Measuring India’s GDP Growth: Unpacking the Analytics & Data Issues behind a Controversy that Refuses to Go Away

R Nagaraj
Indira Gandhi Institute of Development Research

T N Srinivasan
Yale University

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Abstract
Central Statistical Office’s (CSO’s) new series National Accounts Statistics (NAS), with 2011-12 as the base year – and incorporating methodological changes drawn from the UN System National Accounts (UNSNA, 2008) – has been criticised for its reporting widely different annual GDP growth rates from the older series, and being at variance with other available macroeconomic indicators. Critics have raised many analytical and empirical issues that have not yet been addressed. Taking stock of the debate, the paper makes an overall assessment of the new NAS, and offers a few recommendations.

JEL Classification: E01: Measurement and Data on National Income and Product Accounts and Wealth; Environmental Accounts.
E02: Institutions and Macroeconomy


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Nagaraj: nag@igidr.ac.in  Srinivasan: t.srinivasan@yale.edu
1. Introduction

In January 2015, India’s Central Statistical Office (CSO) introduced the new series of National Accounts Statistics (NAS) with the base year 2011-12, replacing the earlier series with 2004-05 as the base year.¹ This is a routine matter for the CSO – as with statistical offices of most countries – to change the base year of the NAS periodically to account for structural changes in the economy, relative prices, and to replace older survey data with newer ones to better capture the economic activities. This time around the revision also had another objective, that is, to update the underlying methodology of NAS to the most recent international guidelines, namely, the UN System of National Accounts, 2008 (SNA 2008).²

For a developing country like India, with vast unorganised (or informal) sector and uneven quality of economic statistics used in the estimation of NAS, base year revision is usually an occasion to improve the methodologies, bring in newer and better databases, and address long held infirmities in the national accounts estimates. Usually the base year revision leads to a marginal rise in the absolute size of the aggregate measures as economic activity get better represented. However, annual growth rates of these estimates do not invariably change – implying that though the absolute size of the economy may have got altered in the base year, its rate of change would not vary.

But the recent revision was different. While the absolute size of gross domestic product at current prices in the base year (2011-12) was marginally smaller (by 2.1 percent) compared to the earlier estimates, there was a significant change in the growth rates for the subsequent years, namely, for 2012-13 and 2013-14 (Figure 1 a, b). For instance, annual economic growth for 2013-14 at constant prices, according to the new series, is 6.2 per cent compared to 4.8 per cent according the old series. More dramatically, manufacturing sector growth rate in real terms for the same years changed from negative 2 per cent to positive 6 per cent. Moreover, the revised estimates did not seem consistent with other macroeconomic indicators such as corporate earnings or credit growth (Figure 2 (i) and (ii))

¹See http://mospi.nic.in/Mospi_New/upload/new_series_NI.htm for all the relevant documents and background studies.
²For a brief exposition of SNA 2008, and a factual account of the main changes in the new NAS, see EPW Research Foundation (2015).
Figure 1a: Disaggregated GDP Growth rates for 2012-13

Source: NAS 2014 and CSO (2015b)

Figure 1b: Disaggregated GDP growth rates for 2013-14

Source: NAS 2014 and CSO (2015b)
Similarly, domestic saving and investment estimates are also much higher in the new series compared to the old (Table 1).

Table 1: Growth rates of saving and investments

<table>
<thead>
<tr>
<th>Year</th>
<th>Growth rate of GDS (%)</th>
<th>Growth rate of GCF (%)</th>
<th>Savings % GNDI</th>
<th>GCF % GNDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-11</td>
<td></td>
<td></td>
<td>6.7</td>
<td>12.8</td>
</tr>
<tr>
<td>2011-12</td>
<td>6.2</td>
<td>-8.5</td>
<td>6.4</td>
<td>9.4</td>
</tr>
<tr>
<td>2012-13</td>
<td>8.3</td>
<td>16.6</td>
<td>14.7</td>
<td>9.2</td>
</tr>
<tr>
<td>2013-14</td>
<td>23.7</td>
<td>6.2</td>
<td>10.6</td>
<td>12.6</td>
</tr>
</tbody>
</table>

Source: NAS 2014 and CS0 (2015b)
Further, in January 2016, CSO has released “First Revised Estimates” (FRE) of the new series. Interestingly, in FRE, even the base year estimates have got changed, thus causing more uncertainty (Rajakumar and Shetty, 2016) (more about it later). For instance, domestic output size for the base year 2011-12 is now lower than that by the old series by 3.4 per cent (compared 2.3 percent as estimated in 2015). Thus for the years 2012-13 and 2013-14, we have 3 sets of estimates in real terms with considerable variations between them (Figure 3 (i) and 3 (ii)).

**Figure 3: (i) Growth rates in 2012-13**

**Figure 3 (ii): Growth rates in 2013-14**

Over last 18 months numerous critical analyses of the methodologies and databases used in the revised estimates have dented the credibility of the new NAS. These have led to a growing scepticism of the new GDP estimates which included policy makers, international investors and economic analysts. However, CSO and the statistical officials have repeatedly responded to these criticisms by asserting that the NAS revision is benchmarked against the best international practices, and it has used larger and improved datasets, hence the estimates are technically better and indisputable. But the debate refuses to go away, as the doubts expressed have only seems to get reinforced with every release of new estimates.³

Besides the on-going debate, there are many longstanding methodological issues that beset Indian NAS, which (strictly speaking) do not follow the global templates; there are some long pending issues which were not addressed in the recent revision. We believe many of these issues are still valid, and they warrant flagging in any methodological review of the NAS.

Thus the paper addresses the foregoing issues in two parts: Part I deals with what can be termed as the “legacy issues” that were ignored in the recent revision, and Part II that deals with the on-going debate on the reliability of the NAS estimates. The second part concentrates mostly on the analytical and methodological issues concerning the recent revision. The review will focus only on the main issues which have come up for scrutiny in public debate thus far, and not address all the methodological changes the revision has put into effect in the new series. The last section will summarise the main finding and our assessment of the way forward.

Considering that the paper reviews widely debated and minutely chronicled methodological and statistical issues, we have to resort to lot of quotations and supporting figures from the original sources. However, to keep the main strands of ideas and evidence easily understandable, we have relegated lot of details in the footnotes and appendices.

Part I

The Legacy Issues

1.1. INTRODUCTION

The Central Statistical Office ⁴(CSO) which puts together and publishes National Accounts Statistics (NAS) changed the methodology and data sources in the New Series of National Accounts with the base year 2011-12(CSO, 2015a). “Besides shifting the

³For instance, even in first week of June 2016, there were 2 op-ed columns critical of the new estimates, which showed the high and rising growth rate is made up of unexplainable “discrepancies” accounted for nearly ½ of the incremental output growth in the January-March 2016 quarter.

⁴Professor P.C. Mahalanobis was the Chairman of the First National Income Committee (FNC) was instrumental in the founding of CSO and also the National Sample Survey, first in the Indian Statistical Institute at Kolkata which was later transferred to the central government and became the National Sample Survey Organization NSSO). The preliminary and final report of FNC set the course of compilation and publication of National Accounts Statistics in India.
base year from 2004-2005 to 2011-12, this series incorporates latest available data from surveys, censuses, new economic activities, expansion of coverage of activities and improvement in procedures, and to the extent possible, the latest recommendations of System of National Accounts (SNA), 2008 in the compilation of national accounts” (CSO,2015bFOREWORD). CSO held a conference on the new series to which data users selected by the CSO were invited. Slides of the presentation at this conference (CSO,2015c) have been in circulation though not officially as a CSO paper. In addition, there has been an extensive discussion and comment in the news media as well as in professional journals, including importantly in the Economic and Political Weekly by experts in national accounts. Critically reviewing and summarizing this vast and diverse literature is beyond the scope of this paper. What we will do instead is to draw on this literature selectively while including all of the important publications of CSO in our assessment of the New Series and the major controversies surrounding it.

Section 2 of CSO(2015 b) entitled “Guiding principles for the New Series”, lists the three major components influencing the present revision exercise as “ (i) Revision of base year to a most recent year (for meaningful analysis of structural changes in the economy in real terms), (ii) complete review of the existing database and methodology employed in the estimation of various macroeconomic aggregates including the choice of alternative databases on individual subjects and (iii) to the extent feasible implementing the international guidelines on the compilation of national accounts, the System of National Accounts. 2008...”6. The first two components are almost routinely undertaken during any revision of the base year and not just the current revision. However, whether or not the second component is in fact a complete review will depend on the extent of the structural changes that have taken place and new data that had become available since the previous base year and also the time and resources CSO devoted to the task.

CSO has not offered any rationale for implementing the SNA 2008 to the extent feasible; in 2015 rather than later, and the social costs/benefits thereof in comparison to undertaking and resolving several well-known and well recognized problems with the old series.[See for example, the Report of the National Statistical Commission (NSC), chaired by C Rangarajan (http://goo.gl/SDVJ9)]. For this reason, we begin with this legacy from the old series in the next Section (Section 1.2). We then discuss the issue relating to major sectors/accounts.

1.2.1 Approaches to the Measurement of Gross Domestic Product

The three independent approaches for estimating Gross Domestic Product and related aggregates are: (i) the production or product approach in which gross value added by units of production of goods and services in the economy are aggregated. (ii) income approach in which the income accruing to domestic primary factor owners for their supply of production factors such as land, labor and capital are aggregated and (iii) expenditure approach in which public and resident private sector expenditures on

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5SNA 2008 was prepared under auspices of the Inter Secretariat working group on National accounts comprising of the European communities (EURO STAT), International Monetary Fund (IMF), Organization for Economic Development (OECD), United Nations and the World Bank.

6See footnote 1 above.
consumption, gross capital formation and of foreigner's expenditure on exports net of imports are aggregated. If we ignore for simplicity complications arising for direct and indirect taxes, except for measurement errors the three approaches would lead to the same estimate of GDP. CSO (2016) gives a good account of the approaches to measurement of GDP. Syrquin's (2016) book review of Coyle (2014) is a good source for the intellectual history of GDP.

Strictly speaking, even in advanced countries product, income and expenditure based estimates are not independently derived and some mixture of the three is used. In the Indian NAS, the mixture is so extensive that it is better called, using a word of Middle English and Yiddish origin according to Merriam Webster, a Mish-Mash or a confused mixture of the three that is in large part, attributable to the persistence of large unorganized sector in GDP as well as in employment. Yet from Table 6.1 of CSO (2015b), which lists compilation categories/sectors for which either a production or income approach is being used, it would seem that even with the changes in the methodology and data sources in the new series, no significant dent in the Mish-Mash legacy seems to have taken place.

1.2.2 Absence of mutually consistent data on Household Income, Consumption, Savings and Investment

The definition of a household in the household consumption expenditure surveys (CES) of the National Sample Survey (NSS), is the conventional ‘kitchen’ definition, i.e., a household consists of all those who usually eat out of the same kitchen. In CES data only on consumption expenditures are collected. Data on household income and their sources are not collected for valid analytical reasons as well as sampling experiments on their reliability in early rounds of NSS, so that estimates from the households of their incomes from their factor supplies are not collected. Moreover, the significant number of labor force participants are self-employed, so that their income is a mixture of operating surpluses from the production activity (example: agricultural, cottage and village industry) in which they are self-employed and wage income from their supply of labor.

Without data on income, clearly household savings cannot be derived. Also some of the durables purchased by households could be of dual-use categories, in that their services could be consumed as well used as intermediate input in home production and or other income earning activities. Data on household purchases of financial instruments are not available in CES. This means that consistent data on income, savings, and investment of households are not available. NSS had experimented with collecting income, consumption, savings and investment data in a mutually consistent manner through an integrated schedule in few early rounds. In fact, the Rangarajan Committee (http://goo.gl/SDVij9) had recommended that NSS should resume canvassing it again. Whether in response or not, NSS in its 70th round (2014) did a Survey on the Status of Agricultural Households in Rural India and collected data on their incomes, their principal sources, expenditures on consumption and productive investment. Whether such a survey will be extended to urban areas and continued is not known.
I.2.3 Measurement of Labour Input and Labour Income: Production Functions

For the unorganized manufacturing and service sectors, which being unorganized are part of the household sector, the new series uses the concept of an “effective labor input” by defining it as a weighted average of labor inputs of owners, hired labor and helpers with their marginal productivity in terms of value added in the base year relative to that of hired labor as weights. These weights are derived from estimated nested Cobb-Douglas production function for each of the relevant sectors (for the base year). As yet the parameters of the estimated production function, and in particular, the data used for non-labor inputs such as capital, land etc. have not been released. Nor is there any information on whether any robustness checks on results of the empirical results, However, an unnumbered slide in an unnumbered page of CSO (2015c) lists for compilation categories of eight nonfinancial service sectors, what it calls conversion factors for converting a unit of owner and helper labor into equivalent units of hired labor. These are the production function parameters. It is unclear whether production functions were estimated for compilation categories/sectors other than these eight.

For some compilation categories (for example: trade and repair services) “where it was felt that the productivity of different categories of labour may not have a significant impact on GVA, especially in the unorganized segment, the LI [labour input] method was used” (CSO, 2015b, p10). In this case, all workers were in effect deemed to be equally productive. Clearly, whether significant marginal productivity differences exist across categories of workers or not is an empirical issue, given technology, i.e., (production function) and quantities of other inputs. This being the case, there is no reason why a production function was not estimated for all relevant compilation categories/sectors in the base year and let the data determine whether or not significant productivity differences exist.

Annexures 2.3.1-2.3.4 of CSO (2015b), list compiling categories by their method of LI measurement. Effective LI is used in 34 categories of unincorporated manufacturing in 2.3.1 and 13 categories of unincorporated non-financial services in 2.3.3; a modified effective LI is used in 11 categories on unincorporated non-financial services in 2.3.4; and finally; a simple LI is used in 9 categories of unincorporated non-financial services in 2.3.2. For each of the 57 compilation categories, a production function could have been estimated, with the parameter values determining the weighting of the three categories of labour instead of an ex ante specification of the LI method to be used as in Annexures2.3.1-2.3.4. However, there are some technical issues relating to the particular production function used by CSO and also whether the marginal productivity different categories of labour, while statistically significant in individual sectors, in the aggregate cancel out. Appendix 1 discusses some of these issues.

I.2.4 Measurement of Value Added at Current and Constant prices in the base and succeeding Years: Choice of Price Indices and Deflation Procedures

For extrapolating value added in years succeeding the base year for each compilation category in the unorganized non-financial services sector, some indicators reflecting the current situation such as sales tax revenue in the case of unorganized trade and service tax (in some cases) as an indicator for growth of respective services (CSO (2015c),) are used in the new series. Annexure 2.5 lists the indicators used for
each of 37 compilation categories, with 2.5.1., listing indicators for value added at current prices, and 2.5.2 listing indicators for value added at constant prices.

The indicators are listed in Annexure 2.5.1 **for extrapolating value added at current prices**. For example, for the compilation category ‘maintenance and repair of motor vehicles and motor cycles, the indicator listed is ‘Motor Vehicles Sales Growth *WPI’. The corresponding indicator **for extrapolating value added at constant prices** is ‘Motor Vehicles Sales Growth’! Thus the index for extrapolating value added at constant prices is unaffected by choice of a price index for deflating the value added at current prices, such as WPI, which has nothing to do with repair and maintenance of motor vehicles and motor cycles or for that matter any services!

The lack of rationale of the choice of price deflator is equally striking in the case of compilation categories 7-11 relating to land transport of passengers and freight. The indicator for current price value added in Annexure 2.5.1 is ‘growth in registered vehicles’* CPI (Transport & Communication). For constant price value added the index is –Growth in Registered Vehicles! Again the there is no reason to expect CPI (Transport & Communication) has anything to do with value added in land transport of passengers and freight—thus replacing CPI (Transport and Communication) by any arbitrary price index will change value added at current prices without affecting constant price value added.

Value added at constant prices of different sectors and in the aggregate are important indicators of real growth. Section 6 of CSO (2015 b) is devoted to a summary of estimation procedures for compilation of National Accounts in the new series. Table 6.1 entitled Gross Value Added (GVA) at Basic Prices lists products and services in its rows by Sectors. Columns 3 and 4 describe the method of estimation of GVA at current and Constant Prices. It is evident that a multiplicity of price indices is being used without much of an explanation of the rationale of their choice. As such defining and measuring real value added has attracted the attention of economists. Appendix 2 is devoted to a brief discussion of the issues. Other issues relating to Price indexes including the absence of a regular procedure for incorporating new goods as they come on the market rather than waiting for the nest base year revision to do so are discussed in Appendix 2.

**I.2.5 Institutional Sectors**

In the new series there are six ‘institutional’ sectors consisting of two private sector financial and non-financial corporations, their two public sector counterparts, General Government and a heterogeneous sector, very misleadingly called ‘household sector’ which in effect consists of all compilation categories sectors of the economy other than those included in the four corporate institutions and general government!

In the old series with base 2004-05 the ‘household sector’ included what are called ‘Quasi Corporations (QCs)’. In the new series, and QCs have been included under private non-financial corporations. No evidence on changes in their structure and inherent characteristics warranting the shift is offered. It seems to have been done for no reason except that the corporate form of organization is emphasized in SNA (2008). Thus the so called ‘household sector’ in NAS includes much more than conventional households consisting of individuals eating from the same kitchen, such as Non-profit institutions helping households (NPISHs) and privately owned partnerships and other
non-corporate financial and non-financial entities. In fact, much of unorganized and unregistered manufacturing including enterprises either with no employee other than its owner or with the owner and an unpaid family member as employees is part of the household sector.

In our view the statistical implications with respect to interdependence of the measurement errors and biases of the any statistic such as, income, consumption and investment of the household sector and the corresponding statistic of the other of the other five have not been carefully analysed. We refer to this issue and its treatment in CSO (2012) in Appendix 2. For example, investment fixed capital assets such as equipment etc. and in stocks in the aggregate and by public and private corporate sectors is estimated by the commodity flow method while the funds available for financing the investment from domestic savings and net capital inflow from abroad are estimated by flow of funds method. The CSO doctrine holds that the data on flow of funds are more reliable than the data of commodity flows so that the discrepancy between the two is treated as due to statistical errors of omission, commission and measurement of investment by asset categories or by production sectors. It is to be stressed that this is only a doctrine, albeit plausible. We are not aware of any study providing theoretical or empirical support for it.

Another aspect of the residual nature of the household sector is that its gross capital formation (GCF), derived as the residual remaining after subtracting from aggregate GCF estimate by the commodity flow method the GCF of the public and private corporate sectors. It is not only part of household sector’s aggregate GCF by definition but is also part of the sector’s gross domestic savings and for this reason it is called “Direct household Savings in the form of Physical Assets” including valuables.

Since no information is available to distribute the aggregate discrepancy among the institutions, the assumptions one makes about the joint probability distribution of the aggregate discrepancy and its distribution among the five sectors implies a probability density of the discrepancy for the residual household sector. Interestingly the investment in the asset category ‘valuable’ appeared in the series with 2004-05 as base in the table of capital formation by asset categories but with no attribution however which institutions financed part or whole of it. In the new series the investment in valuables is assumed to be done and financed by households. But the savings and capital formation by all the six institutions do not appear to be depicted in a consistent fashion to reflect this assumption in the consolidated Investment and its Finance Accounts of the Nation.

An issue that has attracted attention from the late 1950s on is the growing excess of NAS based estimates of private consumption expenditure of households and that from the CES of the NSS. The volume edited by Angus Deaton and Valerie Kozel (2005) includes several papers going back to late 1950s on the issue, in particular, the careful analysis and conclusion of Minhas (1988, reprinted as Chapter 6 in Deaton and Kozel (2005)). Minhas found that “The independent data set (NAS), it would seem fair to conclude, is far short of the touchstone of quality expected of an independent validator dataset. A number of its components are based on such weak evidence and unverified assumptions which seriously diminish its value in a cross validation exercise. On the other hand, the NSS estimates of expenditure on such minor vices such as tobacco and

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intoxicants, and consumer durables and modern consumer services are of doubtful reliability. Nevertheless, despite these difficulties, which have to be overcome in both data sets, an overwhelming proportion of household consumer expenditure data of the NSS and independent private consumption estimates of the NAS do get cross validation.” (Minhas, 2005, p.91).

Deaton and Kozel, writing in 2005, concluded, and we agree with them more than a decade later, that “Minhas’ paper should be compulsory reading for anyone concerned with the issue of national accounts, particularly anyone who does not understand the complexities and approximations involved in the construction of former. Minhas’ chapter lays out the issues that have dominated the contemporary debate, the differential definition and coverage of NAS and NSS consumption, differences in timing, and the heavy reliance in national accounting practice on various rates and ratios that link the observable but irrelevant quantities to relevant but unobservable ones.” (Deaton and Kozel, 2005, p5). Indeed, our experience in the course of writing this paper suggests that difficulties in NAS and NSS data sets that Minhas cautioned that needed to be overcome still remain. In our view overcoming them and generating data whose reliability would no longer be in doubt should have been of greater priority than the rush to incorporate SNA (2008).

I.2.6 Use of MCA-21 Company Data and the ‘Blow Up’ Factor

In the series with 2004-05 as the base year the data for corporate sector was provided by the RBI study on Company Finances from a sample of around 2500 companies outside of agriculture and mining. It is well known that the list of companies from which the sample of 2500 was chosen was defective and incomplete, with some non-operating companies on the list and some recently registered new companies yet to get on the list. Moreover, the procedure by which the sample of 2500 was drawn varied over the years and was by no means random. An unnumbered slide in CSO (2015c) points out that “No uniform methodology for industries due to absence of uniform data on private corporate non-financial sector. Companies selected in RBI sample study not following any sampling scheme and results highly varying in nature”. It is unlikely that the MCA-21 data set used in the new series is uniform and the record of compliance with respect to the mandated requirement to file annul returns is by no means exemplary.

For organized manufacturing the data source in the old series was ASI and the establishments (and not enterprises as in the New Series) registered under the Factories Act. Again it is well known that the list of registered establishments from which ASI chose the establishments in its sample and Census components was incomplete and defective for essentially the same reasons as in the case of the list of registered companies. It is evident therefore attribute to the estimates derived using a non-random sample from a defective sample frame, those derived from using a random sample from non-defective and complete list.

One of the unnumbered slides in CSO (2015c) notes the absence of any “regular source of information on Unorganised Manufacturing and Non-Financial Services “and another reads “2004-05 series did not have separate estimates of GVA for non-financial corporate sectors”
The litany of data related problems with the 2004-05 or the old series discussed in CSO (2015a, b, c) naturally leads to the expectation that the move to the MCA 21 data set and much less of the use of ASI etc. many of the problems have been or would soon be resolved. Unfortunately, it appears that such an expectation is premature. We postpone a detailed discussion of this to Part II. However, since the issue of a blow-up of a sample estimates to a finite population as a whole plagued the old series as well we discuss it a legacy issue.

Consider the simple problem of estimating the population of a district of N villages. If we take a simple random sample of n villages with replacement and the total population of the sample villages is p, then the unbiased estimate of the population of the district is \( \frac{N}{n} \times p \). Thus the blow-up factor is \( \frac{N}{n} \).

Chapter VIII of Ministry of Corporate Affairs Annual Report 2013, entitled “Financial Aggregates of Corporate Sector, para 8.1 says, “As of 31-03-2013, the MCA repository had information for almost 13.02 lakh companies that have been registered in India. Asis to be expected CSO (2015c) devotes many slides to MCA 21. The one entitled MCA data in brief mentions its two e-platforms, namely 23 AC/ACA and XBRL and lists the legal provisions as to which companies are required to file. An important slide with the title Use of MCA 21 data mentions:

CSO estimates in 2011-12 series [New Series] for 2011-12 and 2012-13 [were] prepared based on analysis 5.24 lakh non-financial private companies

5.24 lakh companies constitute approximately 85% of total [Paid Up Capital] PUC of active non-financial corporate sector as provided by MCA.

For default companies, the estimates are blown up by scaler [sic] factor determined based on PUC of reporting companies/PUC of all active companies.

For 2013-14, industry-wise estimated parameters are moved using the growth rate as observed for the 3.08 lakh common companies between 2012-13 and 2013-14.

From the above, though it is not explicit, 5.24 lakh companies were active and submitted returns in 2012-13 from which estimates for both the years 2011-12 and 2012-13 were prepared. In analogy with the above population example ‘n’ is the equivalent of PUC of the 5.24 lakh active companies that reported in 2012-13 and ‘N’ is the PUC of all active companies, whether they reported or not and the blow up factor N/n is 1/0.85 or 1.15. Applying this factor to the 5.24 lakh active companies that filed the total number of companies including those that did not file would be around 5.8 lakhs. On the other hand, if indeed there are 13.04 lakh companies in the MCA Repository, and not just 5.8 lakhs using the 85% share of the 5.24 lakh companies in the total PUC of all registered companies for deriving the blow-up factor, it must be case, those companies out of the 13.04 lakh that did not file, namely, 7.8 lakh, with only 15% share in the total PUC of all registered companies must be on an average small with low values of PUC.

However, as the Chief Statistician of India and Secretary, Ministry of Statistics and Programme Implementation Dr T C A Anant said in an interview with Ishan Bakshi of Business Standard on April 4 2016, “We have already answered the original set of concerns related to the manner in which estimates from the MCA database were used to project for the entire corporate sector. The basic argument is that even with the MCA data, you do not get reports of all active companies that are participating. The major reason being, everybody does not file accounts regularly or on time. So, do you go with
all those companies whose accounts are available, or do you make an estimate for the
ones whose accounts are as yet awaited? The practice in national accounts has been
[to], make an estimate for the whole [of all participating companies]. So, you blow up,
or make same adjustment, for the whole. We do not get a comprehensive number for
every possible establishment in all areas of national accounts. It is an estimate.”

While Dr. Anant’s arguments seem logical, there is a serious statistical problem
in applying the procedure and blow up factor such as the one used in estimating the
population of a district to the MCA data. In the case of choosing a village in the sample
for estimating the District Population the choice is random and made by the statistician
and the village authorities play no role. On the other hand, whether a company files in
time or files at is a company's decision. As such the MCA data are self-selected. Any
blow-up that does not model self-selection and appropriately allows for it in the blow-
up factor will lead to inconsistent and biased estimates. In particular, one cannot rule
out the possibility that a company’s decision to report or not, might depend on the
content of the report were one to be submitted.

I.2.7 Outsourcing, fragmentation of production, Regional and Global Value Chains

Strictly speaking, although this is not a legacy issue its implication for the new
series could be significant. With the WTO agreement on services trade (GATS) in 2001
outsourcing of the service activities that used to be done within a manufacturing
company are being outsourced to specialized service companies within a country or in a
foreign country, so that the value used to be added by the service employees of the
manufacturing company is out sourced to the service companies. This process,
originally described by Jagdish Bhagwati is now very extensive leading to growing
international trade in components and parts on the one hand, and what is called process
trade in which goods are shipped back and forth for completion of all process and the
good is ready as a well as processing is done in several countries. Although the
quantitative significance of the growth of global value chains for India over the last two
decades is not known, what is known that India is a late comer in its participation in
such chains. Unfortunately, the MCA 21 data base is fairly recent and precludes a
reliable retrospective analysis. Such an analysis should be begun as soon as possible.
However, CSO can begin publishing India’s international trade data in gross value and
value added terms

I.2.8 Error Estimates for Sectoral and Aggregate Value Added

The first and final reports of the First National Income Committee, chaired by
late Professor P.C. Mahalanobis, the eminent physicist and statistician and founder of
Indian Statistical Institute in 1932 and of CSO and NSS (in ISI), provided approximate
error estimates for aggregate and sectoral value added. Although these were not
sampling errors in a statistical sense, they were yet informative. The CSO does not
provide similar error estimates so that it is impossible to tell whether NAS are now less
error prone after more than six decades! Better late than never—CSO should start
publishing error estimates as soon as possible.
I.2.9 Revalidation of Company-wise and Industry-wise classification of companies in the MCA-21 Data

Paragraph 23 and Annexure of CSO (2016) mention changes in both levels and growth estimates of GVA follow from the use of latest available data from various (un-named) sources and the consequent revalidation of the classification of companies in the MCA –Dataset. Since new data become available every year the revalidation exercise has to be done every year. Besides companies that had filed for some time, may choose not to file in some year and never come back or would come back after a lapse of time. It is not clear whether its filed tax statements give any clue to a company’s decision to stop filing or to resume filing. It would be of great help if CSO would publish and illustrate with statements file how relevant NAS were extracted from the tax statements and the procedures followed for that purpose and in the revalidation exercise.

The Reserve Bank has recently released MCA-21 data obtained from MCA. Hopefully we will be able to access and analyse these data before publication of this paper.

I.2.10 Panel Data

Although CSO collects and publishes several time series, almost all of them are cross sections and some are cross sections repeated over time. There many issues for which panel data are essential for drawing valid inferences. The econometric theory and tools for panel data analysis including panel co-integration techniques are well developed. It is time that CSO introduces panel feature in its time series.

Part II

2.1 The On-going Debate

This part consists of 2 sections. Section 2.1 describes the compositional changes in domestic output in the new series compared to the old series (2004-05 base year); Section 2.2 deals with the methodological changes made in the new series and the main debates surrounding the new estimates that ensued. We discuss mainly the two sectors, namely, PCS and household sector or unorganised sector, whose estimates have undergone most significant changes.

For sake of convenience, we use the GDP to denote GVA at basic prices in the new series, and GDP at factor cost in the old series.

2.1.1 Changes in the composition domestic output:

To begin with, it is useful to understand the principal changes in the domestic output estimates at current prices in the new series. Table 2 shows the industrial or sectoral distribution of output for the base year, 2011-12, as per the new (revised estimates of January 2016) and the old (2004-05) series. The main changes are the following:
1. In the new NAS (as per First Revised Estimates (FRE 2016)), the absolute size of gross value added at basic prices (GVAbp) is smaller by 3.4 per cent compared to gross domestic product at factor cost (GDPfc) in the old series.

2. Industrial or sectoral composition of domestic output has changed somewhat: secondary or industrial sector’s size has swelled by about 5 per cent of GDP, with a corresponding decline in the tertiary or services sector size, with the size of agriculture or primary or agriculture sector remaining broadly the same (Figure 4 (i) and (ii))

3. In particular, the shares of (a) manufacturing and (b) financial sector have expanded, while that of (i) trade, hotel and restaurants, and (ii) community, social and public services have declined.

4. Similarly, in terms of institutional categories, size of PCS has got enlarged by 11 percentage points of GDP, with a corresponding reduction in the size of household or unorganised sector (relative to GDP) (Figure 5). In per capita terms, implications of the change are even starker: for 2011-12, per capita income in the unorganised or household sector gets reduced to 7.1 per cent of that of the organised sector, compared to 11.1 per cent as per the old NAS.

**Figure 4 (i) Sectoral Composition of GDP New and the Old Series**

```
Primary  Secondary  Tertiary
22%       20%        25%
29%       22%        20%
55%       55%        49%
```

**Figure 4 (i) Sectoral Composition of GDP New and the Old Series**

```
Agriculture  Industry  Services
18%         18%        27%
33%         33%        27%
55%         55%        49%
```

*Source: NAS (2014), NAS (2015)*
Figure 5: Institutional Composition of GDP, for 201-12 (in per cent)

<table>
<thead>
<tr>
<th>Sector/Industry</th>
<th>New NAS (Revision 2016)</th>
<th>NAS 2014 (Old series)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agriculture, forestry &amp; fishing</td>
<td>18.5</td>
<td>17.9</td>
</tr>
<tr>
<td>1.1 Crops</td>
<td>12.1</td>
<td>11.4</td>
</tr>
<tr>
<td>1.2 Livestock</td>
<td>4.0</td>
<td>4.1</td>
</tr>
<tr>
<td>1.3 Forestry &amp; logging</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>1.4 Fishing and aquaculture</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>2. Mining &amp; quarrying</td>
<td>3.2</td>
<td>2.7</td>
</tr>
<tr>
<td>3. Manufacturing</td>
<td>17.4</td>
<td>14.7</td>
</tr>
<tr>
<td>3.1.1 Food Products, Beverages and Tobacco</td>
<td>2.1</td>
<td>0.0</td>
</tr>
<tr>
<td>3.1.2 Textiles, Apparel and Leather Products</td>
<td>1.9</td>
<td>0.0</td>
</tr>
<tr>
<td>3.1.3 Metal Products</td>
<td>2.8</td>
<td>0.0</td>
</tr>
<tr>
<td>3.1.4 Machinery and Equipment</td>
<td>4.1</td>
<td>0.0</td>
</tr>
<tr>
<td>3.1.5 Other Manufactured Goods</td>
<td>6.5</td>
<td>0.0</td>
</tr>
<tr>
<td>4. Electricity, gas, water supply &amp; other utility services</td>
<td>2.3</td>
<td>1.6</td>
</tr>
<tr>
<td>5. Construction</td>
<td>9.6</td>
<td>8.2</td>
</tr>
<tr>
<td>6. Trade, repair, hotels and restaurants</td>
<td>10.9</td>
<td>17.4</td>
</tr>
<tr>
<td>6.1 Trade &amp; repair services</td>
<td>9.8</td>
<td>15.9</td>
</tr>
<tr>
<td>6.2 Hotels &amp; restaurants</td>
<td>1.1</td>
<td>1.5</td>
</tr>
<tr>
<td>7. Transport, storage, communication &amp; services related to broadcasting</td>
<td>6.5</td>
<td>7.3</td>
</tr>
<tr>
<td>7.1 Railways</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>7.2 Road transport</td>
<td>3.2</td>
<td>0.0</td>
</tr>
<tr>
<td>7.3 Water transport</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>7.4 Air transport</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>7.5 Services incidental to transport</td>
<td>0.8</td>
<td>0.0</td>
</tr>
<tr>
<td>7.6 Storage</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>7.7 Communication &amp; services related to broadcasting</td>
<td>1.6</td>
<td>1.1</td>
</tr>
<tr>
<td>8. Financial, real estate &amp; prof servs</td>
<td>18.9</td>
<td>16.5</td>
</tr>
<tr>
<td>8.1 Financial services</td>
<td>5.9</td>
<td>5.7</td>
</tr>
<tr>
<td>8.2 Real estate, ownership of dwelling &amp; professional services</td>
<td>13.0</td>
<td>10.7</td>
</tr>
<tr>
<td>9. Public Administration, defence and other services</td>
<td>12.7</td>
<td>13.8</td>
</tr>
<tr>
<td>9.1 Public administration &amp; defence</td>
<td>6.1</td>
<td>5.9</td>
</tr>
<tr>
<td>9.2 Other services</td>
<td>6.6</td>
<td>7.8</td>
</tr>
<tr>
<td>10. GVA at basic prices</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>GVAbp/GDPfc</td>
<td>8106656</td>
<td>8391691</td>
</tr>
</tbody>
</table>
2.1.2 Changes in the institutional structure of NAS:

Conceptual underpinning of the new NAS is one of a more homogeneous market economy like an advanced capitalist country. The new series uses corporate form of organisation in four out of six institutional sectors; the two excluded being general government and household sector. This could have implications for measurement of output in many activities, as will be discussed later.

2.1.3 Organisational unit of measurement:

In the new series, outside of agriculture and public sector, an enterprise – or the organisational unit of production – is the unit for recording output. In an enterprise value addition could take place in factory or in office or in auxiliary services. Value addition in all these activities are, in principle captured in the company balance sheet, as obtained in MCA 21 database. Table 3 (a) presents a comparative data for the institutional categories, in terms of ownership, in the old and the new NAS.

Table 3 (a): Institutional structure as in NAS 2004-05 and in NAS 2011-12

<table>
<thead>
<tr>
<th>Old (base year: 2004-05)</th>
<th>New (base year: 2011-12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Public Sector</td>
<td>1. Public Non-Financial Corporations</td>
</tr>
<tr>
<td>1.1 Administrative Departments</td>
<td>2. Private Non-Financial Corporations</td>
</tr>
<tr>
<td>1.2 Department Enterprises</td>
<td>3. Public Financial Corporations</td>
</tr>
<tr>
<td>1.3 Non-Departmental Enterprises</td>
<td>4. Private Financial Corporations</td>
</tr>
<tr>
<td>2. Private Sector</td>
<td>5. General Government</td>
</tr>
<tr>
<td>2.1 Private Corporate Sector</td>
<td>6. Household Sector including NPISHs</td>
</tr>
<tr>
<td>2.2 Household Sector including Non-Profit Institution Serving Households (NPISHs)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 (b): GDP shares as in 2011-12

<table>
<thead>
<tr>
<th>Old Series</th>
<th>GDP share</th>
<th>New Series</th>
<th>GDP share</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Organised sector:</td>
<td>43.9</td>
<td>1. Organised sector:</td>
<td>55.1</td>
</tr>
<tr>
<td>1. Public sector</td>
<td>20.3</td>
<td>1. Public sector</td>
<td>20.4</td>
</tr>
<tr>
<td>(i) Administrative dept</td>
<td></td>
<td>(i) General government</td>
<td>9.7</td>
</tr>
<tr>
<td>(ii) Departmental enterprises</td>
<td></td>
<td>(ii) Public non-financial corporations</td>
<td>2.1</td>
</tr>
<tr>
<td>(iii) Non-departmental enterprises</td>
<td></td>
<td>(iii) Public financial corporations</td>
<td>8.6</td>
</tr>
<tr>
<td>2. Private corporate sector</td>
<td>23.7</td>
<td>2. Private corporate sector</td>
<td>34.7</td>
</tr>
<tr>
<td>3. Factory manufacturing</td>
<td></td>
<td>(a) Private financial corporations</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) private non-financial corporations</td>
<td></td>
</tr>
<tr>
<td>4. Recognised educational and medical institutions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II. Unorganised sector</td>
<td>56.1</td>
<td>II. Household sector</td>
<td>44.9</td>
</tr>
</tbody>
</table>

Source: Data users' conference handout, April 13, 2015.
The above table is redrawn in the new NAS as in Table 3 (b). Previously, organised sector consisted of the overlapping categories of (i) public sector, (ii) private corporate sector, (iii) factory manufacturing, and recognised educational and medical institutions, accounting for 40-45 per cent of GDP. Unorganised sector, by definition, was the residual. Share of public sector in GDP in the new series has remained the same as in the old series, though there has been some reshuffling within public sector in the new series: “Administrative department” in the old series has now become “general government”, which in principle includes local administration as well. “Departmental enterprises”, non-departmental and non-financial non-enterprises are now put under the sub-heading: Public non-financial corporation; non-departmental financial enterprises are now put under a separate sub-heading: public financial corporation.

Within PCS, the definition of non-financial private corporate sector (NF-PCS) has undergone a significant enlargement because quasi-corporations (QCs) – that is, non-corporate entities which appear and maintain accounts like the corporate sector – are shifted from the unorganised sector in the older series to NF-PCS in the new series (more about it later). Hence the size of PCS, as noted above, has gone up by 11 percentage points of GDP with a corresponding reduction in the size of unorganised sector, which is now renamed “household sector”. As is widely known PCS consists of (i) non-financial PCS (NF-PCS) and (ii) financial PCS (F-PCS). As per the new NAS, the enlarged size of PCS seems to be on account of NF-PCS, while F-PCS size has remained the same.

For the first time value added (VA) or gross value added (GVA) in PCS is estimated using audited accounts, from the mandatory filing of company balance sheet data with the MCA. Previously, as noted earlier, corporate savings and capital formation were estimated using a RBI’s purposive sample of sample of large companies, blowing up or scaling up the sample estimates for the “universe” of companies using paid-up capital as the blowing up factor.

Correspondingly, unorganised sector’s GVA – now renamed household sector GVA – size has contracted. There is another possible reason for the shrinkage of the unorganised sector. Method of estimating GDP in non-agriculture household sector has changed. Earlier, GDP in a particular activity was a product of VA per worker and number of workers employed in a particular industry or sector. As discussed in Part I, VA/worker was estimated using large sample surveys. However, in the new series GVA is estimated using a production function, which has led to a sharp decline in VA/worker.

The principal difference, however, is with respect to private corporate sector (PCS) whose composition has undergone substantial changes and whose output is, for the first time, being estimated directly and reported as such in the new series.

2.1.4: Changes in manufacturing sector output estimation:

Manufacturing sector receives added attention as it has been at centre of attention in the debate in the new NAS. Until the recent revision, manufacturing sector consisted of two parts: organised/registered/formal sector made up of all factories

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8 For details of the debate on manufacturing sector output estimation, see Goldar (2015) and Nagaraj (2015c).
registered under the factories act, that is, factories employing 10+ workers using power, (or 20+ workers without using power) accounting for about 2/3\textsuperscript{rd} of manufacturing output employing about 20 per cent of the employment. Annual Survey of Industries (ASI) was the principal database to capture the output of registered manufacturing. Rest of the manufacturing sector – called unorganised/unregistered/informal manufacturing – was captured indirectly via period NSS sample surveys.

There were many shortcomings of the foregoing method, most important one being that there was about 2 years lag in getting ASI results, until which time Index of industrial production (IIP) was used for estimating manufacturing sector GVA. However, as IIP's quality deteriorated, quality of estimates of VA in manufacturing was getting affected adversely. Further, the estimation of unorganised sector output was widely considered unsatisfactory, as value added per worker parameter used tended to be outdated, leading to underestimation of output.

The new series has largely done away with ASI, replacing it with corporate sector data, that is MCA-21 database, accounting for nearly 2/3\textsuperscript{rd} of manufacturing value added (Table 4 (i) and (ii)) As mentioned earlier, partnership and proprietary concerns in unregistered manufacturing which follow booking (as per NSS survey data), are defined as quasi corporations, and shifted to PCS. Their growth rate is taken to be same as that of the manufacturing sector in PCS.

### Table 4 (i): Comparison of data sources used for estimating GVA in manufacturing sector

<table>
<thead>
<tr>
<th>Series</th>
<th>Year 1 (Advance &amp; Provisional)</th>
<th>Year 2 (1\textsuperscript{st} Revised Estimate)</th>
<th>Year 3 (2\textsuperscript{nd} Revised Estimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-05 series</td>
<td>IIP</td>
<td>IIP</td>
<td>ASI</td>
</tr>
<tr>
<td>2011-12 series</td>
<td>IIP + Advance filing of corporate Accounts</td>
<td>IIP + MCA 21</td>
<td>MCA 21 + Non-corporate ASI</td>
</tr>
</tbody>
</table>


### Table 4 (ii): Institutional composition of Manufacturing sector GVA

<table>
<thead>
<tr>
<th>Sectors</th>
<th>2013-14</th>
<th>2014-15</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% share</td>
<td>Growth</td>
</tr>
<tr>
<td>Public Sector including Public Sector enterprises</td>
<td>7.9</td>
<td>(NDCU=6.3, DCU=1.7)&amp;</td>
</tr>
<tr>
<td>Private corporate sector</td>
<td>65.2</td>
<td>7.9$</td>
</tr>
<tr>
<td>ASI (non-corporate) &amp; household</td>
<td>26.9</td>
<td>0.7*</td>
</tr>
</tbody>
</table>


* : Growth is derived from relevant two digit compilation categories. Hence the growth is not the same as total IIP growth.

$: derived from MCA 21 data base

@: derived from RBI-sample study and BSE data base

**: derived from past trends

&: derived from analysis of accounts of PSU’s and government budget
2.1. 5 Shrinkage of the unorganised/household sector:

As showed earlier, for 2011-12, unorganised or household sector’s size, as per cent of GDP, has got reduced in the new series to 43 per cent, from 54 per cent in the old series. There are mainly two reasons for it: one, quasi corporations are moved to PCS, and two, output per worker in many activities has contracted on account of the change in methodology. Earlier output per worker was estimated using NSS sample surveys, which was multiplied by number of workers employed in the activity to arrive at the contribution of the activity. The new NAS estimates it by applying a Cobb-Douglas production function. As argued in Part I of the paper, there is no a priori justification for using the particular production function. It would have been more justified if a more general CES production functioned is fitted.

2.1.6 Gross savings and capital formation estimates:

The new series has published gross national savings and capital formation series, in place of gross domestic savings and capital formation series, signifying an increasing role of external savings in the economy. Further, for the first time, savings are reported as a proportion of gross national disposal income (GNDI), including “valuable” (read; gold). On account of large current inward remittance (current transfers) savings as a proportion of GNDI is higher than the traditional measure of gross savings to GDP ratio. Similarly valuable are separately recorded in gross capital formation (Rajakumar, Sawant and Shetty, 2015). Previously, valuables were recorded as a separate asset class but without indicating which institutions owned it. Now the ownership has been assigned to household sector. But CSO has not made a consistent consolidated account of the national capital and finance accounts, as discussed in the previous part of the paper.

9 “2.2 At present, the estimates of value added and related macro-economic aggregates for a number of economic activities carried out in the unorganized segment of the economy are compiled using an indirect method called the Labour Input Method (LIM). In this method, first the labour input (LI) is compiled as the sum of workers, either on the principal status or on the subsidiary status (including the work on subsidiary status of principal status workers), at detailed activity level known as ‘compilation categories (CCs)’.

2.3 The compilation categories are determined by regrouping the economic activities at 3, 4 and 5 digit level described in the National Industrial Classification (NIC), which, in turn, follows the International Standards Industrial Classification (ISIC) of All Economic Activities of the United Nations. As per the recommendations of the Advisory Committee, the same compilation categories of 1999-2000 series based on NIC 1998 were used for the current series(2004-05 =100) because of marginal changes in NIC 2004.

2.4 The benchmark GVA estimates of the unorganized manufacturing and services sectors are then prepared for the compilation categories for the base year of national accounts series using the estimated labour input (LI) engaged and the value added per worker (VAPW) in the activity.

2.5 The base year estimates are projected to subsequent years…” (CSO,2015d, page 3)
2.1.7: Quasi corporations:

Quasi corporations (QCs) are defined in the SNA 2008 as “an unincorporated enterprise that has sufficient information to compile a complete set of accounts as if it were a separate corporation and whose de facto relationship to its owner is that of a corporation to its share holders” (as quoted in Subba Rao, 2015). As per CSO, quasi corporations include:

1. Unincorporated Enterprises covered in Annual Survey of Industries
2. Unincorporated enterprises of manufacturing that are not covered ASI but maintain accounts
3. Cooperatives providing non-financial services
4. Un-incorporated enterprises providing non-financial services maintain accounts
5. Unorganised financial enterprises

If the above listing is correct, then QCs include financial enterprises as well. QCs account for 8 per cent of GVA in the new series. There is no comparable estimates available for the old series, so there is little basis to make a comparison. However, its absolute size seems to be very large. Moreover, QCs are assumed to grow at the same rate as PCS, which could overestimate its size.

Subba Rao (2015) has shown that because of the changed methodology, for 2013-14, share of PCS in domestic savings has gone up from 29.3 per cent to 34.5 per cent, with a corresponding decline in household sector saving share from 67.3 per cent to 59.4 per cent.

Mere shuffling of QCs from unorganised sector to PCS, would not be an issue. But what seem to matter is the changed methodology of estimating GVA, which could have inflated QCs’ size (and hence PCS’s) growth, as the growth rate of QCs is taken to be the same as that of non-financial PCS. To quote an official report, ‘Quasi corporations: Base year estimates projected using appropriate volume indicators and inflated using price

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Two tables in CSO (2015b) provide data on institutional-cum-industrial classification of output. Table 2, page 19 gives data on “GVA for non-financial private corporate sector excluding quasi-corporate sector in 2011-12”; Annexure I on page A-1 gives data on “GVA at basic prices for the year 2011-12 by industry and institutional sector”. The difference in the estimates for PCS between the two tables is on account of quasi corporations. This is the evidence to show that in the official statistics, QCs are defined as part of non-financial PCS. But the information given in the text above shows that unorganised financial enterprises are also included in QCs. Therefore the arguments we raised in Nagaraj (2015d) and in our rejoinder to CSO (Nagaraj, 2015e) merit attention. I gratefully owe this clarification to Rymond Zhong.

This is estimated using industry by institutions GVA table in Annexure – I (page A-1) and GVA for non-financial PCS excluding QCs (Table 2, page 19 (CSO, 2015b).

The hunch is based on the following reasoning. As a large part of QCs are unregistered manufacturing which accounts for about 4-5 per cent of GDP. QCs in services are likely to have much smaller VA per worker. Further considering Subba Rao’s methodological reasoning, one inferred that QCs size is perhaps over stated in the new NAS.
Corporate growth rate in the absence of appropriate indicator.’ (CSO, 2015c; 2nd slide in the section “Household sector”)

Section 3: Methodological changes made in the new NAS and the debate surrounding them:

2.2.1: Private corporate sector:

This is the sector that has witnessed the most significant methodological changes, hence been the eye of the storm. As mentioned earlier, for the first time, output originating in PCS has sought to be directly estimated using the mandatory filing of financial returns with the Ministry of Corporate Affairs (MCA).

Historically, due poor enforcement of the law, only a small fraction of registered companies filed their audited balance sheet with the registrar of companies (Nagaraj 2015d). However, as the large companies (that is, with high paid-up capital) mostly filed their balance sheets, and that PCS was then a small part of the economy, RBI’s small sample of high paid up capital companies was deemed adequate to capture PCS’s savings and capital formation. RBI sample estimates were then “blown up” – using paid-up capital (PUC) as the parameter – get the estimates for PCS.

However, with the phenomenal growth in company registration during the last three decades (with majority of them not filing their balance sheet), the foregoing method has become unreliable, as there is no record of the universe of working companies. The National Statistical Commission report (2001) (Chairman: C Rangarajan) had clearly stated this fact, recommended conducting a census of working companies to ascertain the universe of working companies. To quote the report:

There are more than five lakh [500,000] companies registered in the ROCs but the actual number of companies, which are operating, is not known. This situation seriously affects the reliability of various estimates. An exercise conducted in March 1999 indicated that about 47 per cent of the registered companies filed their balance sheet for the year 1997-98 with the ROCs (http://mospi.nic.in/Mospi_New/upload/css_12.html).

During the last decade, GDP growth accelerated to 7-8 per cent per year mainly on account of services sector. A disaggregation of the growth found that GDP in private corporate sector was the source of rapid growth. Inquiring into possible overestimation of services output growth, Nagaraj (2009) had found a substantial rise in the share of PCS in GDP – estimates derived indirectly derived from NAS. Comparing these estimates with those obtained using CMIE’s Prowess database we had shown that there seems to be a systematic overestimation of PCS output in GDP (Figure 6). For instance, for 2005-06, share of PCS in GDP as per NAS was about 18 per cent, whereas it was just about 8 per cent based on the CMIE data. Even assuming that the latter was an underestimate on account of ignoring small private limited, the gap between the two estimates is so wide that it clearly pointed to a systematic overestimation in the NAS.

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14 See the quotation from the National Statistical Commission report below in the text.
Since 2006 or so, MCA had initiated an effort to encourage companies to file their financial returns electronically, created a web portal where companies can e-file the returns. After considerable efforts – incentives, and threats of de-registration – the e-filing of the returns peaked at over 5 lakh (500,000) companies for two years, namely 2011-12 and 2012-13 (out of over 9 lakh registered companies).

CSO’s decision to use this database to directly estimate national income aggregates for non-financial PCS for the new NAS series was widely welcomed. As per the new NAS, PCS accounted for about 33-34 per cent of GDP in 2011-12. Moreover, since a large part of manufacturing firms belong to PCS, its share in GDP increased and its growth rate over the last 3 years has been consistently high and rising – a widely debated issue.

Since the size of PCS in the new series is significantly larger than previously (indirectly) estimated, there was scepticism about the veracity of the new estimates. However, the estimates reported in the new NAS turned out to exaggerate the size and growth rate of PCS (and hence questionable), which has been at the heart of the debate between the CSO and the NAS user community.

Two methodological issues are at the heart of the debate, as revealed when questioned about the reliability of the PCS estimates (Nagaraj, 2015a). These are (i) the

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The sub-committee of the CSO which went into the issue of using the MCA database for the corporate sector estimation, it its report finalised after the last meeting, had found that the estimates for the PCS were significantly lower than what were indirectly estimated and reported in Nagaraj (2009). However, in the report of the sub-committee released in February 2015, the PCS estimates were found to be substantially higher than those reported in the earlier version of the committee report and also those reported by us.

When pointed out (Nagaraj, 2015a) CSO responded (CSO, 2015) that the enlargement of the size of PCS in the publicly available report was on account of (i) “blowing-up” of the estimates for all the active companies, and (ii) use of disaggregated cost data instead of the aggregate cost data used previously (as discussed in the main text). Both the reasons have remained contentious (Nagaraj, 2015b), and have only strengthen the suspicion of the estimates among the data user community.
blowing up factor, and (ii) inconsistency between the aggregated and the disaggregated cost data which seemed to have yielded widely differing GVA estimates. Put simply, as the number of companies for which accounts are available varies from year to year, the “blowing-up” or “scaling-up” factor corresponding changes, thus greatly affecting the final estimates. To illustrate, for the years 2011-12 and 12-13 MCA database consisted of about 5 lakh companies. Estimates based on the paid-up capital these companies were “blown-up” for about 9 lakh “active companies”. However, for the year, 2013-14, the MCA database plummeted to about 3 lakh companies. So when the estimates based on paid-up capital for 3 lakh companies are blow up to 9 lakh companies, obviously, numbers seems to have overestimated (compared to the previous year) and hence growth rates get enlarged.

Another factor that seems to affect the sample estimates (for the companies for which data are available) is that the cost data obtained from the MCA database seems incomplete and inconsistent, which seems to lead to differing estimates when disaggregated data is used compared to when the aggregated data are used. To quote CSO:

[...] the output as per database was restricted to the total revenue reported [which led to smaller estimates]. However at the time of preparing the final report, it was felt that the individual components under total revenue would reveal the real picture of the economy in a better way. Hence the restriction was removed and output as per database was estimated using the individual components under total revenue in the database (CSO, 2015d: 87).

The debate on the reliability of the PCS estimates bring the focus on lack of accurate estimate of the number of working companies, which was highlighted in the Rangarajan Commission report. In other words, we really do not know how many of the million plus companies registered with MCA actually produce goods and services reasonably regular basis. Describing the size and structure of PCS, Nagaraj (2015d) argued that a majority of the companies could be bogus, fictitious, shell, companies that exist not to produce socially useful output but to serve the interests of business to camouflage their true operations.

If the foregoing arguments and evidence have some value, then there is a serious need to re-look at the blowing-up or scaling up procedure. Further given the inconsistencies in the MCA database, there is a need for a thorough review of the database and cleaning it up before it can be put to estimate the NAS.

2.2.2: Household sector:

As mentioned earlier, until the recent revision, unorganised sector output was estimated indirectly as a product of (i) value added per worker obtained from nationwide sample surveys, and (ii) number of workers employed in each industry. There is a long held and widely accepted view that unorganised sector output is invariably under-reported, or escapes large scale official surveys considering the predominance of traditional or non-formal modes of production. National Statistical Commission (2001) (Chairman: C Rangarajan) has in fact endorsed such a view. It said:
Estimate of gross value added (GVA) per worker as per the FuS [follow-up enterprise surveys] is used for the purpose of GDP calculation. Sometimes there are perceptions from the data users that the FuS estimate of GVA per worker does not reflect the reality (see Annexe 5.17) for the estimates of GVA per worker as per the NSS 51st Round: 1994-95 and Special Enterprise Survey: 1998-99. In fact, the perception is that the same is quite often underestimated.

Reluctance on the part of the enterprises to supply correct and complete information in the surveys is one of the reasons for likely underreporting of receipts and GVA. This reluctance might be due to various reasons such as apprehension that the information supplied may be utilised for taxation purposes. (http://mospi.nic.in/Mospi_New/upload/inds_stat_5.html). (Emphasis added).

Unorganised sector, by definition, consists of innumerable small, traditional, at times irregular, labour intensive and household enterprises, often representing non-market (or pre-modern) forms of production bordering survival strategies of the disguised unemployed. Such enterprises often do not (or cannot) maintain modern double-entry book keeping procedures, or they cannot do so given the informal, irregular nature of their production and low levels of literacy of self-employed workers. Even if some enterprises manage to do so, these are not separated from their personal or family accounts. In other words, unorganised sector in India largely consists of subsistence activities, as opposed to modern or capitalist enterprises, with a clear separation of an individual and family from the legal entity of a company.

Ignoring the received views, the new NAS has assumed that the older methodology over estimated output per worker since it did not distinguish between different kinds of labour. The sub-committee that looked into the matter made the following critical comments on the older methodology. To quote the report:

The Labour Input Method, however, suffers from inherent problems. Firstly, while compiling GVAPW [gross value added per worker]..., it is assumed that there is equal contribution from all categories of workers engaged in an economic activity i.e., the contribution of an employer, a wage-employee (Regular or Casual), or a family worker, is taken to be equal. Second issue is in projecting the LI [labour input] for subsequent years ... The CAGR [compound average growth rate] concept based on past two rounds of EUS [employment unemployment surveys] being used to project the LI ends up overestimating the LI for most of the compilation categories especially in the scenario where there is a drop in the LI over the next two consecutive surveys (EUS). (CSO 2015a: 6).

To overcome the problem the new NAS estimated labour productivity of different category of workers using a nested Cobb Douglas production function, as discussed in Part I of the paper (for details see Nagaraj, 2016). This has resulted in a contraction of labour input in the unorganised sector in the new NAS compared to the old series (Figure 7).
As shown in Part I of the paper, methodology used for the estimation is arguable. There is a need to justify the specific functional form chosen to estimate the effective labour input and how its results are superior to alternative estimates.

As Nagaraj (2016) has shown, there is an inconsistency between the ELI method, which has contracted the contribution of self-employed labour, and the large size of mixed income in the factor income distribution in the unorganised sector. In other words, if the contribution of self-employed (owner-worker) workers is really a fraction of that of wage worker, how is it that their share mixed income accounts for over 70 per cent of all factor income in the unorganised sector (Figure 8)? We have reasons to suspect that the new methodology for estimating labour input has underestimated the contribution of this sector to domestic output.

**Figure 7: Comparison of LI and ELI in Unorganised manufacturing**

<table>
<thead>
<tr>
<th>Year</th>
<th>LI</th>
<th>ELI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-12 (68th Round NSS)</td>
<td>39.6</td>
<td>45.2</td>
</tr>
<tr>
<td>2010-11 (67th round NSS)</td>
<td>15.2</td>
<td>20.9</td>
</tr>
</tbody>
</table>

**Figure 8: Factor income in organised and unorganised sectors in 2011-12**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Wages</th>
<th>Gross profit/mixed income</th>
<th>Depreciation</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organised</td>
<td>45.2</td>
<td>39.6</td>
<td>15.2</td>
<td>72.4</td>
</tr>
<tr>
<td>Unorganised</td>
<td>20.9</td>
<td>6.8</td>
<td>6.8</td>
<td>100</td>
</tr>
</tbody>
</table>
Summary and Conclusions

Summary of Part I

Indian NAS estimates use a mish-mash of income, expenditure and production approaches in estimating national aggregates. From Table 6.1 of CSO (2015b) which lists the approaches used in the new series for various sectors/compilation categories there has not been much of a change in the extent of mish mash.

For the first time CSO has adopted a new ‘effective labour input’ (ELI) method for aggregating three types of labour (owner, hired, and family labor) using their relative marginal productivities in the production of gross value added as weights. The weights are obtained by estimating a nested Cobb-Douglas production function for many of 57 compilation categories considered. For some a modified ELI method is used. For the rest LI method in which the three types are equally weighted and added up. Some technical issues in defining a production function for value added which has no natural unit of measurement with an associated price per unit are not recognized. Nor is the possibility of estimating a separate production function for each of the 57 compilation categories with constant elasticity of substitution among the three types of labour of which Cobb-Douglas function is a special case is not even recognized, let alone implemented.

By definition gross value added (GVA) by an enterprise is the difference between the value of various goods and services it produces in a period and the cost of non-factor material inputs it uses in production. To deflate GVA at current prices for outputs and non-factor inputs should a single deflator for GVA at current prices or should real GVA be defined using a double deflation procedure as the difference between real output, i.e. current value of goods and services produced deflated by an output price index and real input, i.e. current value of non-factor inputs deflated by an input price index? CSO recognizes that in economic theory double deflation procedure is ideal. Yet in its practice, it mostly uses single deflation procedure with wholesale price index (which does not include services and is neither a producer nor a purchaser price index!). Moreover, for monetary policy to control inflation consumer price index (CPI) is used as a suitable indicator, in considering growth consequences of monetary policy real value added (aggregate and sectoral) is used with, say, WPI as the deflator, if the pattern of movement in two indexes are very different as has been the case in India policy dilemma can arise. Besides CSO does not provide any rationale for its choice of its single deflator of any compilation category.

There are six institutional sectors in the new series with two each being the financial and non-financial corporations in the public and private sector respectively. The other two, namely, General government and the household sector, are non-corporate, with the latter in the unorganized sector including many more than conventional households of NSS. In fact, much of the unorganized manufacturing enterprises with just its employer and one helper are in the household sector. Besides as Chapter 4 of CSO (2012) points out the receipts and expenditure sides of the Consolidated Accounts of the nation do not balance for various reasons requiring the introduction of a balancing item in each to account for the statistical errors called statistical discrepancy in each account. In our view the statistical properties of the interdependence of the statistical discrepancies have not been analysed. This lack of balance aspect with respect to investment and its finance when finance for investment (receipts side) is estimated by the flow of funds approach assumed to be more reliable.
than the (expenditure side) use of finance to purchase assets estimated by the commodity flow approach is illustrated in Part I. In particular, it points out that the ‘residual character of the household sector implies that its residually estimated capital formation in physical assets including valuables enters both its savings and capital formation sides as “Direct Savings in the form of physical assets”.

The growing excess of the estimated Private consumption expenditure in NAS as compared to that from CES of NSS is a longstanding issue and its treatment in the book edited by Deaton and Kozel (2005) and the important paper of Minhas is discussed in Part I.

Part I discusses in some detail the many issues that arise from the use of MCA-21 data base and the use of "blow-up factors" to account for companies who choose not to file their returns. Since the decision to file are not a voluntary decision which may depends on the contents of the return were one to be file, there is an inherent of selection bias in the blow-up factors whose size and bias are not known since no correction for self-selection is currently being made.

The final report of the first National Income Committee chaired by Professor P.C, Mahalanobis recognized the inherent sampling and non-sampling errors in sectoral and aggregate GVA and had provided its estimates thereof. CSO has not followed this practice. It is therefore impossible to tell whether the GVA data any less error prone in 2016 than they were in the early 1950s when the Mahalanobis committee reported.

Finally, unlike Statistical Offices of advanced counties CSO publishes most of its time series data in a cross sectional, rather than panel form. It is essential that CSO begins introducing panel features in its data collection over time.

**Summary of Part II**

The base year revision altered the size and composition of the domestic economy in the following manner. In the base year (2011-12),

1. The absolute size of domestic output is smaller by 3.4 per cent, compared to the old series.
2. Industry’s (or the secondary sector’s) share in GDP has expanded by about 5 percentage points, and the share of services or tertiary sector contracted proportionately (with agriculture/primary sector share remaining the same).
3. In terms of institutional composition, private corporate sector’s share (PCS) has expanded by about 11 percentage points, and household or unorganised sector share declined proportionately (public sector’s share remaining the same).

If the foregoing compositional changes represented mere rearrangement of economy’s sub-sectors, then there would be no issue. However, these are apparently the result of the changes made in the methodologies and databases used in preparing the new NAS. As many of the changes seem questionable, the new estimates have been widely contested.

Analytically, the new NAS conceives India except for the household sector and general government, as a corporate economy with the dominant unorganised sector sheltering most of labour force, bulk of whom is self-employed often using family labour. Previously, the economy was first divided into (I) organised and (ii) unorganised sector;
then the organised sector into public sector, and private corporate sector. The new NAS has narrowed the distinction of organised and unorganised sector; the primary distinction now maintained is in terms of corporate and non-corporate sectors, and the secondary distinction is between financial and non-financial sector within each ownership category.

The methodological changes made in the new NAS are widespread, affecting the estimates of all the sectors except (i) public sector and (ii) agriculture and allied activities. This is so because, as noted above, the institutional composition of NAS has changed significantly, together with the methods of estimation and the databases used for the purpose.

Most significant change in the new NAS – as CSO admits – is the direct estimation of the macro aggregates for the private corporate sector (PCS) using the statutory filing of financial returns by corporate firms. Previously, only savings and investment of PCS were estimated using RBI sample of large firms (with high paid-up capital), value added in PCS could only be indirectly obtained – not reported officially – as a residual in the organised sector.

PCS is now expanded to include quasi corporations (QCs) – defined in SNA 2008 as “an unincorporated enterprise that has sufficient information to compile a complete set of accounts as if it were a separate corporation and whose de facto relationship to its owner is that of a corporation to its share holders” – moving them from the unorganised sector. The expansion of the domain of PCS and the newer database has enlarged the share of PCS in GDP (with a corresponding contraction in the size of unorganised or household sector).

There could be yet another reason for the contraction of the unorganised sector, whose output estimation method has changed, reducing the output per worker pretty sharply (under the view that the older series overestimated output per worker).

As these sectoral shuffling is analytically questionable, and the new methodologies are widely debated, the new macro aggregates have become deeply contested. Further, as the revised estimates have even altered the base-year (2011-12) estimates – which never change during the life of the series, going by past practice – they have cast further doubt on the veracity of the new NAS.

Further, behaviour of prices has apparently compounded the problems for the new NAS. Because of a sudden fall in international oil prices, whole sale price index has declined turning the modest rise in nominal GDP into high growth in real terms. So, what we find, quarter after quarter, is that every new estimate brought out by CSO scrutinised for all (or any of) the foregoing problem, and are critically judged.

**Critical questions from the paper are the following:**

- What has the new GDP series really accomplished? Our view is that legacy issues remain, and a host of new problems have been added that could have rendered the new GDP estimates more unreliable.

- Is it really worthwhile pursuing the new series as is? In our view, no.

- So, what should be done? In our view:
We need a statistical audit of the new NAS—drawing upon the best expertise from everywhere.

Changes as needed and appropriate could be introduced in a phased manner in the new series, starting from the easier steps. First step is to change the base year. Next, moving from factor cost to basic prices to better reflect producer incentives. These can be done with minimum effort.

The principal problem has been the use of the MCA-21 database. In our view, since the MCA database is based on the responses of self-selected companies (not the entire population mandated to respond), and, as is well known, uncorrected self-selection can lead to biased estimates of unknown magnitude and sign, efforts must be made to address this problem.

We are all for updating the NAS to the latest global template. However, its adaptation (that is, its “detailed engineering”) for a specific country should be made suitable for the context, and its experience.
References


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Deaton, Angus and Kozel, Valerie (2005), The Great Indian Poverty Debate, New Delhi, Macmillan Publishers.


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Appendix 1

Some Technical Issues Relating to the Production Functions for Value Added

CSO (2015b paragraph 2.18) points out that “in the Labour Input Method (LI Method), as was being used in earlier series, while compiling Gross Value Added Per Worker (GVAPWI) from the Enterprise Survey, it is assumed that there is equal contribution from all categories of workers engaged in an economic activity i.e. the productivity of an employer, a casual wage worker, or a family worker is equal. The new method addresses differential labour productivity by assigning weights to the different categories of workers engaged in an economic activity based on their productivity. The weights were compiled using data on establishments covered in the NSS 67th round survey on unincorporated Enterprises (hereafter referred to as ES). A nested Cobb-Douglas Function has been used for computing the weights for different categories of workers.

In algebraic terms the production function estimated was (in natural logarithms)

\[ \log Y = \log A + \beta \log K + \alpha \log \left[ L_2 + \delta_1 L_1 + \delta_2 L_3 \right] + \gamma S + \epsilon \]  

(1)

Where

- \( Y \) is Gross Value Added (GVA),
- \( K \) is Capital Input,
- \( L_1 \) is Labour Input of Owner (in, say, person days per year)
- \( L_2 \) is Labour Input of Hired Worked (formal and informal - again L in person days per year)
- \( L_3 \) is Labour Input of helper (in person days per year)
- \( S \): A Dummy variable for Sector (Rural = 0, Urban = 1)
- \( \epsilon \): Random Error

There are many implicit assumptions in this formulation of the production function. First, since Value Added by assumption is the difference between the value of goods and services produced by an enterprise, valued at the prices they fetch in the market (the enterprise is assumed to be a price taker in the markets for all the goods and services it produces and sells) and the value of non-primary factor inputs (i.e. intermediate or material inputs it uses in production) at the prices it pays for them (again the enterprise is assumed to be a price taker in its markets for factor and non-factor inputs). Since the production function is being estimated with data over several periods, the question arises whether the GVA is being computed at current or at constant prices. Also given that GVA is difference between the value of outputs and the value of material inputs, of GVA is to be computed at constant prices should the entire difference be deflated by the single price index or whether the value of outputs should be deflated by an output price index and value of material inputs by an input price index? We will discuss the price deflation issues in Appendix 2 while assuming here that \( Y \) is real value added obtained through some deflation procedure.
Unlike a commodity or service for which there is a natural unit of measurement and an associated price per unit there is no natural unit of measurement with an associated price per unit for value added. In a classic paper, entitled “Measurement of Real Added”, Kenneth Arrow (Arrow 1974) addressed this issue in the context of an enterprise with a single output $X$ which produced with a vector $F$ of $n$ primary factors as well as a vector $M$ of $m$ material inputs with a production function

$$G(F, M) = G(F_1, F_2, F_n, M_1, M_2, M_m)$$

(1)

Arrow's analysis, which we reproduce here, proceeded under the assumptions that $G$ is homogeneous of degree (i.e. the technology of production has constant returns to scale) and is separable in primary factors and material inputs, so that it can be written as

$$G = H[J(F_1 .... F_n), N(M_1 .... M_m)]$$

(2)

Where without loss of generality $G$, $H$, and $N$ can be chosen to be homogenous of degree 1.

In (2) $J$ can be interpreted as a value added production function in primary factors and given that it is homogeneous of degree 1, its unit isoquant

$$[(F_1 ..... F_n) \geq 0 | (H(F_1 .... F_n) \equiv 1)]$$

(3)

describes the technology of production function in full.

Similarly, $N$ can be interpreted as a production function for an aggregator of intermediate inputs. Once again given that N is homogeneous of degree 1, its unit isoquant

$$[(M_1 ..... M_m) \geq 0 | (N(M_1 .... M_m) \equiv 1)]$$

(4)

describes the technology of aggregation of intermediate inputs in full.

So far we have been discussing purely technological aspects. Bringing in economics, and using output as the numeraire for measuring prices (so that its price per unit of output $P_x \equiv 1$). Let the unit primary factor prices be $P_1^F .... P_n^F$ and the unit material input prices be $P_1^M .... P_m^M$, then the cost of producing a unit of output $X$ will be

$$= \sum_{i=1}^{n} P_i^F F_i + \sum_{j=1}^{m} P_j^M M_j$$

(5)

Subject to $H[J(F_1 .... F_n), N(M_1 .... M_m)] \geq 1$ (6)

Assuming $J$ and $N$ to be quasi-concave, the first order conditions for minimization of unit cost (5) will be

$$\frac{\partial H}{\partial J} \frac{\partial J}{\partial F_i} \geq P_i^F \text{ with equality if } F_i > 0, \forall i$$

(7)

$$\frac{\partial H}{\partial N} \frac{\partial M}{\partial M_j} \geq P_j^M \text{ with equality if } M_j > 0, \forall j$$

(8)

where in the left hand side of (7) we denote the product of the partial derivative of $H$ with respect to its argument $J$ and the partial derivative of $J$ with respect to its $i^{th}$ argument $F_i$. Analogously the left hand side of (8) we denote the product of the partial derivative of $H$ with respect to its argument $N$ and the partial derivative of $N$ with respect to its $j^{th}$ argument $M_j$.
Multiplying by \( F_i \) both sides of (6) for each \( I \) and each sides of (7) by \( M_j \) for each \( j \) and noting that \( J \) and \( N \) are homogeneous of degree 1 we get

\[
J(F_1 \ldots F_n) = \sum P \frac{F_i}{\delta F_i} \delta J_i \tag{9}
\]

\[
N(M_1 \ldots M_m) = \sum P \frac{M_j}{\delta M_j} \delta N_i \tag{10}
\]

and \( \frac{dH}{dJ} J + \frac{dH}{dN} N = H(J,N) = 1 \tag{11} \)

We can interpret (9) – (11) as follows: At the unit cost minimizing levels of \( F_i^* \) and \( M_j^* \), the ‘quantity’ of real value added produced is \( J(F_1^*, \ldots, F_n^*) \) and its ‘price’ per unit is \( \delta H / \delta J \) at \( (F_1^*, \ldots, F_n^*, M_1^*, \ldots, M_m^*) \) and the quantity of aggregate intermediate inputs is \( N(M_1^*, \ldots, M_m^*) \) and its price is \( \delta H / \delta M \) at \( (F_1^*, \ldots, F_n^*, M_1^*, \ldots, M_m^*) \). Equation (11) says that just 1 unit of output and no more is being produced, that (6) is an equality, which is an implication of the efficiency of input use in production.

These results could be generalized to homothetic production functions etc. Also one could consider enterprises producing more than one output by viewing \( X \) not as a scalar measure of the physical output of a single good or service, but as a vector \((X_1, \ldots, X_q)\) of physical outputs of \( Q \) goods and services. As long as the appropriately defined production possibility set is convex, most of the above results will hold. We will not pursue this here.

Coming back to the New Series, formally the Nested Cobb Douglas Production function can be viewed as a special case of Arrow’s much more general formulation above. It starts with estimate of Value Added \( Y \) for a sector as the difference between value of output and the value of material inputs \( M \) at basic prices and expresses it as a multiplicative function of a function of primary factors of capital and three types of labour, a sectoral dummy and a random measurement error term. Thus taking anti-logs of (1) this function is

\[
AK^{\delta_2} [L_2 + \delta_1 L_1 + \delta_2 L_3)^{\alpha S^\alpha} e^e
\]

One could understand the choice of the Cobb-Douglas (CD) functional form for the production function for value added from the perspective of computational convenience – for example, that the observed share of wages in the cost of output under pure competition would equal the exponent of labour in the CD function etc. However, given CSO’s presumed access to up to date computation and software, there is no reason for the CSO not to estimate other production functions to check whether they explain the data better.

At the very least CSO could have estimated the Constant Elasticity of Substitution (CES) Production functions which in fact originated in doctoral thesis at Stanford of late B.S. Minhas of the Indian Statistical Institute and former member of the Planning Commission. CD function with its elasticity substitution equaling 1 is a special case of the CES function which allows elasticity from zero (corresponding to a fixed coefficient i.e. Leontief production function with L shaped isoquants) to infinity (perfect
substitution, with linear isoquants). Moreover, instead of linearly aggregating the three types of labour by weighting them by their marginal productivity, in estimating CES there would have been no need to aggregate at all by treating the types of labour, along with capital as producing real value added through a CES production function.

In our specification of a separable production for a single output through $H(J,N)$ each of the aggregates of value added $J$ and of material inputs $M$ could be modelled as CES aggregates, with $H$ itself being a CES function of $J$ and $M$. Generalization to several final outputs could be accomplished by viewing the enterprise’s technology as one that enables it to produce a CES index of several final outputs from primary factors and material inputs.
Appendix 2

Price Deflators

In NAS the evaluation of aggregates such as Gross Value Added (GVA), Domestic Product (GDP), Gross Capital Formation (GCF), Private and Government Final Consumption Expenditure (respectively PFCE and GFCE) and Gross National Income (GNI) at current and constant prices and their components and off-shoots is an important task. Since by definition the constant price or ‘real’ version of any aggregate is its version at current prices deflated by some price deflator or price index, it is important to assess how the price indexes available are put together, their strengths and weaknesses and ongoing reforms. Moreover, the phenomenon of inflation and formulation policies to contain it from becoming sustained and excessive requires an appropriate price index for measuring inflation. One of us Srinivasan (2008a, b) discussed many aspects of available price indices as of 2008. Kumar and Boopathy (2014) of CSO update the factual details in the paper of Srinivasan Without rehashing these papers we would like to emphasize a few issues here.

First, gross value added (GVA) at current basic prices is the difference between the value of aggregate gross output of goods and services and the value of intermediate or material inputs used in production. Since in general there is no physical unit and its price for value added how does one deflate the GVA at current prices? Do we deflate with a single deflator for the GVA as a whole or use double deflators by deflating the value of gross output by an output price deflator and the value of material inputs by an input price deflator and viewing the difference between the two deflated values as Real GVA? Christopher Sims (1969) has provided a theoretical justification for Double Deflation. However, in practice CSO uses single deflation mostly except for few sectors. The latest manual published in 2012) on Sources and Methods of NAS, applies to the old series NAS with base 2004-05. In its Chapter 3 on Net Factor Income from the rest of the world, it says “estimates at constant (2004-05) prices have been prepared using single deflation method by adopting(sic) [applying] implicit price deflators of service sector on the current price estimate of net factor income from abroad” (CS) (2012), para 3.5). However, for the agricultural sector Chapter 9, para 9.68 says “For estimation of value added at constant prices, the double deflation method is used...”.

A single deflator for value added has to balance its role as a deflator for the current price value of gross output and its role as a deflator for the current price value of material/intermediate inputs, CSO (2015b) unfortunately does not even attempt to explain its particular choice of single deflators in the New Series.

Turning to the price indices since Srinivasan’s two papers in 2008 many improvements in the compilation and dissemination of price indices. The number of villages and towns from which price quotes are collect have increased substantially. Commodity coverage has increased as well. However, two important issues relating to the Wholesale Price Index (WPI) have not been addressed yet: to introduce services into the index and to convert WPI which is neither a producer price index (PPI), nor a CPI, into a proper PPI. Both these issues were on the terms of reference of the Abhijit Sen Committee that prepared the shift of base year of WPI from 19993-94 to 2004-05. The committee submitted its report in 2008 and the base year change was implemented from April 2010. But the committee left the two issues to be addressed for the next
committee when the base year is to be changed from 2004-05 (http://eaindustry.nic.in/WPI_manual.pdf).

With respect to CPI the news is better. The base of the National Rural, Urban and Combined CPI introduced in 2010 is being changed to 2011-12 and along with the base change many improvements are being introduced (http://mospi.nic.in/Mospi_New/upload/cpi_pr_12may16th.pdf). However, Srinivasan papers had argued, taking its cue from the report of the Boskin Commission in the US that not incorporating the availability of new goods and improvements in the quality of existing goods in a systematic and analytically appropriate way could overstate estimated inflation rates. In India while new goods and new versions of existing goods do enter the price indices during base year change there is systematic procedure for the introduction of new goods and new version of existing goods as they become available.

For the sake of brevity the approach of Divisia in putting together continuous time differentiable price and quantity indices, and their use in the measurement of value added and total factor productivity and its growth is not presented. Diewert and Nakamura (2003, 2013) discuss it.

**Divisia Index approach to GVA.**

Denote GVA at current prices at t as $Y(t)$. By definition,

$$Y(t) = \sum_{i=1}^{N} (P(i, t)Y(i, t)) - \sum_{j=1}^{M} (M(j, t)Q(j, t))$$

Where: $P(i, t) =$ price per unit of product or service at instant t and $Y(i, t)$ its output at t

$M(j, t) =$ price per unit of non-factor input j at instant t and $Q(j, t)$ the quantity of its input at t

Denote by $y(t), p(i, t), y(i, t), m(j, t)$ and $q(j, t)$ the growth rate at instant t of $Y(t) ... ... ... Q(j, t)$ and by $s(i, t)$ the share of the value of output of i at t in $Y(t)$ and by $r(j, t)$ the share of the cost of input j at t in $Y(t)$. It can be easily shown that:

$$y(t) = \sum_{i=1}^{N} s(i, t)[p(i, t) + y(i, t)] - \sum_{j=1}^{M} r(j, t)[(m(j, t) + q(j, t)]$$

Rearranging the terms

$$y(t) = \left[\sum_{i=1}^{N}[s(i, t)y(i, t)] - \sum_{j=1}^{M}[r(j, t)q(j, t)]\right] +$$

$$\left[\sum_{i=1}^{N}[s(i, t)p(i, t)] - \sum_{j=1}^{M}[r(j, t)m(j, t)]\right]$$

Sum (1)

Sum (2)

Sum (1) can be called the instantaneous rate of growth $v(t)$ of the QUANTITY INDEX $V(t)$ of Value Added and Sum (2) can be called the instantaneous rate of growth $p(t)$ of the price index $P(t)$ of value added so that the instantaneous growth rate $y(t)$ of value
added is the sum of the instantaneous growth rates $v(t)$ of its Quantity index and $p(t)$ of its Price Index. Although formally it might seem that by integrating the exponential of $v(t)$ between two discrete time periods one can obtain the change in value added between the two, it is not quite that simple because the actual quantum of change depends on the actual time path of $v(t)$ among the infinitely many possible ones.