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Manufacturing Slowdown in India: New Evidence from a Double Deflation Approach

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Abstract:

We measure real value added in the Indian manufacturing sector for the period 2011-12 to 2015-16 using the double deflation approach. In contrast to the single deflation approach followed by the Central Statistics Office, our approach mitigates terms of trade bias by removing the unwanted effect of changes in relative prices of material inputs to outputs on real value added, by deflating material inputs and outputs by their respective price indexes. We find that the official figures understate manufacturing real value added during the period 2011-12 to 2013-14, and overstate it thereafter, as well as miss an apparent manufacturing contraction that occurred in 2014-15. Our results are corroborated by the movement of high frequency indicators that are correlated with manufacturing activity. Further, the official figures overstate gross value added at the overall economy level over the entire period, as well as overstate its growth rate.

1. Introduction

Nominal value added is the difference between the value of an industry's output and the cost of raw materials or intermediate inputs. Real value added is obtained by deflating nominal value added by suitably chosen price indexes. A proper estimate of real value added is necessary for various reasons such as maintaining the national income accounting identities in real as well as nominal terms thereby ensuring the equality of GDP when measured by value added, income and expenditure approaches (Sato 1976), and performing productivity analyses of an industry by separating out the contribution of primary inputs from economies of scale and technical change, among others (Cassing 1996).

The two basic approaches to deflating nominal value added are the single deflation approach and the double deflation approach. The single deflation approach deflates nominal value added by an output price index, while the double deflation approach deflates outputs and material inputs separately, by their respective price indexes. The Central Statistics Office (CSO) uses the single deflation approach to measure manufacturing real valued added in India (CSO 2015). However, for the sake of consistency between GDP figures from the value added and expenditure approaches, the United Nations System of National Accounts (SNA) recommends the use of the double deflation approach to create a Laspeyres type index of manufacturing real value added (UN 2008). Implementing the latter in the Indian context is complicated by the absence of an official intermediate inputs price index.

Laspeyres type double deflation indexes of real value added mitigate the unwanted effects of changes in relative prices of material inputs to outputs (terms of trade) on real value added, by deflating material inputs and outputs by their respective price indexes (Hansen 1974). These effects are unwanted since they would otherwise get conflated with the effects of changes in physical inputs and outputs, thereby polluting the measurement of physical productivity of primary inputs, one of the main aims of correct measurement of real value added (Sato 1976). The extent of terms of trade bias in a single deflation real value added measure is therefore an important empirical issue, which we investigate in this paper.

Double deflation has been attempted in India, especially for the manufacturing sector (Balakrishnan and Pushpangadan 1994, Rajakumar and Shetty 2015, Dholakia 2015). In this paper, we deviate from the earlier empirical literature in the Indian context by using more recent time periods and introducing some methodological variation. Moreover, we compare single deflation and double deflation real value added for the entire economy which has not been attempted before.

2. Double deflation attempts in India: Review of Literature

Balakrishnan and Pushpangadan[i] (1994) were the first to measure manufacturing value added in India using the double deflation approach, as a prelude to measuring total factor productivity growth in manufacturing during the decades of the 70s and 80s. The input price deflator used by them was a weighted index of wholesale prices of major input groups, with weights calculated from the 1973-74 input-output transactions table of the CSO. Inputs were grouped into 19 groups according to the availability of wholesale prices that most closely represented them.

BP1994 found that the relative prices of inputs rose during the 70s, and then declined during the 80s, while value added under double deflation was higher than that under single deflation for most of the 70s and 80s, with the gap between the two reaching 52.6% by the end of the period. Their results do not vary much when they use weights from the 1983-84 input-output transactions table as a robustness check. Since the work of BP1994, other attempts have been made at generating double deflation value added figures for manufacturing, briefly reviewed in Balakrishnan and Pushpangadan (2002).

In more recent work, Rajakumar and Shetty[ii](2015) generate a manufacturing real value added series for India for 2011-12 to 2013-14 using the double deflation approach. They construct an intermediate input price index using input-output tables for 2007-08 as well as data from the 2004-05 series of the Wholesale Price Index (WPI). The shares of various commodity groups in manufacturing sector's consumption of intermediate inputs from the input flow (absorption) matrix were used as weights for the corresponding commodity groups in the WPI to generate an intermediate input price index as a weighted average of WPI of the corresponding commodity groups. WPI of individual commodity groups in the 2004-05 series were indexed to 2011-12 using the splicing method. The output price index used was the implicit deflator from the 2011-12 series of manufacturing GVA. RS found that the size as well as growth rate of manufacturing real added under double deflation is lower in 2012-13 and 2013-14 than that reported by the CSO (which follows the single deflation method).

Their findings were criticized by Dholakia (2015) on the grounds that the intermediate input price index constructed by RS did not take into account the price of construction and services inputs into the manufacturing sector, although the two accounted for 15.4% and 17.5% of total inputs respectively. To the extent that construction and services input prices move differently from those of commodity inputs, the intermediate input price index of RS will be biased. Using the GDP deflator for construction and services (ratio of value added at current and constant prices) as a proxy for their price levels, Dholakia finds that construction and services inflation rates were higher than that of commodity inputs. This implies a negative bias in the intermediate input price index of RS.

A negative bias in the intermediate input price index caused by faster growth in the prices of the omitted inputs i.e. construction and services will translate into a negative bias in the double deflation value added. When taking construction and services inputs into account and deflating them by their associated GDP deflators, Dholakia (2015)therefore finds that manufacturing double deflation value added is greater than that of RS in levels as well as growth rates.

We extend the work of Dholakia (2015) in three ways. First, we make use of more recent data to generate a longer manufacturing real value added series, spanning 2011-12 to 2015-16. Second, we use the newly created producer price index (PPI) to deflate services inputs into the manufacturing sector, rather than the services GDP deflator. Third, we generate double deflation value added figures for the entire economy in addition to the manufacturing sector.

3. Data and Methodology

We create and compare four indexes of real value added for India: (1) manufacturing single deflation (MVASD), (2) manufacturing double deflation (MVADD), (3) overall economy single deflation (GVASD), and (4) overall economy double deflation (GVADD). The formulas for single and double deflation measures for manufacturing as well as the overall economy are displayed in Equations (1a) and (1b),

$$\frac{SL_t}{100} = \frac{\frac{P_tQ_t - W_tX_t}{\frac{P_tQ_t}{P_0Q_t}}}{P_0Q_0 - W_0X_0}$$

(1a)

$$\frac{DL_t}{100} = \frac{P_0Q_t - W_0X_t}{P_0Q_0 - W_0X_0}$$

(1b)

where SL refers to a single deflation measure of real value added index, DL refers to a double deflation measure of real value added index, t refers to the current period, 0 refers to the base period (2011-12 for all indexes), P is a vector of gross output prices, Q is a vector of gross output levels, W is a vector of intermediate input prices, and X is a vector of intermediate input levels. A real value added index for period t is the ratio of real value added at period t to period 0. $P_tQ_t$is therefore gross output at current prices, P_0Q_t is gross output at constant prices, W_tX_t is intermediate inputs at current prices, and W_0X_t is intermediate inputs at constant prices.

Data on P_tQ_t, P_0Q_t, W_tX_t, and $W_0X_t$for the manufacturing sector as well as the overall economy is available for the period 2011-12 to 2015-16 from National Accounts Statistics 2018 statement 1.5 (NAS 2018). Note that SL is constructed from this data, following the single deflation approach i.e. deflating nominal value added by a Paasche index of gross output prices. The Paasche output price index is the implicit output deflator from NAS 2018 i.e. the ratio of nominal value of output to real value of output$\frac{P_tQ_t}{P_0Q_t}$. Since SL is constructed using the single deflation approach, it suffers from terms of trade bias since it does not take into account intermediate input prices.

DL is a double deflation real value added index of Laspeyres type. Note that DL will equal SL if the output and intermediate input price indexes coincide exactly. Measuring the terms of trade bias, defined as the difference between DL and SL, is one of the objectives of this exercise. NAS 2018 does not provide a separate implicit deflator for intermediate inputs since it adopts the single deflation approach to measuring manufacturing real value added (we therefore cannot use W_0X_t from NAS 2018 since it is equal to $W_tX_t/\frac{P_tQ_t}{P_0Q_t}$). We must therefore compute a Paasche price index for intermediate inputs $\frac{W_tX_t}{W_0X_t}$, and use it to deflate the nominal value of intermediate inputs W_tX_t to recover the real value of intermediate inputs W_0X_t, which can then be used to compute DL. It can be shown that when$\frac{W_tX_t}{W_0X_t} > \frac{P_tQ_t}{P_0Q_t}$, we have $DL_t > SL_t$ and vice versa.

The India KLEMS database provides nominal and real values of the three major intermediate input categories i.e. Energy, Materials, and Services used in the manufacturing sector as well as overall economy for the period 2011-12 to 2015-16, with base year 2011-12. The basic source of data for intermediate input use in manufacturing as well as the overall economy is the input flow (absorption) matrix for the years 2007-08 and 2013-14, with suitable interpolation to ensure consistency of the intermediate input time series in current prices with the official National Accounts (NAS). Let $W_t^E X_t^E$,$W_t^M X_t^M$, and $W_t^S X_t^S$be the nominal values of energy, materials and services inputs into the manufacturing sector at time t. Let $W_0^E X_t^E$,$W_0^M X_t^M$, and $W_0^S X_t^S$ be the corresponding real values at time t. Then, the Paasche intermediate input price index for the manufacturing sector is displayed in Equation (2).

$$\frac{W_tX_t}{W_0X_t} = \frac{W_t^E X_t^E + W_t^M X_t^M + W_t^S X_t^S}{W_0^E X_t^E + W_0^M X_t^M + W_0^S X_t^S} \tag{2}$$

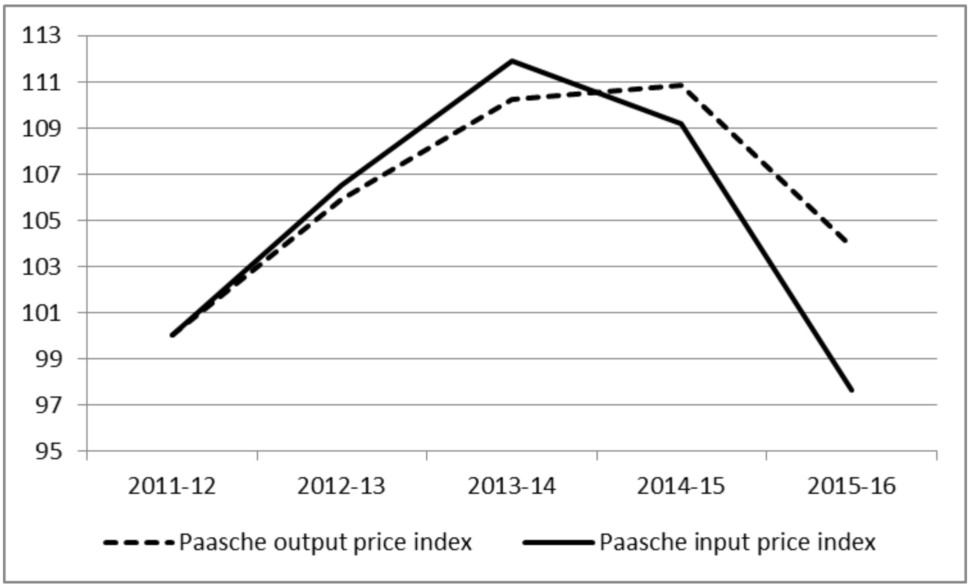
Note that both construction and services are included in intermediate inputs in the India KLEMS database, thus addressing the criticism of Dholakia (2015). While commodity inputs at current prices are deflated using the appropriate WPI, services inputs at current prices in the India KLEMS database are deflated using the implicit services GDP deflator from National Accounts Statistics, which is the same treatment of services as in Dholakia (2015). However, this is not consistent with a double deflation approach, since the same deflator is being used to deflate services outputs at current prices. The input Producer Price Index (PPI) can be used as an alternative to the services implicit GDP deflator to deflate services inputs at current prices. The input PPI measures the prices of goods and services as they enter the production process i.e. purchaser's prices, and are suitable for use as deflators in National Accounts (GOI 2017).

For the services sector, the input PPI is constructed on the basis of price data from the CPI as well as the Business Service Price Index (BSPI) put out by the Office of the Economic Adviser in the Department for Promotion of Industry and Internal Trade, Government of India. Weights for the input PPI are based on the input structure reflected in the Use Table 2011-12. Choice of CPI price data to generate input PPI is justified by common point of purchase and sale of services, as well as a competitive environment ensuring that rates of change of producer and consumer prices remain close to each other (GOI 2017). As opposed to this, the implied GDP deflator for services (ratio of nominal to real value added of services) is derived using a combination of WPI (despite the fact that it does not cover services), CPI, and quantum indexes to deflate nominal value added to recover real value added. We deflate $W_t^S X_t^S$ by the services input PPI to get an alternate measure of $W_0^S X_t^S$ used in the manufacturing sector. A similar procedure is followed at the economy wide level.

4. Results and Discussion

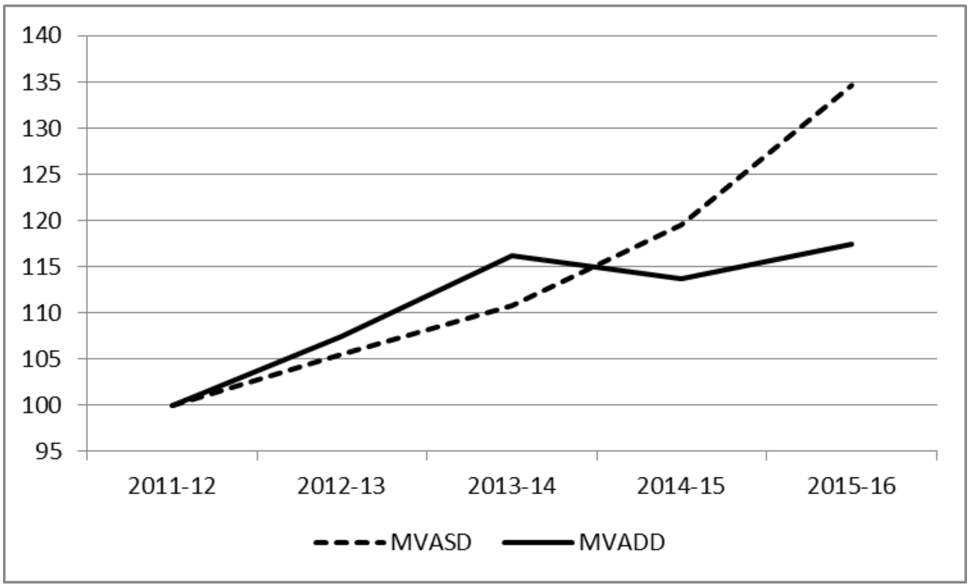
We first examine the result for the manufacturing sector, and then the overall economy. The Paasche output and input price indexes for manufacturing are displayed in Figure 1. Clearly, they do not move together, with the input price index exceeding the output price index till 2013-14, and falling below the output price index from 2014-15. We would therefore expect that MVADD (i.e. DL) would exceed MVASD (i.e. SL) till 2013-14 (indicating a negative terms of trade bias in MVASD) and thereafter fall below MVASD from 2014-15 (indicating a positive terms of trade bias in MVASD). This is exactly what we observe in Figure 2.MVASD thus understates the extent of real value addition in the first half of the period, and subsequently overstates it. The terms of trade bias, defined as the percentage difference between MVASD and MVADD is displayed in Figure 3. This bias is quite large, reaching a maximum of 14.64% in 2015-16.

Figure 1: Paasche output and intermediate input price indexes



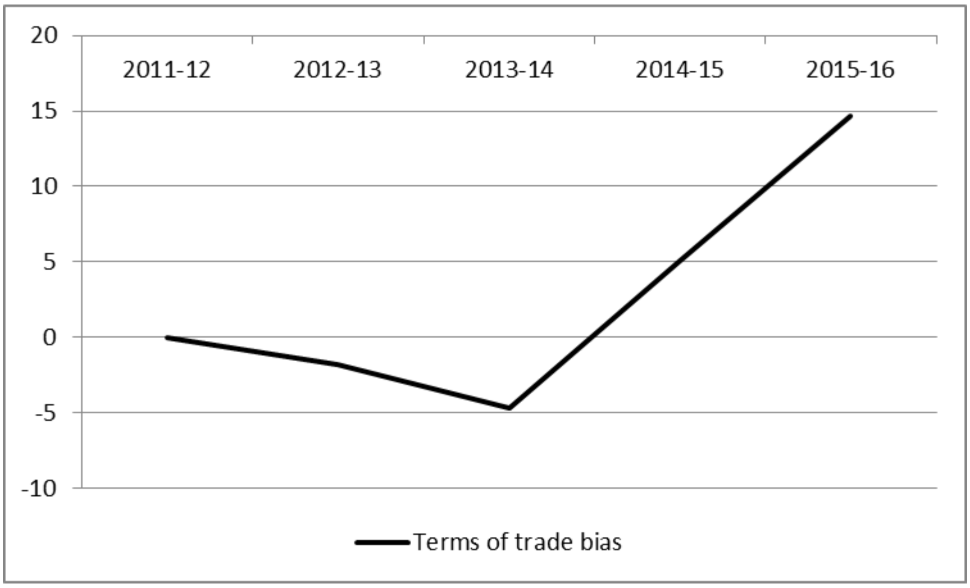
Note:-The diagram is based on authors' calculation

Figure 2: MVASD and MVADD



Note:-The diagram is based on authors' calculation

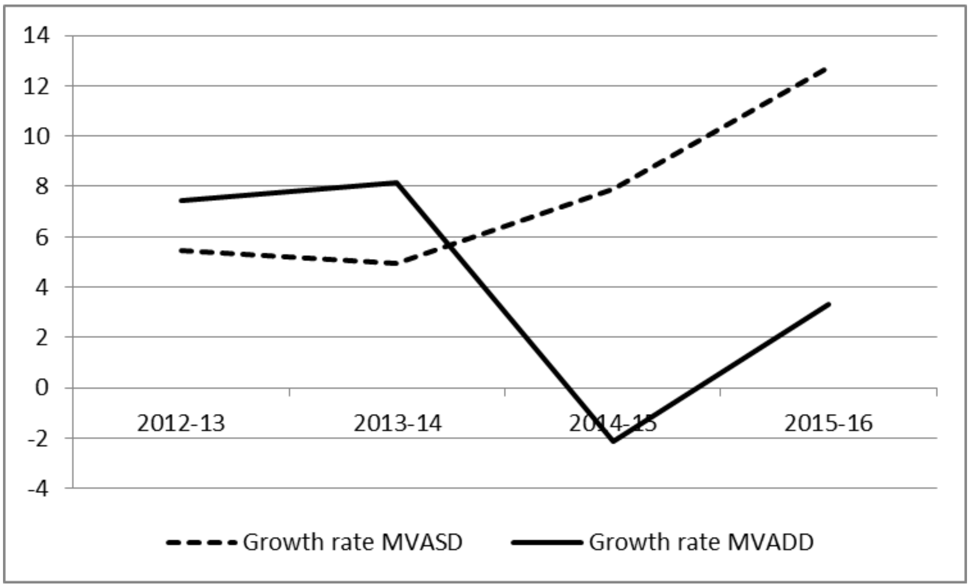
Figure 3: Terms of trade bias in manufacturing



Note:-The diagram is based on authors' calculation

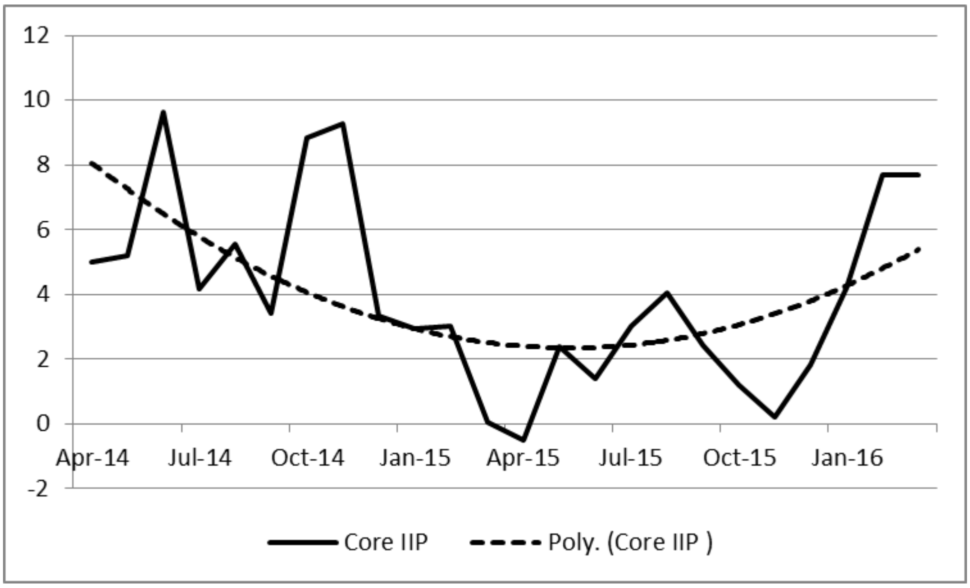
The MVADD figures show a pronounced contraction in manufacturing value added in 2014-15. This contraction is not captured by the MVASD data, which instead shows an expansion. However, all four high frequency (monthly) indicators in the Mint Macro Tracker that are correlated with industrial sector performance show signs of a contraction in 2014-15, as reflected by the second order polynomial fitted to the data (see Figures 5 through 8). These indicators are core sector IIP, bank's non-food credit, rail freight traffic, and manufacturing Purchasing Manager's Index (PMI). Data for these indicators were extracted from Kwatra and Bhattacharya (2019). The high frequency indicators support the idea of a manufacturing contraction in 2014-15, as reflected in the MVADD figures. Growth rates of MVASD and MVADD are displayed in Figure 4, showing faster growth of MVADD than MVASD till 2014-15, followed by slower growth thereafter.

Figure 4: Growth rate of MVASD and MVADD



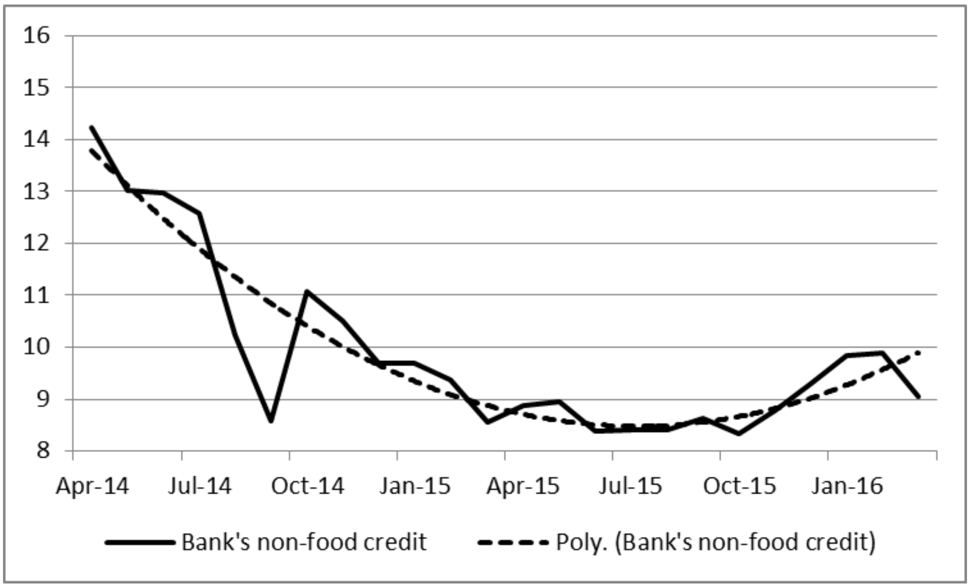
Note:-The diagram is based on authors' calculation

Figure 5: Core sector IIP year on year growth rate



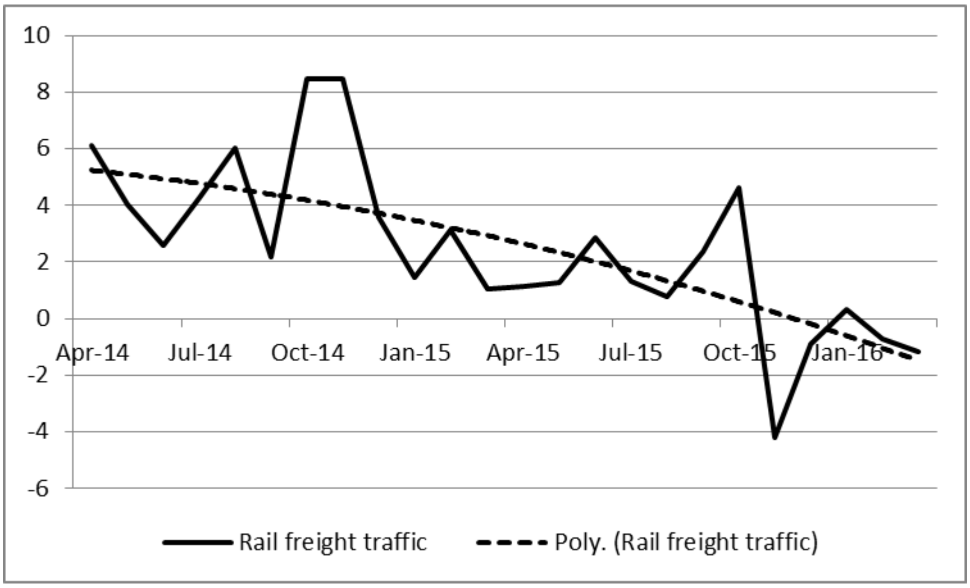
Source:- Kwatra and Bhattacharya (2019)

Figure 6: Bank's non-food credit year on year growth rate



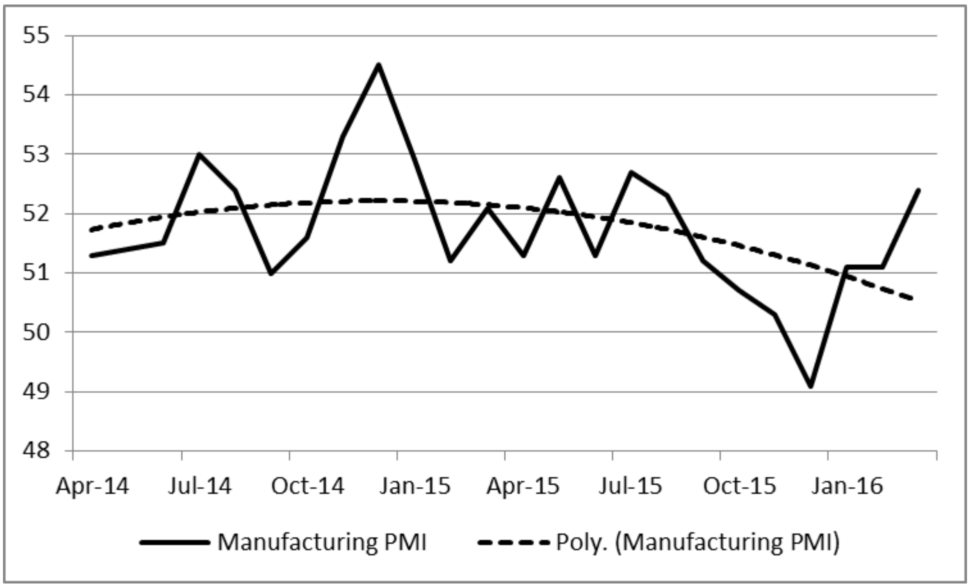
Source:- Kwatra and Bhattacharya (2019)

Figure 7: Rail freight traffic year on year growth rate



Source:- Kwatra and Bhattacharya (2019)

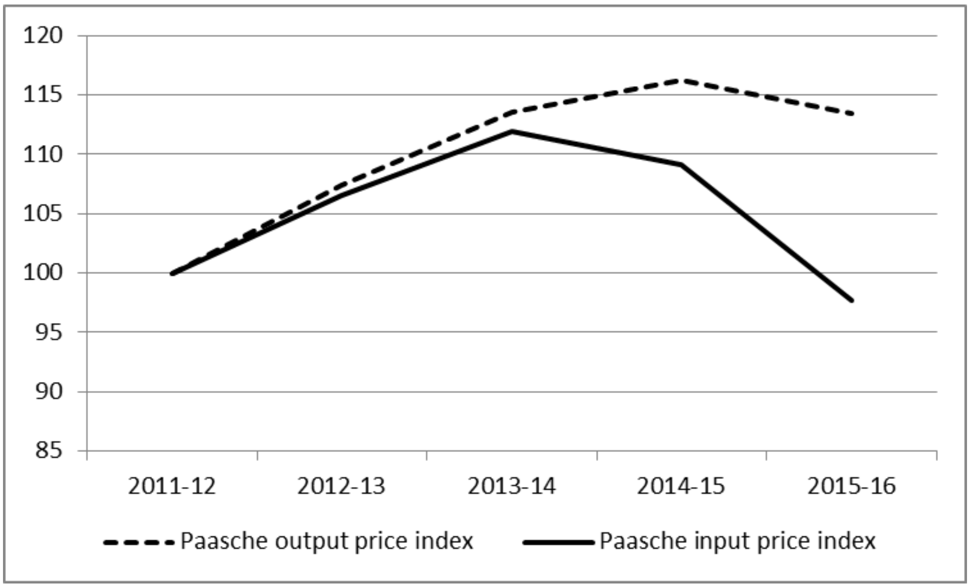
Figure 8: Manufacturing PMI year on year growth rate



Source:-Kwatra and Bhattacharya (2019)

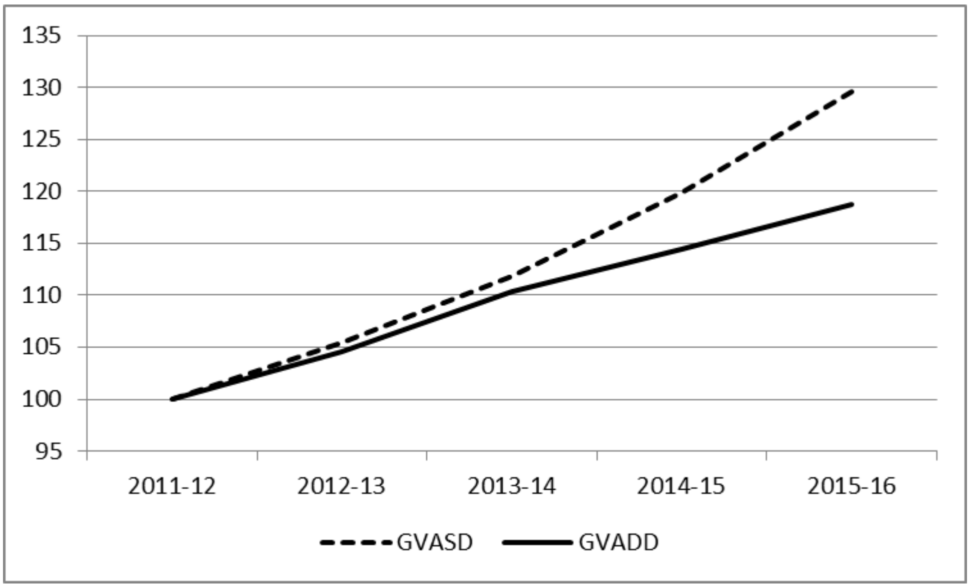
We now turn our attention to the overall economy. The Paasche output and input price indexes for overall economy are displayed in Figure 9. The input price index is lower than the output price index over the entire period. We would therefore expect that GVADD (i.e. DL) would lie below GVASD (i.e. SL) for the entire period, indicating a positive terms of trade bias in GVASD i.e. that GVASD overstates the extent of real value addition over the entire period. This is exactly what we observe in Figure 10. The terms of trade bias, defined as the percentage difference between GVASD and GVADD is displayed in Figure 11. This bias is quite large, reaching a maximum of 9.06% in 2015-16. Figure 12 displays the growth rates of GVASD and GVADD, with the latter showing slower growth over the entire period.

Figure 9: Paasche output and intermediate input price indexes



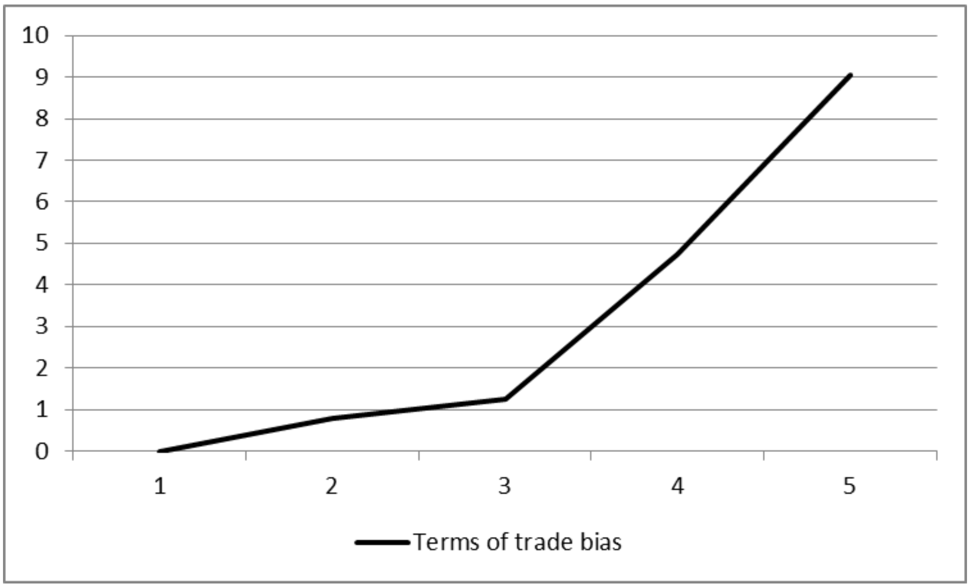
Note:-The diagram is based on authors' calculation

Figure 10: GVASD and GVADD



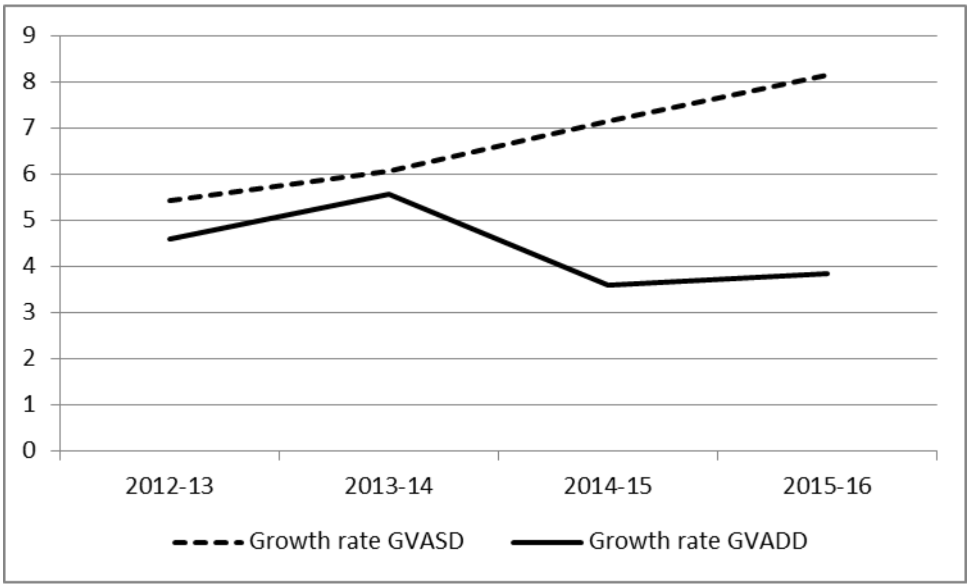
Note:-The diagram is based on authors' calculation

Figure 11: Terms of trade bias in the overall economy



Note:-The diagram is based on authors' calculation

Figure 12: Growth rate of GVASD and GVADD



Note:-The diagram is based on authors' calculation

In conclusion, we find that the double deflation approach to measuring real value added provides significantly different conclusions about the performance of the manufacturing sector and the overall economy, both in terms of levels as well as growth. These differences are driven by differences in the movement of the corresponding output price indexes and the intermediate input price indexes. The manufacturing contraction and the slowdown in the overall economy in 2014-15 are visible only in the double deflation value added figures. In the case of manufacturing, the contraction is corroborated by the movement of high frequency indicators that are correlated with manufacturing sector performance.

References

Balakrishnan, P.&Pushpangadan, K (1994): "Total Factor-Productivity Growth in Manufacturing Industry: A Fresh Look,"*Economic &Political Weekly*, 29(31),2028-2035.

Balakrishnan, P.&Pushpangadan, K (2002): "TFPG in Manufacturing: The 80s Revisited,"*Economic & Political Weekly*, 37(4),323-325.

Cassing, S (1996):"Correctly Measuring Real Value Added."*Review of Income and Wealth*, 42(2), 195-206.

CSO (2015):"Changes in Methodology and Data Sources in the New Series of National Accounts: Base Year 2011-12," Central Statistics Office. New Delhi: Government of India.

Dholakia, R (2015):"Double Deflation Method andGrowth of Manufacturing: A Comment."*Economic & Political Weekly*, 50(41), 88-90

GOI (2017):"Report of the Working Group: Producer Price Index," Office of the Economic Adviser, Department of Industrial Policy and Promotion, Government of India.

Hansen, B (1974): "A Proposed Real Net Output Index: A Comment,"*The Review of Economics and Statistics*, 56(3), 415-416.

Kwatra, N. & Bhattacharya,P (2019):"Economy is Slowing: Mint's Macro Tracker Shows,"*Livemint*, 30 Jan,2019, available at https://www.livemint.com/politics/policy/economy-is-slowing-mint-s-macro-tracker-shows-1548781168732.html

Rajakumar, J.D. & Shetty, S.L (2015): "Gross Value Added: Why not the Double Deflation Method for Estimation?"*Economic and Political Weekly*, 50(33), 78-81.

Sato, K (1976): "The Meaning and Measurement of the Real Value Added Index,"*The Review of economics and Statistics*, 58(4), 434-442.

UN (2008):*System of National Accounts 2008*.NewYork: United Nations.

[i] BP1994 hereafter

[ii]RS hereafter.