculture Sector in total GVA has seen a secular decline, from above 35 percent in 1980 to below 20 percent in 2011 and on the contrary, the share of Market Services has been continuously increasing, from 20 percent in 1980 to 35 percent in 2011. There is a steep incline in the share of Market Services in around the year 2003-04. Non-market Services share has remained at around 20 percent for the entire period, with no secular trends evident. However, there are some upturns and downturns since the 1990s. There has been a slight improvement in the Construction Sector and Intermediate Goods Manufacturing Sectors (from 5percent in 1980 to around 8 percent in 2011). On the other hand, Consumer Goods Manufacturing has seen a slight decline over the years Rest of the sectors – like Electricity, Investment Goods Manufacturing, Mining, have remained stagnant at less than 5 percent over the entire period. Our next attempt is to see how these have broad sectors grown from 1980 onwards and if there is a pattern in the 3 decades across the sector. This would also reveal how each of the industries reacted to the different policies that characterized each decade under our study.

Table 5.1.1: GVA growth rate of Broad sectors in India – by sub-periods

SL No	Broad Industry Description	1980 to 1989	1990 to 1999	2000 to 2011	1980 to 2011
1	**Agriculture**	3.00	2.95	3.05	3.00
2	**Mining**	7.88	4.69	4.07	5.38
3	**Consumer Goods**	4.09	4.43	5.89	4.90
4	**Intermediate Goods**	7.52	6.65	8.09	7.46
5	**Investment Goods**	8.71	5.30	10.41	8.27
6	**Electricity**	8.43	7.00	5.68	6.90
7	**Constructio n**	3.75	5.42	8.69	6.20
8	**Market Services**	6.69	7.84	9.79	8.26

9	**Non Market Services**	6.53	6.08	5.29	5.91
	Total Economy	5.19	5.54	7.04	6.02

Source: India KLEMS dataset version, 2015.

Overall, the Total Economy has been growing at an average rate of 6 percent p.a. in 1980-2012. This has been perpetuated by the superior performance of 7 percent p.a. post 2000s. Market Services and Investment Goods Manufacturing Sectors have been the fastest growing sectors in the entire period, growing at above 8 percent p.a. While Market Services continued accelerating from 1980 to 2012, the Investment Goods Manufacturing Sector has shown cycles. Agriculture has been stagnant throughout each of the sub-periods, growing at around a lowly 3 percent p.a. It has been argued that the reason for this stagnancy is the recent lack of importance given by the government towards agriculture. On the other hand, the Electricity sector, which had impressive growth rates through the 1980s and 1990s, slowed down and grew at only around 5 percent p.a. in the 2000s. Similar trends are shown in the Mining Sector as well. Construction Sector has seen a reverse trend – while it had a very slow growth in the 1980s an 1990s, it showed a remarkable growth rate of 8 percent p.a. in the 2000s.

A table on growth rate of broad sectors often does not give the full picture of drivers of aggregate growth. We need to know beyond the trends in broad sectors for our assessment of India's growth story. In the next paragraphs, we compute the contribution that each industry makes to the overall economy wide growth. This allows us to extend the scope of growth analysis to the different industries which comprise the economy. The weighted sum of the individual industry growth along with a reallocation term gives the aggregate growth for the economy. The reallocation term is positive if value added shifts from low growth industries towards high growth industries. Figure 5.1.2 below sums up the growth momentum generated by each industry groups.

Figure 5.1.2: Contribution of Broad Sectors to overall growth

Source: India KLEMS dataset version 2015.

We find nothing about agriculture and manufacturing that has already not been documented yet. However in case of India, that services have been leading the growth engine is seen to be true. Nevertheless we have not had any detailed analysis of which sectors within services are actually pulling the engines of services growth and this is crucial as there is wide heterogeneity amongst services both in terms of efficiency and employment (Nayyar, 2012). He argues that there are several divisions within the service sector - informal versus formal, public versus private, labor versus capital intensity and aspects of technological divide. These leave questions on ability of service sector as leader of growth momentum in India. In this context, we assess the contributions from various segments of market services to overall growth in services.

Figure 5.1.3: Contribution of different sub-industries to Service Sector growth

Source: India KLEMS dataset version 2015.

The detailed analysis of the service sector reveals that much of the growth of the service sector can be accrued to the contribution of the Trade, Business Service and Financial Services industries. This possibly indicates the role of increasing ICT in contributing to growth. This fact may be synchronized with the overall changes in the policy and outlook of the government undertaken in the period of study. For

instance, as mentioned in detail above, the period of the 1980s saw considerable deregulation in the business environment and the 1990s saw large scale liberalization policies. These induced more efficient allocation of resources through import of modern technology and inflow of FDI. Business Services and Financial Services specially benefitted from the inflow of FDI, allowing more foreign competition to seep through the economy. The opening up of the economy along with the devaluation of the currency undertaken in 1991 greatly increased trade flows and this consequently became the greatest driver of growth for the Service Sector.

To conclude, the analysis of the broad patterns of the economy shows that the Services Sector has been one of the primary drivers of growth in the Indian economy for the past three decades. To be more specific, the Market Services within the Services Sector has been the primary driver of overall growth in the Indian Economy. Trade, Business Services and Financial Services thrived during this period, contributing the largest to growth in the period of study. However, these patterns do mask the mechanism that underlay the growth mechanism in India during its transition phase. We would like to ascertain the role of each industry in the growth story of India – how the performance of each shaped the growth process of India and in turn shaped their performance as well. This calls for a more disaggregated analysis of the different sources of output growth.

5.2 The Disaggregated Growth Story - Industry Perspective on GVA growth

As discussed in the previous section, we need to progress beyond macro perspectives as at the industry level, there are differences in technology that describe the good or services that is being produced as well as the regulatory environments that surrounds these industries. Further a detailed industry analysis using KELMS dataset also allows in tracing the sources of growth either to input expansion or efficiency improvements (TFP). These have important policy directions.

India experienced an impressive overall GDP growth rate of 6 percent per annum in the period 1980-2011, an impressive record from the 'Hindu rate of growth' of the Post-Independence period. It grew at around 5 percent in the 1990s and around 6 percent in the 1990s. While these figures provide interesting facts by themselves, we look at the growth performance of the constituent individual 27 industries that comprise the Indian economy. From Figure 5.2.1, we find that Post and Telecommunication, Business Service and Financial Services have been the fastest growing industries in India over the entire period of 1980-2012, growing at 14 percent, 13 percent and 10 percent per annum respectively. This pre-eminence of industries in the Service Sector confirms the well known "Service-led Growth" hypothesis that is endemic to India's growth story. All the industries mentioned above had significant changes in their business environment beginning 1980s covering regulation as well as policy measures. On the contrary, Agriculture (3 percent p.a.) and Wood Products (-0.52 percent p.a.) have by far been the worst performers in the period of study. However, looking at the overall time period masks considerable heterogeneity in the growth performance of these industries in different sub-periods.

Figure 5.2.1: Overall GVA growth rate by industry: 1980-2011

Source: India KLEMS dataset version, 2015.

The performance of each industry in the Indian economy for each decade is shown in Table A3

of the Appendix. It is discernible that while the industries in the Manufacturing Sector performed well in the 1980s, they were ousted by the performance of the industries in the Service Sector in the post liberalization phase. In the decade preceding the 1990 liberalization, many of the industries of the Manufacturing Sector (Electrical Equipments (11 percent p.a.), Rubber and Plastic Products (10 percent p.a.) and Coke and Nuclear Fuel (15 percent p.a.) etc) were the frontrunners in terms of growth. Post liberalization saw services take prominence in the growth story of India – many of the industries in the Service Sector grow at more than 7 percent p.a. in the periods 1990-99 and 2000-11. This includes Trade, Hotels and Restaurants as well as Business Service and Post and Telecommunication. Interestingly, the Agriculture Sector, which still remains the primary labour absorption source in India, remained stagnant over the entire period. On the contrary, Post and Telecommunication improved remarkably after the liberalization phase in India, through increased FDI and more foreign competition. This allowed large telecom companies like Bharti Airtel and Essar to expand their businesses in India to their current fortunes.

The next step after having documented the GVA numbers by sectors, involves looking at the sources of growth at the industry level. The above Table decomposes real gross value added growth for the period 1980-2012 for the constituent industries in the Indian economy. The contribution of an input is defined as the product of value share of the input and the growth rate of the input. Thus each input contributes to output in proportion to its value share, while TFP contributes to output growth point for point. Figure 5.2.2 gives a comprehensive overview of the sources of growth for each industry. It is clear that capital service contribution has been a major contribution to growth for each of the industries, while TFP growth has been important mainly in the industries of the service sector. There is a high variation in output growth as can be ascertained in the Table 5.2.1 – with Business Service, Post and Telecommunication and Financial Services growing at over 10 percent p.a. while Agriculture grew at a modest 3 percent p.a. In terms of factor inputs, it can be seen that capital service contributes to output growth to a larger extent than labour for most of the industries (a notable exception in Construction, where Labour contributes 93 percent to growth). The contribution of Total Factor Productivity in each industry shows a mixed picture with large variations. On one hand, TFP contributes to almost 50 percent of the growth in the Post and Telecommunication industry, while TFP in the Coke and Nuclear Fuel industry shows a negative contribution of -6.23. Although there is wide variability, most of the industries in the Manufacturing Sector show negligible or even negative TFP growth. On the contrary, many industries of the service industries do not show significant contribution of TFP in their growth story.

Figure 5.2.2: Sources of GVA Growth for each industry

Source: India KLEMS dataset version 2015.

Table 5.2.1: Sources of aggregate GDP growth by industry- 1980-2011

SL No	KLEMS Industry Description	GVA Growth	Capital service Contribution	Labour Input Contribution	TFP

1	**Agriculture, Hunting, Forestry and Fishing**	3.00	1.83	0.47	0.70
2	**Mining and Quarrying**	5.38	5.35	1.17	-1.14
3	**Food Products, Beverages and Tobacco**	6.40	3.15	1.61	1.63
4	**Textiles, Textile Products, Leather and Footwear**	5.23	4.56	0.74	-0.08
5	**Wood and Products of wood**	-0.52	4.69	0.35	-5.56
6	**Pulp, Paper, Paper products, Printing and Publishing**	6.03	3.16	1.99	0.88
7	**Coke, Refined Petroleum Products and Nuclear fuel**	6.85	12.57	0.51	-6.23
8	**Chemicals and Chemical Products**	9.53	3.92	1.26	4.35
9	**Rubber and Plastic Products**	9.60	8.30	1.89	-0.59
10	**Other Non-Metallic Mineral Products**	7.70	6.85	1.12	-0.27

11	**Basic Metals and Fabricated Metal Products**	6.25	5.80	1.18	-0.73
12	**Machinery, nec.**	7.42	4.78	2.67	0.03
13	**Electrical and Optical Equipment**	9.35	4.63	1.78	2.93
14	**Transport Equipment**	8.31	6.43	1.57	0.32
15	**Manufacturing, nec; recycling**	7.16	4.42	1.94	0.80
16	**Electricity, Gas and Water Supply**	6.90	3.66	1.42	1.82
17	**Construction**	6.20	2.39	5.77	-1.96
18	**Trade**	7.02	4.48	1.81	0.74
19	**Hotels and Restaurants**	7.71	4.95	1.98	0.78
20	**Transport and Storage**	6.77	2.84	2.41	1.53
21	**Post and Telecommunication**	13.92	5.34	2.43	6.15
22	**Financial Services**	10.27	5.01	2.51	2.76
23	**Public Administration and Defence; Compulsory Social Security**	6.06	0.85	0.78	4.42
24	**Education**	7.01	4.48	2.51	0.01
25	**Health and Social Work**	6.88	4.80	2.24	-0.16
26	***Business Service***	12.82	8.89	2.84	1.09

27	***Remaining Other services***	5.21	2.78	1.75	0.68

Source: India KLEMS dataset version 2015.

Overall we find evidence of significant contribution to overall GDP growth by capital services in most industries, thereby implying that capital input expansion driven growth. Compared to conventional measures of capital stock, our measure of capital services are theoretically pertinent, as it takes asset heterogeneity into account, while aggregating capital services. This is of particular importance, given the importance of equipment investment for economic growth, which is growing faster in the Indian economy. We construct aggregate capital service measures, considering asset heterogeneity. We distinguish between asset types, non-ICT machinery (construction, non-ICT machinery, transport equipment) and ICT machinery (hardware, software and communication equipment). This distinction also helps us examine the dynamics of investment composition in the Indian economy, in particular in terms of a change in the composition favoring equipment investment.

A study by Erumban and Das (2014) points out that there is an increasing share of equipment capital in the aggregate economy and its broad sectors, dominantly in the manufacturing sector. This fact is well illustrated in Figure A1 in the Appendix, which shows the share of equipment capital in gross capital stock for each of the broad sectors of the economy. While the service sector shows relative lower growth in the transport equipment capital, manufacturing, industry and agriculture shows high growth rates. This is particularly true in the 2000s as compared to the 1980s & 1990s. Therefore, it may be interesting to look into the causes of increasing quality of capital in Indian economy, led primarily by an increasing share of equipment capital. One may attribute the increasing share of machinery and equipment in aggregate capital stock to the many policy reforms in the 1980s and 1990s that helped firms ease many capacity constraints, and relaxed many restrictions on import of capital goods and foreign direct investment, particularly in the manufacturing sector. These might have helped expand the machinery investment in the economy, predominantly in the manufacturing sector. However, the benefit of this has triggered to the other sectors of the economy as well, though not to the extent of manufacturing. The effect of taking account of this quality aspect of measured capital input would be that we will be able to measure the TFPG more precisely, by attributing that part of the output growth that is due to the capital composition changes. In other words, we may see a higher capital contribution to output growth, and a lower TFPG growth, which is close to reality, than what have observed in the past by many studies.

Finally we highlight the industry contributions to the aggregate value added growth at the disaggregate level of Indian economy. The methodology for computing the industry contribution is due to Jorgenson et al (2005) where in aggregate value added growth is defined as the weighted average of industry value added and shows that this reflects the weighted contributions of industry capital, industry labor and TFP. The weights on capital or labor reflects three factors (i)-the relative size of industry value added in aggregate value added (iii) the share of industry capital or labor income in industry gross output and (iii) the share of industry value added in industry gross output. The weights on industry TFP reflect the relative size of the industry value added in aggregate value added and share of industry value added in industry gross output.

Figure 5.2.3: Contribution of each sector to GVA Growth

Source: India KLEMS dataset version, 2015.

The table shows huge variations in industry contributions to aggregate value added. We rank the industries by their contributions to aggregate GVA and find that industries which make the five largest contributions are – trade, agriculture, other services, financial services and construction. What is interesting from the ranking is that most manufacturing groups make very low contributions to aggregate growth- the two industries which perform relatively better are basic metals, chemicals and textiles. It is important to note that there are no manufacturing industries within the top 10 contributors to aggregate value added. This seriously questions the outcomes of policy reforms – both industrial de regulations as well as trade reforms as far as manufacturing is concerned. Agriculture and construction remain the only two non service industries in the context of major contributors to aggregate value added.

To sum up, the disaggregated picture using our dataset reveals a story that is in general consistent with the existing "Services-led growth" story of India. We find that Post and Telecommunication, Business Service and Financial Service have been the fastest growing sectors in the Indian economy over the period of study. A more detailed view of the growth process shows that while many industries have been at the growth forefront in the pre-liberalisation phase, the post liberalisation entailed the prominence of the services sector. A decomposition of the GVA growth shows that TFP is one of the major factors contributing to the growth of the industries of the services sector. However, growth accounting in the value added approach does not allow us to determine the roles of the intermediate inputs like energy and materials to the growth of industries.

5.3: The disaggregated Growth Dynamics - Inputs or TFP

The preceding paragraphs show the importance of disaggregated analysis of India's economic growth. Our major assertion remains that the service sector drives the engine of growth - more precisely market services as opposed to other services within service industries. Delving deeper into the "Service-led growth" story, we also see that most service industries are amongst the major contributors to the economy value added growth. As regards the sources of overall growth, capital services especially Equipment Capital is the main contributor to the observed growth. However one must examine the full breadth of the industry level data - BIG India KLEMS dataset to fully appreciate the origins of India's observed growth during the period 1980-2011. A disaggregated industry level examination allows us to trace the overall growth to the industries of concern as well as at the level of the industry, examine if growth is via input accumulation or TFP. This allows us to study the contributions across all industries and also understand the sources of growth at the industry level (Jorgenson, M Ho and K Stiroh, 2005).

The Big India KLEMS dataset uses a gross output production function and in turn allows construction of variables – inputs such as energy, material and services in the production process in addition to primary inputs- labor and capital at the level of individual industries. Table 5.3.1 examines the sources of growth at the disaggregate industry level using a KLEMS production function, where industry output is defined as gross value of output as against a gross value added specification used in the previous section. A glance at Table 5.3.1 shows that in terms of GVO growth, Post and Telecommunication and Business Service have been the fastest growing industries in the Indian economy. On the flipside, the Agriculture sector and the Wood Products industry has proven to be the slowest

growing industries during the period 1980-2012. Notably, there is a large dispersion in the growth rates of the industries, from a lowly 0.32 percent p.a. to 14 percent p.a. From the picture emerging from the sources of growth, it is clear the capital contribution has been a major driver of growth in many of the industries. This is true specifically of the Business Services, where Capital Services contributes to about 50 percent of the growth in the industry. Trade sectors also show similar trends. Contribution of energy and labour has generally been negligible. Material contribution have been a major source of growth in the industries of the Manufacturing Sector (most notably Rubber and Plastics, Machinery, and Electrical Equipments), often contributing to around 40 percent to 50 percent of the overall growth in these industries. Contribution of TFP to growth in each industry has been fairly uneven. Some industries like Post and Telecommunication and Public Administration enjoyed around 50 percent of their growth from increases in TFP, other industries like Construction, Wood Products and Health and Social Work actually faced negative TFP growth. On the contrary, the contribution of services has been fairly even for all the industries in India, although it may not have played an overwhelming role in the growth of these industries (except in cases like Footwear and Transport and Storage where services contribute to around 30 percent of growth).

Even though, we find that inputs form a major source of aggregate growth, we still examine the TFP growth by industry for the 27 industries that comprise the Indian economy as we feel it is important to comment on productivity growth for Indian economy at the disaggregate industry level as there exists many views about productivity performance of Indian economy [for e.g. Bosworth and Collins (2008), Virmani (2008), Rodrik and Subramanian (2005) and Dougherty (2009)] using data sources that are considerably less rigorous than the India KLEMS data set- both in terms of the methodology underlying the construction of the variables and as detailed coverage of the Indian economy.

Table 5.3.2 presents estimates of TFP growth by industries and sub periods for the Indian Economy. Looking at the overall picture Post and Telecommunication, Public Administration and Financial Services has been the forerunner in terms of TFP Growth, while most other industries (like Mining, Wood Products and Agriculture) has shown negligible or even negative TFP growth. The following observations are in order. One, there is wide variation in TFP growth even when we look at the different sub-periods. Industries like Manufacturing and Financial services showed TFP growth of 4 percent and 3 percent p.a. during the 1980s respectively, while other sectors had negative growth of TFP like Construction and Mining. Two, This superior performance in terms of TFP growth of the industries in the Service Sector continued in the 1990s and 2000s. TFP in Post and Telecommunication grew at an astonishing 12 percent p.a. in the 2000s. On the contrary, Mining and Education had TFP growth rate well below -2 percent p.a. during the same time. Finally, looking at the trend of each industry through the different sub-periods, we see that there have been large differences – some industries like Construction which had high TFP growth pre-liberalization, ultimately ended up having negative TFP growth in the 2000s. Same can be said about other industries like Business Services and Other Services. Other sectors, like Mining, have shown wildly fluctuating TFP growths – from a high of 2 percent p.a. in the 90s to a low of -3 percent p.a. in the 2000s. There have been some industries those showed notable improvements over the time period as well. For instance, Post and Telecommunication, from a negative TFP growth in the 1980s, ended up with a 12 percent p.a. growth in the 2000s. Similar improvements can be seen in other industries as well, like Financial Services and Electrical Equipment. The performance of Public administration has been stable throughout.

Thus we find that many of the industries of the Service Sector have been the forerunners in terms of TFP growth, and this has been manifested through remarkable performance in the post liberalisation phase. Most of the other industries have shown very modest TFP growth, indicating that India still has scope to improve efficiency. Some industries like Construction and Wood products have actually seen declining TFP growth. With this heterogeneity in mind, it may be interesting to study how each industry contributed

to overall TFP growth in the Indian economy.

Table 5.3.1: Sources of growth for Indian Economy 1980-2012: 27 industries

SL No	KLEMS Industry Description	GVO Growth	Labour Contribution	Capital Service Contribution	Energy Contribution	Material Contribution	Service Contribution	TFP
1	**Agriculture, Hunting, Forestry and Fishing**	2.90	0.34	1.37	0.02	0.42	0.23	0.53
2	**Mining and Quarrying**	5.51	0.89	4.05	0.28	0.98	0.65	-1.34
3	**Food Products, Beverages and Tobacco**	7.36	0.29	0.54	0.14	3.93	1.77	0.69
4	**Textiles, Textile Products, Leather and Footwear**	6.81	0.21	1.28	0.12	3.02	1.54	0.64
5	**Wood and Products of wood**	0.32	0.19	1.99	-0.02	0.40	0.50	-2.76
6	**Pulp, Paper, Paper products, Printing and Publishing**	7.30	0.53	0.82	0.24	3.73	1.31	0.67
7	**Coke, Refined Petroleum Products and Nuclear fuel**	7.42	0.05	1.37	0.46	4.32	0.78	0.45
8	**Chemicals and Chemical Products**	8.93	0.26	0.85	0.62	4.72	1.36	1.11
9	**Rubber and Plastic Products**	10.85	0.40	1.73	0.22	6.24	1.35	0.91

10	**Other Non-Metallic Mineral Products**	8.39	0.37	2.31	1.10	2.68	1.57	0.36
11	**Basic Metals and Fabricated Metal Products**	7.47	0.26	1.21	0.93	3.40	1.74	-0.07
12	**Machinery, nec.**	8.24	0.67	1.18	0.11	4.18	1.20	0.90
13	**Electrical and Optical Equipment**	10.46	0.43	1.08	0.21	4.92	1.99	1.83
14	**Transport Equipment**	9.32	0.30	1.21	0.19	5.16	1.71	0.75
15	**Manufacturing, nec; recycling**	10.92	0.63	1.41	0.10	5.09	2.19	1.49
16	**Electricity, Gas and Water Supply**	7.16	0.55	1.41	1.07	1.47	1.25	1.41
17	**Construction**	6.55	1.96	0.82	0.15	3.75	1.57	-1.70
18	**Trade**	6.42	1.39	3.60	0.12	0.21	0.72	0.39
19	**Hotels and Restaurants**	7.36	0.65	1.61	0.19	3.61	1.47	-0.18
20	**Transport and Storage**	7.33	1.11	1.25	1.36	1.43	2.00	0.17
21	**Post and Telecommunication**	14.37	2.03	4.34	0.26	1.44	0.72	5.57
22	**Financial Services**	10.24	2.04	4.06	0.13	0.31	1.42	2.28
23	**Public Administration and Defence; Compulsory Social Security**	5.99	0.54	0.61	0.05	0.35	1.39	3.05

24	**Educatio n**	6.66	2.23	3.97	0.01	0.05	0.56	-0.17
25	**Health and Social Work**	4.71	1.18	2.61	0.02	1.33	0.68	-1.12
26	***Business Service***	13.35	1.91	5.92	0.26	1.85	3.20	0.22
27	***Remainin g Other services***	5.27	1.53	2.42	0.01	0.47	0.39	0.45

Source: India KLEMS dataset version, 2015.

Table 5.3.2: TFP for industrial sectors of Indian economy- KLEMS dataset

SL No	KLEMS Industry Description	1980-2011	1980-89	1990-99	2000-11
1	Agriculture, Hunting, Forestry and Fishing	0.526895	0.662368	0.57331	0.386612
2	Mining and Quarrying	-1.33696	-2.15963	1.912322	-3.42769
3	Food Products, Beverages and Tobacco	0.688085	1.993032	-0.53996	0.732744
4	Textiles, Textile Products, Leather and Footwear	0.641308	-0.21942	0.470353	1.42932
5	Wood and Products of wood	-2.75529	-0.19622	-7.3495	-0.84609
6	Pulp, Paper, Paper products, Printing and Publishing	0.667332	1.616843	-0.45738	0.892461
7	Coke, Refined Petroleum Products and Nuclear fuel	0.446057	0.679605	-0.66718	1.198597

8	Chemicals and Chemical Products	1.112367	2.129147	-0.89492	2.02252
9	Rubber and Plastic Products	0.912482	-0.80848	1.265607	1.908929
10	Other Non-Metallic Mineral Products	0.356832	1.148656	0.170901	-0.08209
11	Basic Metals and Fabricated Metal Products	-0.06759	-0.74707	1.521897	-0.88254
12	Machinery, nec.	0.896217	1.308672	0.35089	1.041315
13	Electrical and Optical Equipment	1.831862	2.73697	0.786456	2.024202
14	Transport Equipment	0.752201	0.266393	0.554175	1.281578
15	Manufacturing, nec; recycling	1.493181	4.411401	1.82374	-0.97095
16	Electricity, Gas and Water Supply	1.414455	1.758322	1.124051	1.39856
17	Construction	-1.69958	-3.38306	-0.87973	-1.12017
18	Trade	0.386312	0.410943	1.167645	-0.28327
19	Hotels and Restaurants	-0.17505	-1.33629	1.768976	-0.92413
20	Transport and Storage	0.171612	-1.2506	0.174848	1.235571
21	Post and Telecommunication	5.572777	-1.7113	3.392095	12.85307
22	Financial Services	2.279663	2.907695	0.605667	3.203636

23	Public Administration and Defence; Compulsory Social Security	3.048388	2.092927	2.992601	3.811472
24	Education	-0.16584	1.685188	0.698737	-2.2746
25	Health and Social Work	-1.11882	-0.58376	0.376516	-2.76623
26	*Business Service*	0.218437	1.667729	0.295208	-0.93251
27	*Other services*	0.451847	2.946441	1.728514	-2.48299

Source: India KLEMS dataset version, 2015.

As with the case of industry contributions to aggregate GVA, we can also compute the industry origins of aggregate TFP (constructed through the KLEMS production function). The industry origins of aggregate TFP are important as they capture not only resource reallocation within the economy thereby leading to productivity gains/losses but also because some sectors within the economy show productivity growth relative to other sectors, there by become more dynamic in comparison to the rest of the industries at the economy level and this has implications for overall economy wide TFP levels. Figure 5.3.1 attempts to identify those industries which lead the overall TFP growth of the economy. The largest contribution arises either because the sector has a high Domar weight or has a high TFP or both. In our case, we find that public administration (a non-market service) contribute the most to the aggregate economy TFP on the basis for a TFP growth of around 3.5 percent per annum for the period 1980-2011. The second largest contributor on the other hand has a weight calculated as the ratio of industry output to aggregate GVA of 0.35 with a moderate TFP growth of less than 1 percent per annum. It is interesting to note that the combined GVA of the three largest contributors to TFP is around 37 percent on an average of total economy value added during the period 1980-2012. There remain sharp inter-industry differences in contribution to aggregate TFP. We also see that many industries have negative contribution to TFP and this reflects their TFP performance. It is also important to see that non-market services like education, health and social work have not been amongst the high TFP growth achievers and hence their low contribution. In the case of manufacturing industries, we find mixed evidence as regards contribution to overall TFP and given manufacturing sector's stagnant share despite plethora of reforms addressing manufacturing goods is a cause of concern.

Figure 5.3.1: Industry contributions to aggregate TFP - 1980-2012

Source: India KLEMS dataset version 2015.

6. Conclusion – Did we tell a new story?

The paper documents India's economic growth for the period 1980-2012. The period is marked by various debates on the triggers of economic growth ranging from structural breaks argument to actual aspect of reforms- *attitudinal shift* in the bureaucracy towards private sector and hence private corporate investment led growth to the lagged impact of trade and other policies. It may be pointed out that there is not

sufficient evidence to understand the dynamics of growth at what we call" disaggregate level" be it services led growth argument or near stagnant performance of manufacturing even when India was growing at around 9 percent per annum. Therefore the use of datasets- India KLEMS, which allows examination of the sources of growth and productivity at the industry level as the *new way* of looking at the old growth story of Indian economy.

There is no doubt about the fact that growth dynamics make use of datasets - in case of India, Central Statistical Organization (CSO) provides key inputs that are required to assess the growth prospects of India. Other sources like - RBI, Annual Survey of Industries and NSSO together with CMIE offers data at various levels of dissagregation to examine growth dynamics. However aggregation from 'bottom-up" involves serious statistical computations in order to undertake the right kind of aggregation techniques. The India KLEMS dataset stands apart from the others as issues like undertaking examination of sources of growth or an industry contribution to aggregate GDP growth or even industry origins of aggregate TFP are captured through variables which have strong theoretical underpinnings. Further the dataset captures a set of industries (based on NACE revision) and offers an economy wide dataset disaggregated into several industries which comprise the economy for a long period of time- cross section as well as time series. Therefore the use of this dataset for the Indian economy to offer a fresh view of India's growth experience since 1980s at a disaggregate industry level is the "*new aspect of India's economic growth"*.

Finally, what did we learn that we did not know about India's growth experience? These are our observations. A broad picture of the GVA growth shows that Services Sector has been the fastest growing sector in the Indian economy, with industries in the market services like post and telecommunication, and Business Services growing fastest in the post liberalisation phase. The contribution of each industry to aggregate GVA growth shows huge variations as well. Interestingly, most of the industries in the Manufacturing Sector contribute very little to GVA growth despite the large scale deregulation program undertaken by the Indian government. Decomposing the output growth for each sector reveals that capital service has been a major contributor to growth in most industries. On the other hand the influence of TFP on growth is mixed - while many of the industries of the Service Sector show high TFP growth, other industries show negative TFP growth. Using the gross output approach, we are able to further decompose the output growth of each industry to account for the contribution of intermediate inputs (Energy, Materials and Services). Our analysis is consistent with the one using value added - capital service is a major impetus of growth for most industries and TFP is significant mainly in the service industries. However, we also find that materials have been a major factor in the growth story of many industries in the Manufacturing Sector. The contribution of each industry to aggregate TFP shows wide variations as well. Interestingly, we find that Public Administration (a non-market service) and agriculture has been the largest contributors to aggregate economy-wide TFP. This result must be treated with caution. There are two factors affecting the contribution of each industry to aggregate TFP – the individual industry TFP as well as the share of the industry in total value added. The performance of Public Administration and Agriculture may be as a manifestation of either of the factors.

Appendix

Table A1: Industrial Classification of the India KLEMS dataset

Sl. No.	Description of Industries
1	**Agriculture, Hunting, Forestry and Fishing**
2	**Mining and Quarrying**
3-15	**Manufacturing sector**
3	Food Products, Beverages and Tobacco
4	Textiles, Textile Products, Leather and Footwear
5	Wood and Products of Wood
6	Pulp, Paper, Paper Products, Printing and Publishing
7	Coke, Refined Petroleum Products and Nuclear Fuel
8	Chemicals and Chemical Products
9	Rubber and Plastic Products
10	Other Non-Metallic Mineral Products
11	Basic Metals and Fabricated Metal Products
12	Machinery, nec
13	Electrical and Optical Equipment
14	Transport Equipment
15	Manufacturing, nec; recycling
16	**Electricity, Gas and Water Supply**
17	**Construction**
18-26	**Service sector**
18	Trade
19	Hotels and Restaurants
20	Transport and Storage
21	Post and Telecommunication
22	Financial Intermediation
23	Public Administration and Defense; Compulsory Social Security
24	Education
25	Health and Social Work
26	Business Service
27	Other Services

Source: Industry level Productivity Database-Phase I & II

Table A1 provides an overview of all the series included in our database. Measures of capital (K), labor (L), energy (E), material (M) and service (S) inputs as well as gross output (GO), have been constructed using National Accounts Statistics (NAS), Annual Survey of Industries(ASI), NSSO rounds, and Input-Output Tables (IO). In building annual time series on gross output, five inputs and factor income shares various assumptions are made to fill up gaps in industry details and link series over time. As we know that NSSO rounds of unregistered manufacturing, Input-Output Transaction Tables, Employment and Unemployment Surveys by NSSO are available only for certain benchmark years. Thus using information from these data sources necessitates interpolation and assumption of constant shares for building series of output and inputs. The construction of growth accounting series like total factor productivity, labour productivity are based on theoretical models of production and needs additional assumptions

that are spelt out in subsequent chapters of the manual. Finally, the Other Series like NDP at factor cost, compensation of employees etc are additional series which are used in generating the growth accounts and are informative by themselves.

Table A2: Variables in our Multifactor Productivity Database for 27 Industries (Annual Time Series 1980-81 onwards)

Variables	**Descriptions**
GVA	Gross value added (GVA) at current prices
	Gross value added (GVA) at constant prices
	Real gross value added index
	Annual growth rate in GVA (in per cent)
GVO	Gross value of output (GVO) at current prices
	Gross value of output (GVO) at constant prices
	Real gross output index
	Annual growth rate in GVO (in per cent)
Labour Input	Labour employment persons
	Growth rate of labour employed (in per cent)
	Labour quality index
	Labour input index
	Growth rate of labour input
	Labour income share in GVA
	Labour income share in GVO
Capital Input	Capital stock at constant prices at the base year
	Growth rate of capital stock (in per cent)
	Capital stock index
	Capital income share in GVA
	Capital income share in GVO
Energy Input	Energy input series
	Growth rate of energy input(in per cent)
	Share of energy input in GVO
Material Input	Material input series
	Growth rate of Material input(in per cent)
	Share of material input in GVO
Service Input	Service input series
	Growth rate of Service input(in per cent)
	Share of service input in GVO
TFP (MFP)	TFP index
	Growth of total factor productivity (in per cent)
Other Series	NDP at factor cost at current prices
	Compensation of employees at current prices
	Mixed income at current prices
	Self-employed earnings at current prices
	Gross fixed capital formation at current prices
	Gross fixed capital formation at constant prices with the base year 1999-2000

Source: Industry level Productivity Database-Phase I & II

Table A3: GVA growth rates of 27 industries – categorized by sub-periods

SL No	KLEMS Industry Description	1980-2011	1980-1989	1990-99	2000-11
1	Agriculture, Hunting, Forestry and Fishing	3.00	3.00	2.95	3.05
2	Mining and Quarrying	5.38	7.88	4.69	4.07
3	Food Products, Beverages and Tobacco	6.40	7.68	4.63	6.90
4	Textiles, Textile Products, Leather and Footwear	5.23	4.01	5.98	5.51
5	Wood and Products of wood	-0.52	-1.91	-1.37	1.24
6	Pulp, Paper, Paper products, Printing and Publishing	6.03	8.15	3.42	6.62
7	Coke, Refined Petroleum Products and Nuclear fuel	6.85	15.48	-0.03	6.10
8	Chemicals and Chemical Products	9.53	9.84	8.61	10.06
9	Rubber and Plastic Products	9.60	10.19	11.05	7.95

10	**Other Non-Metallic Mineral Products**	7.70	9.20	7.56	6.68
11	**Basic Metals and Fabricated Metal Products**	6.25	3.50	7.02	7.68
12	**Machinery, nec.**	7.42	9.03	3.91	9.14
13	**Electrical and Optical Equipment**	9.35	11.36	4.53	11.85
14	**Transport Equipment**	8.31	6.66	7.23	10.45
15	**Manufacturing, nec; recycling**	7.16	8.16	6.50	6.95
16	**Electricity, Gas and Water Supply**	6.90	8.43	7.00	5.68
17	**Construction**	6.20	3.75	5.42	8.69
18	**Trade**	7.02	5.82	7.00	7.94
19	**Hotels and Restaurants**	7.71	5.99	9.12	7.82
20	**Transport and Storage**	6.77	5.90	6.13	7.97
21	**Post and Telecommunication**	13.92	5.57	13.39	20.63
22	**Financial Services**	10.27	11.01	9.44	10.42
23	**Public Administration and Defence; Compulsory Social Security**	6.06	6.99	5.87	5.52
24	**Education**	7.01	6.66	7.99	6.45

25	**Health and Social Work**	6.88	7.36	7.68	5.86
26	***Business Service***	12.82	9.14	14.01	14.58
27	***Remaining Other services***	5.21	6.09	5.29	4.47

Source: India KLEMS dataset version 2015.

Figure A1: Equipment Share in aggregate Capital Stock in different broad sector, 1980-2011Source: Erumban and Das (2014)

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