The Challenges of Integrating National Accounts and Productivity Accounts in Global India: The Role of the KLEMS Dataset

Deb Kusum Das (Ramjas College, University of Delhi)

Paper Prepared for the IARIW-OECD Special Conference: "W(h)ither the SNA?"

Paris, France, April 16-17, 2015

Session 7: Human Capital, Growth and Productivity in the SNA
Friday, April 17
10:45-12:45

Discussant: Kevin J. Fox (University of New South Wales)

The Challenges of Integrating National Accounts and Productivity Accounts in Global India: The Role of the KLEMS Dataset.

Deb Kusum Das
Department of Economics
Ramjas College
University of Delhi
India
dkd_ramjas@yahoo.com

Abstract

A long standing demand for statistical datasets to understand sources of growth and role of multifactor productivity involves integrated production accounts. The new architecture for National Accounts involves development of integrated GDP-Productivity accounts as proposed by Jorgenson and Landefeld (2006). National Accounts Statistics (NAS) in India constitutes the key macroeconomic database for understanding the macroeconomic health of the country. However to understand the industry sources of economic growth, we need to develop the productivity accounts- The KLEMS dataset. The rich India KLEMS dataset allows for an internationally comparable productivity database at the industry level in a unified framework covering the entire Indian economy on relevant measures of employment, labor quality, capital formation, intermediate inputs energy, material and services. The purpose of this paper is to explore how to bring about a new architecture for National Accounts in India? We outline several data challenges that need to be overcome in order to provide multifactor productivity database at a disaggregated industry level to encompass a new integrated production and productivity accounts for India on the lines proposed by Jorgenson and Landefeld (2006) as new architecture of US National Accounts.

Key words- Multifactor productivity, KLEMS datasets and Integrated National Accounts System
JEL classification-E10, O4 and C55

March 2015

==========

Paper prepared for the IARIW-OECD Special Conference on *"W(h)ither the SNA?"* at OECD Paris, April 16-17, 2015. The author thanks IARIW for financial support to participate at the conference. I am grateful to K L Krishna for his suggestions and advice in shaping the paper. I thank G C Manna for educating me on various data sources that are used for NAS estimates. The usual disclaimers apply.

The Challenges of Integrating National Accounts and Productivity Accounts in Global India: The Role of the KLEMS Dataset.

Deb Kusum Das

1. Introduction.

A modern evolving economy like India, achieving strong, sustainable and inclusive growth, and increasing well-being, relies heavily on increases in the productivity of all factor inputs. In recent decades there has been an explosion of empirical studies on economic growth. The new debate is characterized by the interest in the determinants of growth and, in particular, the contrast between those who consider the accumulation of capital as the key factor for growth and those who emphasize the centrality of the multifactor factor productivity (MFP). Further, as India stands today as one of the world's leading emerging economies, the focus of policies are shifting toward enhancing the economy's potential for growth and competitiveness and in turn making demands for more rigorous economic indicators to understand and analyze India's growth and competitiveness in a comparative global perspective.

Thus the need for comprehensive data base on key economic indicators of productivity and competitiveness assumes tremendous significance. The key source of such information consists of countries national accounts dataset, more precisely production and income accounts of nations which allow us to document the economic activities of the nation. Moreover independent research using KLEMS type formulation of multifactor productivity is generating the multifactor productivity (here after MFP) in many developed world-USA, Canada, Japan, Korea and EU and emerging economies- India, China, Brazil, Argentina to name a few.

The national accounts provide its users with the most comprehensive overview of developments in national economies. The accounts are constructed within an integrated and internationally accepted framework that promotes data consistency and international comparability. The System of National Accounts (SNA) is a framework for the formulation of a set of accounting procedures that the national governments use to compile routinely to track their economies. In India, national accounts statistics (NAS) is the key source material for all macroeconomic data of the country and is widely used both for research and policy making as well in private and public domain.[1] The present system of National Accounts Statistics followed by India is in conformity with the SNA-1993 (SNA-2008 to the extent data are available). There are however issues with regard to data gap to compile the full set of accounts of SNA 1993. Further like many developing countries, India faces hurdles in shifting to SNA 2008.[2] The annual

[1] Independent India has a long history of bringing out the national income which dates back from the period 1948-49. The first official estimates of national income for the period 1948-49 to 1950-51 were released in 1956 which were conventional estimates based on the methodology devised by the National Income Committee (NIC).

[2] Implementing 2008 SNA is a challenge to Indian national accountants. The main concern is the availability of detailed data on income and expenditure of various institutional sectors. Other challenges concern the

National Accounts Statistics (NAS) of India are presently compiled by the Central Statistical Organization (CSO) of India and is a useful tool to calculate major economic indicators like Gross Domestic Product (GDP), Gross National product (GNP), saving rates, trade balance.

The challenge in emerging economies like India is to develop new economic data for the resolution of policy issues involving long-term growth. There has been a long standing call worldwide for statistics on "*sources of growth*"[3] especially for India, which is still making a transition from a closed economy to a market driven open country. Therefore information on GDP integrated with multi factor productivity statistics assumes significance as it allows explaining the observed economic growth. In particular, issues like industry origins of aggregate productivity growth, importance of sectors like manufacturing and trade in accounting for observed productivity growth and roles of labor hours and composition versus capital services in accounting for observed output growth by industry hold tremendous importance when assessing the overall competitiveness of the economy at the industry level.

The purpose of this paper therefore is to explore how to bring about a new architecture for National Accounts in India in providing multifactor productivity by industry information? Here "architecture"[4] refers to the conceptual framework for the national accounts. In particular, how can the system of national accounts be enhanced in order to stay relevant in providing the data needed to understand the evolving global economy and key economic developments especially aspects of growth and productivity in Indian economy.

The structure of the paper is as follows- In section 2, we review the National Accounts Statistics (NAS) in India and its usefulness from the point of view of understanding the evolving Indian economy in a global environment. Section 3 documents the construction of the INDIA KLEMS DATASET with reference to productivity statistics and understanding of sources of growth at the industry level. In the next section, we discuss the new architecture for India's national accounts in incorporating productivity statistics with the GDP by Industry and in the process allowing decomposing the industry contributions of inputs and MFP to the sources of GDP growth at the aggregate as well as detailed industry levels and highlight the data challenges that need to be addressed to integrate PRODUCTIVITY ACCOUNTS and NATIONAL ACCOUNTS within the National Accounts Statistics (NAS)) framework of India. The final section concludes the paper.

---

inclusion of the informal sector in the national accounts in a regular basis. Though some specific proposals of 2008 SNA have been implemented to the extent data is available, India would like to implement the remaining recommendations of 2008 SNA. This will require closer cooperation between the statistical offices and other agencies responsible for compilation of macroeconomic statistics. See the paper by T Rajeswari (2011)

[3] Strassner (2014) argues that research output of Solow (1957), Denison (1967), Griliches and Jorgenson (1967) on one hand and US-postwar Recovery, Big Slump, IT Boom, the Great Recession have reinforced the long standing call for statistics on "Sources of Growth

[4] The notion of a new architecture for NAS in India is borrowed from "A *NEW ARCHITECTURE FOR THE U.S. NATIONAL ACCOUNTS* (Jorgenson 2009)". According to the author the need arises, because the focus of the U.S. national accounts is shifting from economic stabilization policy toward enhancing the economy's growth potential. A second motivation for the new architecture is to integrate the different components of the decentralized U.S. statistical system and make them consistent.

2. National Accounts Statistics in India- An overview

The evolution of National Accounts has a long history in India[5]. Though the official estimates of national income are available on regular basis since 1948-49 , however many point estimates of either the national income or income relating are available in the literature covering the period ranging from the second half of the nineteenth century to 1948-49 (Kolli 2007). Amongst the early attempts mention must be made of research work in British India [Dadabhai Naoraji for British India (1867-68), Atkinson (1875) VKRV RAO (1925-29) and many others]. After Independence, attention was paid to the development of official estimates of national income and related aggregates [Government of India set up a High Powered Expert Committee in 1949 known as "National Income Committee" under the Chairmanship of Prof. P.C. Mahalanobis, with Prof. D.R. Gadgil and Prof. V.K.R.V. Rao as members, to make recommendations regarding the compilation of national income estimates, the improvement of the statistical data base on which the estimates were to be based and to suggest measures to promote research in the field of national income]. The official estimates of national income are available on regular basis since 1948-49. The National Accounts undergoes periodic revisions to take into account the structural changes of Indian economy (the latest revision is on 2010-11 base year)

The presentation of national accounts data vary by country, however the core of the national accounts include the following accounts for the economy as a whole and its main economic actors. (1) P**roduction accounts** which record the value of domestic output and the goods and services used up in producing that output. (2) I**ncome accounts**, which show primary and secondary income flows - both the income generated in production (e.g. wages and salaries) and distributive income flows (predominantly the redistributive effects of government taxes and social benefit payments) and (3) **expenditure accounts**, which show how disposable income is either consumed or saved.

National Accounts Statistics (NAS) is the source material of all macroeconomic data for Indian economy. Its key features are the estimates of national product and its division between consumption and capital formation. In addition, the accounts of the public sector and consolidated accounts of the nation are also provided. The NAS are compiled by the CSO, following the recommendations and guidelines enunciated in the United Nations - System of National Accounts (UN-SNA), brought out by the United Nations for the purpose of standardisation of computations of NAS and comparability of these statistics across the countries.[6] It is published annually by the central statistical organization under the Ministry of Statistics and Programme implementation of the Government of India. The publication is organized in five sections. The major use of the NAS is to assess how a country's economy is performing over time. These data are immensely useful for the purpose of building-up macro-economic models for projecting long and short-term expectations about future prospects.

[5] Refer to Table Annex-1 in Kolli (2007) for point estimates of National Income for the second half of the 19th century to first half of 20th century for historical details on National Accounts in India

[6] Kolli(2007) provides a historical record of the development and the current status of the National Accounts Statistics in India

The annual national accounts of India are presently compiled by the CSO following the conceptual framework of SNA 1993. India is in Phase 4 of ISWGNA's six milestones in the Implementation of SNA 1993 with the compilation of integrated accounts of the economy up to finance accounts, expenditure data as per the functional classifications, COICOP and COFOG. Rajeswari (2010) discuss the recommendations of SNA 1993 that presently form a part of Indian national accounts statistics (INAS).[7] Implementing SNA2008 is a challenge to national accountants. The main concern is the availability of detailed data on income and expenditure of various institutional sectors. Other challenges concern the inclusion of the informal sector in the national accounts in a regular basis. Though some specific proposals of SNA 2008 have been implemented to the extent data is available, India would like to implement the remaining recommendations of SNA2008. This will require closer cooperation between the statistical offices and other agencies responsible for compilation of macroeconomic statistics.

Salient Features of India's National Accounts Statistics (NAS)

A detailed appraisal of NAS database would indicate that we can find out about the economic health of the economy- GDP and National Income for the economy and broad sectors. In particular, we can find the performances of agriculture and live stock sectors as well as non agricultural goods production. Further key indicators of performances in services sectors are also outlined. It also document expenditures on GDP- consumption expenditure, savings and capital formation. Information on private final consumption expenditure in domestic market is available by type of goods and services. The estimate of domestic savings and gross capital formation is available in current and constant prices by type of institution. In addition, Information on gross capital formation is available by type of assets and industry of use. A large data base is available under public sector transactions- comprising administrative departments, departmental enterprises and non departmental enterprises.

A key feature of NAS (India) is the multiple disaggregated statements-The levels of disaggregation are agriculture and allied activities- live stock, forestry and logging, fishing, mining and quarrying; electricity gas and water, constructions. In India, the informal sector accounts for almost 50 per cent of India's GDP and accounted for 93 per cent of total employment including agriculture and 82.4 per cent of employment in non-agricultural economic activities [according to the survey on employment and unemployment carried out in the year 2004-05 by the National Sample Survey Organisation (NSSO)], therefore domestic product and value of output for manufacturing – registered and un registered is a significant statistical database. As regards services, domestic product from trade, hotels and restaurant, railways, other than railway transport, communication, banking and insurance, real estate and other services constitute an important database.

[7] T Rajeswari (2011) lists and discusses all the recommendations of SNA 1993, which forms part of NAS. Further, the author lists the SNA 2008 and implementation strategy of CSO, Government of India. Also see appendix tables 2A and 2B

TABLE 1: National Accounts Statistics (NAS): Summary

Part-I: Macro-economic Aggregates	Macroeconomic Aggregates present the summary statements of macroeconomic aggregates (GDP, NDP, GNP, and NNP at factor cost and market prices, indirect taxes less subsidies, Consumption of Fixed Capital, Net National Disposable Income, Personal Disposable Income, Private Final Consumption Expenditure (PFCE) in the domestic market, Government Final Consumption Expenditure (GFCE), exports and imports, Gross Domestic Capital Formation, Net Domestic Capital Formation and Savings) and their inter-relationships, growth rates, implicit price deflators, consolidated accounts of the nation (GDP and Expenditure, National Disposable Income and its appropriation, Capital Finance and external transactions) and performance of the public sector
Part-II: Domestic Product	The part of NAS entitled `Domestic Product' presents statements on GDP and NDP by sector of origin or by economic activity (agriculture, forestry and logging, fishing, mining and quarrying, registered and unregistered manufacturing, electricity, gas and water supply, construction, trade, hotels and restaurants, railways, transport by other means, storage and communication, banking and insurance, real estate, ownership of dwellings and business services, public administration, defence and other services), along with the percentage distribution and growth rates.
Part III: Consumption, Saving and Capital Formation	Consumption, Saving and Capital Formation provides the estimates of PFCE, (compiled by 161 commodity groups, but presented in the NAS by about 38 commodity groups, the broad groups being, food, beverages and tobacco, clothing and footwear, gross rent, fuel and power, furniture, furnishing, appliances and services, medical care and health services, transport and communication, recreation, education and cultural services and miscellaneous goods and services. The PFCE estimates are also presented by type of goods namely, durable goods, semi-durable goods, non-durable goods, services, direct purchase abroad by resident households and direct purchase in the domestic market by non-resident households and extra territorial bodies The estimates of Capital Formation comprising Fixed Capital Formation and Change in Stocks are presented by type of assets (separately construction, machinery and equipment) and by type of institutions, i.e. public, private corporate and household sectors. Estimates of Capital Formation are also presented (at current and constant prices) by industry of use. The estimates (separately at current and constant prices) of Net Fixed Capital Stock (NFCS), inventory and Net Capital Stock are presented by type of institutions namely, public sector – separately for administrative departments, DCU and NDCU, private corporate sector – separately for joint stock companies and co-operative banks, societies, and the household sector. The estimates (separately at current and constant prices) of NFCS, Inventory and Net Capital Stock are also given by industry of use.
Part-IV: Public Sector Transactions	Public Sector Transactions' deal, besides details of the Public sector component of aggregates like GDP and NDP (by type of institution and economic activity), GFCE (by purpose), Savings, Capital Formation; this part also presents the economic accounts separately for administrative departments, Departmental Commercial Undertakings (DCUs) and Non-Departmental Commercial Undertakings (NDCUs). Estimates of Factor Incomes, i.e. compensation of employees and operating surplus of the public sector by economic activity and type of institution are also presented. Thus information is presented in a three-fold classification namely, by factor incomes, by economic activities and by type of institutions. Property incomes namely, components of rent, interest and Financial Intermediary Services Indirectly Measured (FISIM) in public sector are also presented by type of economic activity and type of institution
Part-V: Disaggregated Statements	Disaggregated Statements' presents detailed disaggregated statements at the crop/item/category level. The statements include the details of value of output, input and value added for each type of economic activity. Thus the details provided under agriculture relate to the value of output of each of the crops as well as various livestock products and the total inputs used in the sector by items. Under mining and quarrying, the details provided relate to the value of output and inputs of major minerals and minor minerals with further disaggregation of major minerals into fuel minerals, metallic minerals and non-metallic minerals. The nature and extent of disaggregated data vary from industry to industry depending on the availability of information and procedure of estimation. Besides, disaggregated estimates, in respect of savings, relate to financial assets and the liabilities of the household sector. Capital Formation by type of assets and by type of institutions and external transaction accounts are also presented in this part.

Source: National Accounts Statistics, CSO, Government of India

The official estimate of factor incomes was introduced in 1976. Estimates of factor incomes are presented for the following categories- compensation of employees, operating surplus and mixed income of self employed. Further, estimates of factor incomes are prepared by institutional sectors and also industry of origin.[8]

Several other data sources supplement the efforts of National Accounts Statistics in India. The Central statistical office (CSO), Ministry of Statistics and Programme Implementation publishes five yearly input-output (IO) tables. The foreign trade data at ITC HS codes are available from the Directorate General of Commercial Intelligence and Statistics (DGCI&S), Ministry of Commerce and Industry, GoI and constitutes the most significant data sources for India's exports and imports. CSO also collects data from different sources for its own estimates- annual survey of industries for registered manufacturing, national sample survey organization rounds (NSSO rounds) for unorganized manufacturing. In addition, databases available from labor bureau, ministry of agriculture, departmental annual reports, Reserve Bank of India – Handbook of statistics on Indian Economy and Money and Banking. The primary source of the Agriculture data is Ministry of Agriculture, Government of India. Annual data series are available for more than 18 variables under agricultural production and inputs.

Finally, we comment on some new changes in the National Accounts Statistics (NAS) of India introduced in Jan 2015[9]. The new series of national accounts is notable for many important changes made based on SNA 1993 and 2008. First, GDP will now be measured at market prices and not factor costs and two, a new concept called GDP at basic prices have been introduced to take cognizance of value added at factor cost and indirect taxes on production, net of subsidies. Further, there have been changes in methodology underlying the new series- use has been made of annual accounts of companies as submitted to the ministry of corporate affairs, government of India in place of sample studies from Reserve Bank of India. Two striking features of the new series are – higher estimates of domestic savings and investments and changes in growth rates in new series on account of definitional change in GDP and usage of data from private corporate sector.

Till date, only a few studies (Sivasubramanian, 2001; Virmani, 2004; Bosworth and Virmani, 2007; Gupta, 2008 and Das et al, 2010) have made an attempt to estimate the MFP at the aggregate level. Non availability of data to measure the inputs that are needed to compute MFP

[8] Refer to the chapter on Factor Incomes for details of methodology and data base for compiling estimates of factor incomes. See Sources and Methods (2007), National Accounts Statistics, Central Statistical Organization, Government of India.

[9] The new series on National Accounts Statistics has been introduced after a comprehensive review of both the database and the methodology employed in the estimation of various aggregates. Besides shifting the base year from 2004-05 to 2011-12, the series incorporates latest available data from surveys and Censuses, new economic activities, expansion of coverage of activities, improvements in procedures and to the extent possible, the latest recommendations of System of National Accounts, 2008 in the compilation of national accounts **(CSO, METHODOLOGY AND DATA SOURCES IN THE NEW SERIES OF NATIONAL ACCOUNTS, March** 2015). See the CSO (MOSPI, Govt of India) website for reports of various expert groups constituted for the new series of NAS, India.

has always remained a major hindrance for most of the studies using the NAS statistics as a core database. Further, methodological improvements in measuring MFP (Jorgenson et al 1987) have made data demands more stringent due to improved measures of inputs especially labor and capital and inclusion of intermediate inputs such as energy, material and services in accounting for output growth.

The Indian economy is becoming increasingly integrated with the rest of the world; however as the major macroeconomic statistical database of India, NAS suffers from a limitation due to unavailability of any kind of indicator on Global competitiveness- especially multifactor productivity statistics by industry as well as aggregate economy. Further, in emerging market economies- like India, where "*Growth"* estimates are surrounded in measurement challenges and the availability of statistical database on sources of growth assumes importance for any policy related research.[10] The non availability of MFP estimates within NAS and its importance in a globally competitive business environment makes the KLEMS dataset an important research activity as it overcomes this deficiency by providing estimates of MFP. This is discussed in the next section.

3. INDIA KLEMS Dataset -1980-2010: MFP Estimates

The India KLEMS dataset is the first comprehensive documentation of economy wide measures of labor input, capital input, intermediate input and multifactor productivity at the level of disaggregated industrial sectors comprising the entire Indian economy. The creation of this dataset was funded by the Reserve Bank of India with technical support from the Central Statistical office (CSO), government of India.[11] The India KLEMS database has a two-fold objective: First, to create an internationally comparable India KLEMS productivity database at the industry level in a unified framework covering the entire Indian economy on relevant measures of productivity, employment creation, labor quality, capital formation and productivity growth. For this, time series data on value added as well as gross output, capital, labor and intermediate inputs for a harmonized industrial classification is constructed. The period of the study has been from 1980-81 till 2009-10 covering a span of 30 years. Second, to generate analytical and policy oriented research using the constructed database to focus attention on issues of productivity and competitiveness for the Indian economy.

Using this dataset a researcher can undertake studies on skills, investment and technological change of the aggregate economy as well as its sub sectors. Further, the dataset has been

[10] The new GDP numbers from NAS based on 2010-11 base year raises more puzzles and confusion. The revised series of NAS has stirred a debate on NAS growth estimates. See articles in EPW February 7, 2015 and February 14, 2015 which questions the changes and reviews the changes made in estimates based on new methodology

[11] India KLEMS dataset is available on the RBI website- vide a press release dated 11th June 2014. The creation of the India KLEMS dataset was undertaken under an advisory board chaired by Professor K L Krishna. Many international and national productivity experts served on the advisory committee- Dale Jorgenson, Marcel Timmer, Mary O Mahony, Bart Van Ark, B N Goldar, Ramesh Kolli and Late Suresh Tendulkar. Conceptual issues pertaining to measurement of inputs especially labor and capital were discussed extensively with CSO via several workshops. The research work was supervised by Professor B N Goldar and comprised the following team members- Deb Kusum Das, Abdul Azeez Erumban and Suresh Aggarwal.

constructed along the same lines as the EU KLEMS database (see O' Mahony and Timmer, 2009 for a description of EU KLEMS database) and allows comparison with countries which are also carrying out the construction of similar databases.[12] The variables are organized around the growth accounting methodology- rooted in neo classical production theory and clear conceptual framework within which interactions amongst the variables can be examined.

The following broad sectors- agriculture forestry and fishing; mining and quarrying; manufacturing; electricity, gas and water supply; construction and services for measurement and analysis of productivity for the entire economy. At a disaggregated level, database is created for 26 industries. The industrial classification is constructed by building concordance between NIC 2004, NIC 1998, NIC 1987 and NIC 1970 so as to ensure continuous time series. This classification is very close to the International Standard Industrial Classification (ISIC) revision 3.

Table 3.1 Industrial Classification for 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

[12] See Jorgenson 2014, Growth Strategy after the World Financial Crisis. Presentation at RIETI WORLD KLEMS SYMPOSIUM, May 2015

Sl. No.	Description of Industries
24	Education
25	Health and Social Work
26	Other Services

Source: Das et al (2014), Measuring Productivity at the Industry Level- THE INDIA KLEMS DATA BASE: DATA MANUAL Version 1

The data base covers 26 industries comprising the entire Indian economy for the following- (1) Labor input: various concepts of labor input (employees, self-employed) and harmonized measures of persons engaged have been developed. (2) 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. (3) 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 and (4) 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

As the core of the project entails construction of the time series of the necessary variables required for computing total factor productivity as well as labor productivity for the defined industrial classification, measures of capital (K), labor (L), energy (E), material inputs (M) and service inputs (S) as well as gross output (GO) and value added (VA) have been constructed using National Accounts Statistics(NAS), Annual Survey of Industries(ASI), NSSO rounds and input-output tables (IO). For certain industries annual data from NAS and ASI are used to compute time series on gross output. However, NSSO rounds of unregistered manufacturing, Employment and Unemployment Surveys by NSSO and Input-Output Tables are available for benchmark years. This necessitates interpolation and assumption of constant shares for construction of time series of Gross output (unregistered manufacturing, services sectors) intermediate inputs and labor inputs.

The construction of the India KELMS dataset[13] can be discussed under the following heads: In 3.1, we discuss the measurement of output (gross versus value added specification). The construction of labor and capital inputs is in 3.2 and followed by intermediate inputs. The estimates of multifactor productivity and labor are discussed in section 3.3 and final section outlines the data challenges.

3.1: Measurement of Gross Output and Value added

The methodology for measuring industry output, and value added was developed by Jorgenson, Gallop and Fraumeni (1987) and extended by Jorgenson (1990). Following a similar approach as

[13] The detailed construction of the variables-output as well as inputs-labor, capital, material, energy and services are discussed in Deb Kusum Das, Abdul Azeez Erumban and Suresh Aggarwal (2014) - Measuring Productivity at the Industry Level- THE INDIA KLEMS DATA BASE. This manual is available upon request from the authors.

explained in Jorgenson et al. (2005, Chapter 4) and Timmer et al. (2010), Chapter 3), the time series on gross output and intermediate inputs for the Indian economy. 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. The data source and methodology used documented in Das et al (2014).

National Accounts does not provide Gross Output series for all sectors of the economy. For those sectors, primarily service sectors, gross output series has been constructed using information from Input –Output Transaction Tables (IOTT). We take the benchmark year gross output to value added ratio for the relevant sector from IOTT for years 1978-79, 1983-84, 1989-90, 1993-94, 1998- 99, 2003-04. These ratios are linearly interpolated for intervening years and applied to the gross value added series obtained from national accounts to derive the output estimates consistent with NAS at current prices. The nominal estimates are then deflated with implicit GVA deflators from NAS to arrive at constant price series.

NAS provides estimates of Gross Domestic Product (GDP or gross value added) by industries at both current and constant prices since 1950. We use the current price GDP data since 1980 from the most recent National Accounts series which is based on 2004-05 prices. GDP estimates are adjusted for Financial Intermediation Services Indirectly Measured (FISIM). The value of such services forms a part of the income originating in the banking and insurance sector and, as such, is deducted from the GVA. The nominal estimates of output are deflated with suitable WPI deflators to arrive at constant price series for manufacturing sector. For services sector NAS based GDP deflators are used to derive constant price estimates.

Gross value added of a sector is defined as the value of output less the value of its intermediary inputs. This value added created by a sector is shared among the factors of production, labour and capital. 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. However, the NAS estimates of value added for a few industry groups are at a more aggregate level, requiring the splitting of the aggregates. In such cases, the NAS estimates of value added have been split to obtain estimates of value added at a higher level of disaggregation. For obtaining the estimates of GVA for registered manufacturing industries, we have used data from the Annual Survey of Industries (ASI) based on the National Industrial Classification 1998 (NIC-1998), whereas, for the unregistered manufacturing sector, we have used results from four rounds of NSSO surveys- [40th (1983-84), 45th round (1989-90), 51st round (1994-95) 56th round (2000-01) and 62nd round (2005-06)]) to obtain value added estimates.

3.2 Measurement of inputs- labor, capital and intermediate 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. National Accounts does not provide data on employment. Therefore, we rely on Employment and Unemployment Surveys (EUS) published by National Sample Survey Office (NSSO) once in every five years. EUS provides estimates of work participation rates by sectors classified on the basis of National Industrial Classification, which are used to derive number of employees in each sector using population estimates from various population censuses. However, EUS provides more than one definition of employment based on activity status, which are usual principal status (UPS), usual principal and subsidiary status (UPSS), current weekly *status* (CWS) and current daily status (CDS). Since UPSS is the most liberal and widely used of these concepts (Aggarwal (2004), Papola (2007), and Sundaram (2009)), we estimate the number of employed persons using UPSS definition. However, UPSS definition suffer from limitations such as: (1) the UPSS seeks to place as many persons as possible under the category of employed by assigning priority to work; (2) no single long-term activity status for many as they move between Productivity growth in India under different policy regimes October 2014

For the measurement of capital services we need capital stock estimates for detailed assets and the shares of capital remuneration in total output value. The measurement of capital services by type of activity requires information on two basic inputs: investment series by industry cross classified by type of asset and the price indices of investment goods to deflate the series on yearly investment. The methodology for the measurement of capital services is based on Dale Jorgenson et al (as developed by Jorgenson and Griliches, 1967, and outlined in Jorgenson, Gollop and Fraumeni, (JGF), 1987, Chapter 4). Since our measure of capital input takes 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 and ICT equipments (hardware, software and communication equipment).[14] We exploit multiple sources of information 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 time series of intermediate inputs, energy, material and services, are constructed using the methodology developed by Jorgenson, Gallop and Fraumeni (1987) and extended by Jorgenson

[14] 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.

(1990). Following Jorgenson et al. (2005) and Timmer et al. (2010), the time series on intermediate inputs are derived using input output (IO) tables which gives the flows of all commodities in the economy, as well as payments to primary factors. Proportions of energy, material and service inputs in total Intermediate Inputs are calculated from the benchmark IOTT for years mentioned before, and for intervening years these are linearly interpolated. This interpolation involves an implicit assumption that for each IO sector technological change occurred progressively between the benchmark years. For years It is to be noted that among all service sectors for government owned sector Public Administration and Defense is a special case where no intermediate inputs are given in IOTT tables. Consequently value added to output ratio from System of National Accounts tables have been applied to nominal GVA figures of NAS to estimate the output for this sector.

3.3 Measurement of factor income shares

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. Under the assumption of constant returns to scale with two factors of production i.e., labour and capital, the sum of the labour income share and capital income share is 1. The labour income share is defined as the ratio of labour income to GVA. Capital income share is accordingly obtained as one minus labour income share. 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[15].

The computation of labour income share for the 26 study industries involves two steps. First, estimates of CE, OS and MI have to be obtained for each of the 26 study industries from the NAS data which are available only for the NAS sectors[16]. Second, the estimate of mixed income has to be split into labour income and capital income for each industry for each year (except for those industries for which the reported mixed income is zero, for instance, public administration)

Basis data sources used for the computation of labour income share are NAS, ASI and unit level data of survey of unorganized manufacturing enterprises. These data sources are used to obtain estimates of CE, OS and MI for each of the 26 study industries. For splitting the labour and non-labour components out of the mixed income of self-employed, the unit level data of NSS employment-unemployment survey are used along with the estimates of CE, OS and Mi basically obtained from the NAS.

[15] See statement 76.1- factor income by economic activity, National Accounts Statistics, 2012, CSO, government of India.

[16] For specific details of constructing labor income share, see Das et al (2014), Measuring Productivity at the Industry Level- THE INDIA KLEMS DATA BASE: DATA MANUAL Version 1

3.4 Estimates of Growth of Labor and Multifactor Productivity by Industry

The data constructed for gross value added and gross output, labour input, capital inputs, intermediate inputs and factor income shares are used to estimate MFP growth as indicated in table below. The methodology of measurement of MFP growth for individual industries is from KLEMS framework and the aggregation from industry level productivity measures to measures for broad sectors and the economy as a whole.

Table 3.2.: Variables in our Multifactor Productivity Database for 26 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
Land Input	Land input series for Agriculture sector
MFP **LP**	MFP and LP index Growth of multi factor productivity (in per cent) Growth of labor productivity (in per cent)
Other Series	NDP at factor cost at current prices Compensation of employees at current prices

Variables	Descriptions
	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: Das et al (2014), Measuring Productivity at the Industry Level- THE INDIA KLEMS DATA BASE: DATA MANUAL Version 1

In summing up, the MFP as well as LP estimates along with measures of outputs- both gross value added and gross output and inputs- Labor, capital and intermediate inputs based on the India KLEMS dataset comprises a rich dataset. This database is unique in its details on labor and capital inputs by industry and this allows breaking inputs down into components in order to fully quantify sources of growth in an international perspective. Though the primary motive of the KLEMS dataset is to provide productivity trends by industry but at the same time issues like – how much does capital input contribute to growth, what is the labor contribution to gross output by education? Contributions to aggregate MFP by industries can also be addressed via this data set. Further the data on inputs can also be studied from the perspectives of innovation, skill formation, investments in ICT and services contribution to output growth. This is core of the next section.

4. New Architecture of India's National Accounts Statistics: Multi Factor Productivity Estimates

Two of the most important statistical tools for analysis of economic growth are the national accounts (encompassing gross domestic product, or GDP) and the multifactor productivity (MFP) statistics, which measure output per unit of combined inputs[17]. The advantage of our multifactor productivity database is that it ensures complete consistency with National Accounts.[18] The integration of the two data bases- national accounts and KLEMS productivity datasets allows many rich applications of such a combined database- analysis of industry-level MFP to assess the effects of information and communication technology (ICT) on economic growth[Oliner and Sichel (2000) and Dale W. Jorgenson (2001)] as well as the role of services- construction, finance/insurance, and business services are characterized by negative MFP trends, which seem implausible and suggest that measurement of volume of output for these

[17] Productivity statistics integrated with National Economic Accounts' GDP statistics have long been sought to provide a rich source of information for policy makers, business analysts, and economists. The usefulness of such integrated analysis on the sources of growth within the framework of the U.S. national income and product accounts (NIPAs) was first presented by Jorgenson and Landefeld (2006) in A New Architecture for the U.S. National Accounts.

[18] Two scholarly research outputs- S. Sivasubramanian (2000), National Income of India in the 20th Century and Sivasubramanian (2004), The Sources of Economic Growth in India- 1950-51 to 1999-2000 are the first attempt at integrating national accounts and productivity estimates for India.

industries is problematic [Gullickson and Harper (2002)]. [19] In addition, this database will open avenues to make international comparisons including the emerging economies with similar data [XXXX]. Therefore the new architecture of India's national accounts system will ensure the availability of statistical data on the sources of growth- so far an independent research enquiry in India.

Jorgenson and Landefeld New Architecture for US National Accounts

In a pioneering research work, Jorgenson and Landefeld (2006, 2009) have proposed a new architecture for US national accounts. The core of the new national accounts is the integration of National Income and Product Accounts (NIPA) compiled by Bureau of Economic Analysis (BEA) with productivity statistics generated by Bureau of Labor Statistics (BLS). The new architecture provides a fully articulated set of economic flows and stocks in a system of seven accounts: (1) production, (2) domestic receipts and expenditures, (3) foreign transactions current account, (4) domestic capital account, (5) foreign transaction capital account, (6) domestic balance sheet, and (7) US international investment position. The new architecture would provide production accounts at both aggregate and industry levels. This would require the development of estimates of real capital and labor services. The 1993 SNA and BLS (1993) provide measures of the price and quantity of labor services. These are combined with the price and quantity of capital services introduced by BLS (1983) to generate price and quantity indexes, as well as multifactor productivity.[20] The final step in combining the NIPAs with the productivity statistics is integrating BEA and BLS estimates of industry output through the use of common source data, estimating methods, and balancing techniques.[21]. The implementation of integrated production and productivity accounts still remains a challenge: countries that provide KLEMS Data within National Accounts are Australia, Canada, Denmark, Finland, Italy, Mexico, The Netherlands, Sweden and the United States .[22]

In many advanced countries, still the multifactor productivity program is not within the national accounts system as it is viewed an input for analytical papers with little connection to the system of national accounts.[23] In developing countries like India, there remains enormous data challenges to integrate NAS with MFP datasets as MFP estimates draws time series data from

[19] Abdul Azeez and Das D K (2015) examine the role of ICT in Economic Growth in India as an application of India KLEMS database which is consistent with NAS of India. In another paper, Das D K, Abdul Azeez and Suresh Aggarwal (2013) examine the MFP trends in India's services both market as well as non market. Both these studies use the India KLEMS dataset and address important issues for Indian economy.

[20] According to Jorgenson and Landefeld (2009), the new architecture would provide measures of capital services for all productive assets in the US economy. The primary challenge for development of these measures is the absence of market rental data for most types of capital.

[21] Barbara M. Fraumeni, et al. (2006) developed the first steps toward integrating the national accounts with the productivity statistics by describing the conceptual framework, developing illustrative accounts, and describing differences in source data and methods that require resolution

[22] Baldwin and Harchaoui (2004) provide a blue print for Canadian system of national accounts.

[23] In UK,-independent estimates developed at the Bank of England and at the National Institute of Economic and Social Research have shown that U.K. relative multifactor productivity performance deteriorated relative to the U.S. in the post-1995 period compared to the early 1990s.

multiple sources- some of which are not even published annually on one hand and on the other, it will require a great deal of effort in terms of collaboration of many institutions which cater to different databases. In India, a prototype BEA/BLS industry-level production account can be formed through a synthesis between NAS (CSO) and MFP estimates formed through KLEMS Dataset (RBI)[24]- Integration of Productivity Accounts with National Accounts.[25]

4.1 Integrating GDP and MFP statistics- New Architecture for Indian NAS

In the following paragraphs, I discuss some of the challenges that arise within NAS database in order to compile multifactor productivity estimates. The main objective of the KLEMS database is to provide a multifactor productivity database based on gross output production function with capital, labour and intermediate inputs, covering the entire economy as well as industrial sub sectors. This would mean the construction of inter industry accounts, labour accounts and capital accounts and more specifically, constructing measures of labor, capital and intermediate inputs at the industry level as a first step towards developing the MFP database. As far as the two inputs-labor and capital are considered, the KLEMS dataset involves construction of labour and capital services, that takes account of productivity differences between various categories of capital (such as ICT and non-ICT) and various types of labour (in terms of skill, gender and age)[26]. However, there are a number of data issues that need to be resolved while constructing an India KLEMS database. These include concordance of various data sources over time; definitional problems particularly in employment and wage data and the lack of disaggregate output, capital formation and employment data at detailed industry, asset and skill levels.

1. **Value Added by Industry Data series: National Accounts Statistics and KLEMS database**
   - The National Accounts Statistic (NAS) brought out by the CSO (Central Statistical Organization, Government of India) is the basic source of data for the construction of value added series for the project.
   - A major difficulty in using the value-added estimates of the NAS is that the NAS provides estimates of value added for a much smaller number of industries (17) than required for the KLEMS-India project. It is important to note that the NAS does not provide estimates of value-added for different industries belonging to the manufacturing sector. Rather, estimates are provided for registered and unregistered manufacturing and for total manufacturing.
   - In India-project, the value-added data from the Annual survey of Industries (ASI) for registered manufacturing and National Sample Survey Organization's (NSSO) enterprise

[24] See Fleck et al (2012)- A Prototype BEA/BLS Industry-Level Production Account for the United States, paper presented at the 2nd World KLEMS conference, Cambridge, Massachusetts, August 9-10, 2012.

[25] This is an important research agenda for the new phase of India KLEMS research project Disaggregate Industry Level Productivity Analysis for India: The KLEMS Approach being hosted at the Centre for Development economics, Delhi School of Economics, Delhi, India. This new phase is being funded by Reserve Bank of India.

[26] The major data sources on which India KLEMS would rely on are- National Accounts Statistics (NAS), National Sample Survey Organization (NSSO) and Annual Survey of Industries (ASI)

based surveys on unorganized manufacturing (conducted by the CSO periodically) would be used to disaggregate the aggregate value-added manufacturing data available in NAS to 2 or 3-digit level industries as required for India KLEMS classification.

2. **Capital Stock by Industry Data series: National Accounts Statistics and KLEMS database**

• As far as construction of capital input series is considered, the KLEMS methodology of using capital services data, which takes account of productivity differences between various categories of capital (such as ICT and non-ICT), would be used. Thus quantity indices of capital input and time series on the values of capital compensation (at current prices) have to be built for 31- industries comprising the Indian economy. The major data source for construction of series on capital services would be National Accounts Statistics (NAS).

• However, construction of capital stock series is a complex task due to a number of difficulties. First, as in case of value added, the capital stock estimates of the NAS are for a much smaller number of industries and the NAS does not provide estimates of capital stock for different industries belonging to the manufacturing sector. Second, the estimates of GFCF available in the NAS are at industry-level only.

• In India KLEMS project, the NAS capital stock estimate will be split at a lower level of disaggregation in several cases. The estimate for Trade, for instance, will have to split into that for Wholesale trade and Retail trade. Similarly, the estimate for 'Other Services' will have to be split to obtain separate estimates for (a) Education, (b) Health and Social Work, and (c) Other Community, Social and Personal Services. In the case of Transport and Storage, the NAS capital stock estimates for railways, other transport and storage will have to be added to form the estimate required. In these cases, it seems that the apportioning of the NAS estimate of capital stock may be done on the basis of some benchmark capital-output ratios and time series on value added in the constituent industries. Also, for constructing capital stock, the project would use CSO's detailed worksheets on capital formation (these worksheets are not available in the public domain) by type of industry and type of assets as per availability of data.

3. **Labour Input by Industry Data series: National Accounts Statistics and KLEMS database**

• The labour input series in this project would be based on industry- wise information on the (a) quantity (persons and working hours), and (b) quality (distribution of quantities by age, gender and education level) of labour.

• The project would rely mainly on NSSO employment and unemployment surveys for constructing labour accounts. To construct reliable estimates on employment and, hence labour productivity is a challenging task as many adjustments would have to be made in the available data to make it comparable to 31-industries for this project. As regards workers' earnings, average wage or salary earnings per day received by regular wage/salaried employees and average daily wage for casual workers in public works and works other than public works is available. Wage information has not been compiled specifically for each of the activities or industry divisions by the NSSO.

• The project would use the unit level data of the NSSO and try to get the weekly wage rate of the regular or salaried workers for a particular educational category corresponding to different activities or industry divisions.

4. **Inter-Industry Accounts: Gross Output, Energy, Material and Services**
   • A major objective of the KLEMS project is to provide productivity estimates at the industry level using the gross output production function with Capital, Labour and Intermediate Inputs as inputs. The Supply and Use table are used to calculate the intermediate input index and the input weights for growth accounting.
   • Input-output (IO) tables are available for eight years 1968-69, 1973-74, 1978-79, 1983-84, 1989-90, 1993-94, 1998-99 and 2003-04. These have been prepared and published by the Central Statistical Organization (CSO), Government of India. The industrial classification for the latest 2003-04 table distinguishes 130 sectors, while most of the earlier tables distinguish 115 sectors. Both the USE (Absorption) and Supply (Make) tables have been published. It may be noted that CSO adheres to the SNA specifications to a considerable extent.
   • In India-KLEMS project, the CSO's SUTs tables would be first adapted to the industrial classification of KLEMS, and annual time series of SUTS would be generated. Relevant price data would be compiled for use in calculating the Tornqvist indices of gross output, value added and intermediate inputs at the industry level.

4.2: The Way forward: Challenges for NAS

To integrate MFP estimates within NAS database, there are several challenges which have been highlighted in the previous section. If these challenges have to be met, we need to outline various steps that need to be undertaken so that both input and outputs measures are in place to generate estimates of both labor as well as MFP.

4.2.1. Goss value added and Gross output: measurement issues

The construction of Gross valued added series involves – establishing a concordance between the classification used in the NAS and the 26 study industry classification used for the KLEMS dataset. For manufacturing industries where direct estimates of GVA were not available from NAS, estimates have been made using additional information from ASI and NSSO unorganized manufacturing data. For 6 out of 13 manufacturing sectors GVA data are directly available from NAS. For the remaining 7 industries GVA data is constructed by splitting the NAS data using ASI or NSSO distributions. For India KLEMS, output is adjusted for Financial Intermediation Services Indirectly Measured (FISIM). The value of such services forms a part of the income originating in the banking and insurance sector and, as such, is deducted from the GVA. The NAS provides output net of FISIM for some industry groups at a more aggregate level. For instance, in the estimates of GVA obtained for the registered manufacturing sector, adjustment for FISIM in NAS is made only at the aggregate level in the absence of adequate details at a disaggregate level. However, we have allocated FISIM to all the sectors of manufacturing by redistributing total FISIM across sectors proportional to their sectoral GDP shares. Similar redistribution of

FISIM has been done in case of Trade sector and Other Services sector. There however remain issues that are far from resolved- issues like estimating GDP at basic prices, remain to be resolved in future datasets of India KLEMS.

The construction of the gross output series from 1980 to 2008 at current and constant prices involves- Gross Output of Agricultural Sector, of Mining and Quarrying and Construction- NAS provides nominal and real GVO series for 1) Crops and Plantation, 2) Animal Husbandry and (3) Forestry and Logging (4) Fishing. By aggregating the GVO of these four subsectors we derive the GVO of Agricultural sector. The Gross output estimates of Mining and Quarrying and Construction at current and constant prices from 1980-2008 is also directly taken from NAS. For manufacturing industries time series on gross output is obtained by adding the magnitudes for registered and unregistered segments of manufacturing. As mentioned earlier, NAS estimates of gross output for manufacturing industries are at a more aggregate level. In such cases the aggregate output of NAS at current prices has been split using additional information from ASI and NSSO unorganized sector reports. Finally, gross output series for services sectors and Electricity, Gas and Water supply has been constructed using information from Input –Output Transaction Tables of the Indian economy published by CSO.[27]

4.2.2 Labor Input by industry-measurement issues-

The construction of time series of labour input requires estimation of numbers of persons. While in India number of persons has been used as a measure of labour input, OECD (2001) and EU KLEMS have estimated labour- productivity in terms of output per labour hour worked. OECD does not favor using count of jobs and has published international comparisons of productivity for OECD countries that uses unadjusted hours. Efforts have been made to estimate persons and adjust it for changes in labour skill by calculating the labour education index, thus obtaining the education corrected labour input[28]. Most of the recent indices of composition of labour input are based on the methodology of (JGF) Jorgenson, Gollop, and Fraumeni (1987) and uses the Tornqvist translog index. There are however, lot of disagreements on the use of this methodology in the Indian context, as it assumes the existence of perfectly competitive labour markets where wage rate is the indicator of a person's marginal productivities. The data on employment is essentially derived from the unit level record data of National Sample Survey (NSS). For the construction of labour composition index we require data on employment and earnings by education and by industry. We

[27] GVO to GVA ratios for Services sectors are obtained from IOTT benchmark years of 1978-79, 1983-84, 1989-90, 1993-94, 1998-99, 2003-04. • These ratios are linearly interpolated for intervening years and applied to GVA series of NAS to derive the output estimates consistent with NAS both at current and constant prices.• It is to be noted that for government owned sector Public Administration and Defense no intermediate inputs are given in IOTT tables. Consequently value added to output ratio from System of National Accounts tables have been applied to real and nominal GVA figures of NAS to estimate the output for this sector

[28] The methodological issue is how to estimate number of persons employed. In India the total workforce in the country and its distribution over economic activities may be obtained from the decennial Population Census and the Employment and Unemployment Surveys (EUS) of the NSSO.

distinguish five types of educational categories for each of 26 industries. These are up to primary, primary, middle, secondary & higher secondary, and above higher secondary.[29]

4.2.3 Construction of capital services by industries- measurement issues

The measurement of capital services by type of activity requires information on two basic inputs: investment series by industry cross classified by type of asset and the price indices of investment goods to deflate the series on yearly investment. We obtained investment by broad industry groups by asset type from the NAS, which is not publicly available. In addition, for those sectors for which the investment matrices were not available from CSO, we gather information from other sources (e.g. ASI for organized manufacturing and NSSO surveys for unorganized manufacturing) and benchmark it to the aggregate investment series from the National Accounts. We distinguish between 4 different asset types– construction, transport equipment, non-ICT machinery, ICT equipments (hardware, software and communication equipment). These have been categorized into (i) investment in non ICT assets and (ii) investment in ICT assets. From NAS and other sources we could construct investment series for three asset types, construction, transport equipment and machinery (including ICT). Additional information has been collected to obtain investment series for ICT assets. To transform the nominal investment series into volumes, price deflators for each asset type are also obtained from the NAS.

Industry-level estimates of capital input require detailed asset-by-industry investment matrices. The basic data source for the non ICT assets comprising construction, transport equipment and non ICT machinery is the National Accounts Statistics. However in the public domain, NAS provides only information on aggregate capital formation by industry of use for 9 broad sectors. CSO has provided the detailed asset wise data underlying the published aggregate gross fixed capital formation by these broad industry groups, separately for public and private sectors. The public units were aggregated from administrative, departmental and non departmental enterprises.

Since official statistics on ICT investment is still not comprehensive in India, we rely on alternative sources to impute ICT investment. However, whenever the information is available from official sources, we exploit such information, and ensure consistency with official statistics. The available information on ICT investment in India includes software investment from NAS since 1999-00. Further, ASI's ICT investment series in organized manufacturing sectors since 1998 and NSSO 62nd round (2005-06) data on ICT investment in unorganized manufacturing, CMIE's PROWESS firm level data on gross fixed assets in hardware, software and communication equipment (1989-2009) and World Information Technology and Services Alliance (WITSA) estimates on ICT spending by broad sectors of the economy since 2000 are the available data sources.

[29] For details of methodological as well as data related aspects of labor input construction, refer to the Das et al (2014) Data Manual.

4.2.4 Intermediate inputs- measurement issues

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. There are several steps that need to put in place to generate the time series of intermediate inputs- (1) establishing concordance is done between IOTT and industries, (2) Obtaining estimates for Material, Energy and Service Inputs for Industries in benchmark years, (3) Projecting a time series (1980 to 2008) of proportions of Material, Energy and Service Inputs in Total Intermediate Inputs for each of the 26 industries**,** (4) ensuring consistency with NAS and (5) constructing Deflators of Materials, Energy and Service Inputs for Industries separately and creating constant price series.

4.2.5 Factor income shares- measurement issues

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 computation of labour income share for the industries involves two steps. First, estimates of CE, OS and MI have to be obtained for each of the 26 study industries from the NAS data which are available only for the NAS sectors. Second, the estimate of mixed income has to be split into labour income and capital income for each industry for each year (except for those industries for which the reported mixed income is zero, for instance, public administration).[30]

The purpose of this Grand Challenge is to accelerate the development of new economic data for the resolution of policy issues involving long-term growth (Jorgenson 2010). A way forward for MFP statistics in India has to be through proper coordination between different statistical agencies as computation of MFP estimates requires several data sources and necessary assumptions to move forward especially in creating a time series dataset from static data points. Productivity research in India has a long history and the development of the India KLEMS dataset signals the first attempt at collaboration between academia and statistical agencies to create estimates of MFP for Indian economy and in turn answer questions pertaining to sources of growth in India.

5. Summary and Conclusion

The need for comprehensive data base on key economic indicators of productivity and competitiveness assumes tremendous significance for an emerging economy like India. The key

[30] Refer Das et al (2014) Data Manual for construction of factor incomes shares by industries.

source of such information consists of national accounts dataset, more precisely production and income accounts of nations which allow us to document the economic activities of the nation. However a recent pioneering research work by Jorgenson and Landefeld (2006, 2009) proposed an integration of production accounts with MFP statistics. The usefulness of MFP estimates is many, especially when sources of growth become an important development agenda and allows answers for questions like industry sources for aggregate MFP growth, contribution of sectors such as manufacturing as well as services to the observed GDP growth etc. Further such databases allow international comparisons and policy related research.

The National Accounts Statistics in India is a comprehensive database for understanding the macroeconomic aspects of the economy with detailed database centered on GDP, Savings, capital formation etc. However a limitation of the NAS is the non availability of any estimates of MFP by aggregate economy or at the level of industries. MFP estimates in India have remained primarily an academic exercise but little emphasis on policy issues arising out of observed MFP growth rates. The creation of the KLEMS Dataset funded by Reserve Bank of India and with technical support from CSO is the first attempt at providing MFP estimates for the economy at the level of industries by incorporating new and improved methodology of estimating MFP and using multiple data sources from CSO-government of India statistical databases- NAS, ASI, NSSO, IO Tables, WPI etc.

In India, the new architecture for NAS that is proposed is based on the pioneering research work of Jorgenson and Landefeld (2006, 2009), who propose a new way of integrating production accounts (BEA) with the MFP accounts (BLS). A synthesis between RBI (MFP estimates) and NAS (production Accounts) is therefore posed as the new framework. However, major challenges remain. The aim of the present study was to outline the new framework and highlight the challenges that need to be overcome to allow MFP estimates within the NAS. The present study makes a beginning on what can be conceived as the new architecture for India's National Accounts Statistics. We need to draw up a blue print of what needs to be done for computation of consistent MFP estimates to overcome serious measurement challenges that exist still in the India KLEMS database.

Finally, the India KLEMS project has generated industry-level production accounts, like those presented by Jorgenson, Ho, and Stiroh (2005) for the U.S. and for the economies of 25 EU members by O Mahony and Timmer (2009) and other major U.S. trading partners, such as Australia, Canada, Japan, and Korea. The project includes account for 26 industries, covering the entire economy for the period 1980-2010. This has been made possible by involvement of India's apex monetary agency and statistical agencies -RBI and CSO. The way forward lies in synthesis between MFP statistics based on India KLEMS dataset from RBI merged with NAS from CSO.

Annexure

Table1: Recommendations of the System of National Accounts (SNA) 2008: Implemented with data issues

1. Valuation of various GVA, NVA and related aggregates at basic prices and GDP at market prices instead of factor cost.
2. Estimates of the institutional sectors – Non-financial and financial Corporations, General Government and households are shown separately, in view of their 'intrinsic difference in their economic objectives, functions and behaviour'.
3. Distinction between General Government and public corporations has been made and units have been allocated to institutional sectors so that general government and other public units can be identified separately. Changes in the new series of national accounts, BY 2011-12 Page 6
4. Unincorporated enterprises belonging to households, which have complete sets of accounts, tend to behave in the same way as corporations. Therefore, as recommended by SNA 2008, such enterprises have been treated as quasi corporations. Some examples of quasi-corporations in the Indian context are proprietorship and partnership enterprises, maintaining accounts.
5. The head office has been allocated to the non-financial corporation's sector unless all or most of its subsidiaries are financial corporations, in which case it is treated as a financial auxiliary in the financial corporation's sector. In the 2004-05 series, the recommendation had been adopted for service sector wherein GVA estimates were compiled from enterprises in this sector. In the new series, this approach has been adopted for the mining and organised manufacturing sectors also.
6. Sub-sectoring of Non-Profit Institutions (NPIs) in the corporate and government sectors has been done in respect of autonomous bodies and Section 25 companies.
7. Expenditure on Research & Development (R&D) has been capitalized in Government, Public Corporations and Private Corporations and hence has become part of capital formation.
8. Output of Financial Intermediation Services Indirectly Measured (FISIM) has been calculated using a reference rate for the financial sector, except in the case of central bank (Reserve Bank of India).
9. Output of central bank (RBI) is measured at cost.
10. Non-financial assets in the earlier series were classified as 'construction' and 'machinery'. In the new series, as recommended by SNA2008, non-financial assets have been classified as 'dwellings, other buildings and structures', 'machinery and equipment', 'cultivated biological resources' and 'intellectual property products'.
11. Consumption of fixed capital has been measured at the average prices of the period with respect to a constant-quality price index of the asset concerned.
12. Harmonization between SNA and BPM in respect of the external sector transactions has been achieved since RBI has adopted BPM6 in its compilation.

Source: CSO (2015), CHANGES IN METHODOLOGY AND DATA SOURCES IN THE NEW SERIES OF NATIONAL ACCOUNTS, March 2015

References

Aggarwal, Suresh Chand (2004): Labour Quality in Indian Manufacturing: A State Level Analysis, *Economic and Political Weekly*, vol. 39 (50), pp.5335-44.

Atkinson, F J (1902): A Statistical Review of the Income and Wealth of British India, *Journal of the Royal Statistical Society,* Vol. 65, No. 2 (Jun., 1902), pp. 209-283

Bosworth B., Collins S. and Virmani A. (2007), *"Sources of growth in Indian Economy"* NBER Working Paper No. 12901.

Baldwin J R & Tarek Harchaoui, 2005. "The Integration of the Canadian Productivity Accounts within the System of National Accounts: Current Status and Challenges Ahead," NBER Working Papers 11107, National Bureau of Economic Research,

CSO (2007), National Accounts Statistics: Sources and Methods, Central Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India.

Denison A (1967), Why Growth Rates Differ. Washington D.C.: Brookings Institution.

Das, Deb Kusum, Abdul Azeez Erumban and Suresh Aggarwal (2014) - Measuring Productivity at the Industry Level- THE INDIA KLEMS DATA BASE

Das Deb Kusum , Abdul Azeez Erumban and Suresh Aggarwal (2013) Revisiting the service-led Growth in India Understanding India's service sector productivity growth, paper presented at the IARIW-UNSW Conference on Productivity: Measurement, Drivers and Trends, November 26-27, 2013 Sydney, Australia

Das Deb Kusum, Abdul Azeez Erumban, Suresh Aggarwal and D Wadhwa, (2010): "Total Factor Productivity Growth in the Reform Period: A Disaggregated Sectoral Analysis", Paper presented in the 1st World KLEMS conference at Harvard University. USA

Economic and Political Weekly, February 7, 2015 and February 14, 2015

Erumban, Abdul Azeez and Deb Kusum Das (2015),' Information and Communication Technology and Economic Growth in India, Mimeo

Fleck et al (2012) - A Prototype BEA/BLS Industry-Level Production Account for the United States, paper presented at the 2nd World KLEMS conference, Cambridge, Massachusetts, August 9-10, 2012.

Fraumeni, Barbara M., Michael J. Harper, Susan G. Powers, and Robert E. Yuskavage. 2006. "An Integrated BEA/BLS Production Account: A First Step and Theoretical Considerations." In A New Architecture for the U.S. National Accounts, ed. Dale W. Jorgenson, J. Steven

Landefeld, and William D. Nordhaus, 355-435. Chicago and London: University of Chicago Pres

Griliches and Jorgenson (1967) '*Sources of Measured Productivity Change: Capital Input,*' American Economic Review, 56, No.2, 50-61.

Gullickson, William, and Michael J. Harper. 2002. "Bias in Aggregate Productivity Trends Revisited." Monthly Labor Review 125(3), 32

Gupta A, (2008) Gupta, A. (2008): "Indian Economy-TFP or Factor Accumulation: A Comprehensive Growth Accounting Exercise", Working Paper Series, University of British Columbia.

Jorgenson D W (1990) Jorgenson, Dale W, 1990. "Aggregate Consumer Behavior and the Measurement of Social Welfare,"Econometrica, Econometric Society, vol. 58(5), pages 1007-40, September.

Jorgenson D.W. (2001), '*Information Technology and The U.S. Economy*', American Economic Review, 91(1), 1-32.

Jorgenson, Ho, and Stiroh (2005) Jorgenson, D. W., Ho, M. S. and Stiroh, K. J. (2005), '*Information Technology and the American Growth Resurgence*', MIT Press, Cambridge

Jorgenson, Dale W., and J. Steven Landefeld. 2006. Blueprint for expanded and integrated U.S. accounts: Review, assessment, and next steps. In *A new architecture for the U.S. national accounts*, ed. Dale W.Jorgenson, J. Steven Landefeld, and William D. Nordhaus, 13-112. Chicago: University of Chicago Press.Jorgenson,

Jorgenson, Dale W., and J. Steven Landefeld. 2009. Implementation of a new architecture for the U.S. national accounts. *American Economic Review* 99 (2): 64-68.

Jorgenson, D.W. (2009), 'A New Architecture for the U.S. national Accounts', *Review of Income and Wealth, Volume 55, Issue 1, pages 1–42, March 2009*

Jorgenson, Dale W (2010). A NEW ARCHITECTURE FOR THE U.S. NATIONAL ACCOUNTS, Department of Economics, Harvard University, September 20, 2010

Jorgenson, Dale W (2014), Growth Strategy after the World Financial Crisis. Presentation at RIETI WORLD KLEMS SYMPOSIUM May 2015

Jorgenson, D.W. *et.al.* (1987), Productivity and US Economic Growth, Harvard University Press, Cambridge Mass

Kolli R (2007), " Compilation of National Accounts Statistics in India-A Historical Perspective,` Journal of Income and Wealth, volume 29 number 1

O'Mahony, M. and M.P. Timmer (2009), "*Output, Input and Productivity Measures at the Industry Level: The EU India KLEMS database*", Economic Journal, 119(538), pp. F374-F403

Oliner Stephen D. & Daniel E. Sichel, 2000. "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?," Journal of Economic Perspectives, American Economic Association, vol. 14(4), pages 3-22, Fall.

Papola T S (2008), "Employment Challenge and Strategies in India" ILO Asia-Pacific Working Paper Series, January 2008.

Rajeswari T (2011) IMPLEMENTATION OF 1993 SNA AND CHALLENGES IN IMPLEMENTATION OF 2008 SNA IN INDIA

Sivasubramanian, S. (2000) The National Income of India in the Twentieth Century, (New Delhi: Oxford University Press

Sivasubramonian S. (2004), *The Sources of Economic Growth in India: 1950-51 to 1999-2000*, New Delhi: Oxford University Press

Solow, Robert M. (1957). "Technical change and the aggregate production function". *Review of Economics and Statistics*

Strassner (2014), Integrated GDP & Productivity Account at the Industry Level, presentation made at the Industry Economic Accounts Data Users' Conference, March

Sundaram, K. (2007): Employment and Poverty in India, 2000-2005, *Economic and Political Weekly*, Vol. XLII (30), pp.3121-31.

Timmer, Marcel P.; Robert Inklaar; Mary O'Mahony and Bart van Ark (2010), *Economic Growth in Europe: A Comparative Industry Perspective*, Cambridge: Cambridge University Press.

Virmani A. (2004), "Sources of India's Economic Growth" , ICRIER Working Paper No. 131, Indian Council for Research on International Economic Relations, New Delhi.