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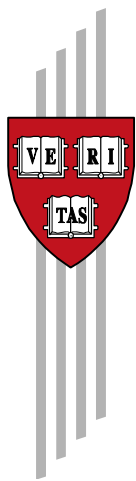
# Validating India's GDP Growth Estimates

Arvind Subramanian

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## Working Papers

Center for International Development  
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# **Validating India's GDP Growth Estimates**

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*July 2019*

This paper was presented at the India Policy Forum (IPF) organized by the National Council of Applied Economic Research (NCAER) in New Delhi on July 10, 2019. I am deeply grateful to all those who have commented on my recent paper on GDP growth estimates and to participants at the IPF. My special thanks to a number of colleagues and friends for helping me compile this follow-up paper. Errors remain mine alone.

## I. Introduction

My recent research paper [“India's GDP Mis-estimation: Likelihood, Magnitudes, Mechanisms, and Implications,”](#) (hereafter “GDP paper”) and the associated [op-ed](#) in the Indian Express on June 11, 2019 have generated considerable debate. This is encouraging because serious argument and counter-argument are the basis for good policy-making. Since the issue itself is of great importance, the counter-arguments to my analysis warrant a considered response. That is the aim of this note, which is a complement to the original paper, addressing both the larger issues and some of the specific points that have been raised.

The note is structured as follows. Section II describes my engagement with India’s GDP estimation when I was Chief Economic Adviser. Section III elaborates on the framework/approach underlying the GDP paper. Section IV makes explicit the key puzzle surrounding India’s growth estimates, and addresses the possible explanations for it. Section V explores the puzzle in greater detail. Section VI provides additional cross-country evidence on growth and price deflators, which support the findings of the original paper, namely that growth during 2011-16 was likely overestimated by a significant margin. Section VII addresses two broad objections to the main findings. Section VIII discusses some of the methodological critiques of the paper. Section IX offers some thoughts on the way forward.

## II. Background

In January 2015, the CSO released new estimates using a new base year (2011-12 versus 2004-05), new data and new methodology.<sup>1</sup> My team and I reviewed these estimates carefully—and immediately had questions about the new numbers. We consequently investigated the matter, but still could not find convincing answers, so we began to express our doubts internally and then externally.

In the prominent opening chapter of the annual *Economic Survey* written in February 2015, we said specifically that “the growth estimate for 2013-14 is puzzling” (Appendix 1). The puzzle was that the new estimate had revised that year’s growth figure up by 1½ percentage points, showing that growth was high and rising at a time when India was undergoing a “mini crisis”, as evident in all the other indicators. The Box noted especially the contrast between the weak index of industrial production (IIP) and the strong estimates of formal manufacturing from the national income accounts. The Box concluded as follows:

“Until a longer data series is available for analysis and comparisons, and until the changes can be plausibly ascribed to the respective roles of the new base, new data, and improved methodology, the growth narrative of the last few years may elude a fuller understanding.”<sup>2</sup> Regardless, the latest numbers will have to be the prism for viewing the Indian economy going forward because they will be the only ones on offer. But, the balance of evidence and caution counsel in favour of an interpretation of a recovering rather than surging Indian economy.”

Thus, all the issues that I raised in my recent paper—the inconsistency between GDP growth and other macro-indicators, the puzzling divergence in manufacturing estimates, the need for caution in

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<sup>1</sup> Throughout this paper, any mention of a year, say 2002, will refer to the fiscal year, 2002-03.

<sup>2</sup> Underlining added here.

using the GDP estimates—were flagged by my team and I almost immediately after the new estimates were released.

As we continued to investigate the matter, the puzzle only deepened. In 2015-16 and 2016-17, India recorded an exceptionally high GDP growth of 7.5 percent together with weak growth in key indicators, such as credit, exports, and investment. Accordingly, in July 2017, Volume 2 of the *Economic Survey* devoted a section (Appendix 2) that asked whether any other countries had achieved such high growth with such weak indicators in the post-1991 period. It found that no other countries had done so.

The Mid-Year Economic Analysis of 2015 focused on the deflator problem, including a Box with a detailed discussion of the deflators used for deriving real estimates from nominal estimates, especially in the services sector (<https://dea.gov.in/sites/default/files/MYR201516English.pdf>, pp. 6-9).

Thus, starting early on and throughout my tenure as CEA, my team and I continually grappled with the issue of GDP measurement and the possible problems with it, expressing our concerns in the relevant documents. The new GDP paper is consequently just another step in attempting to resolve the original puzzle, building on the previous analysis. It is also not the final word on this issue, and aims to stimulate further research on the subject.

### **III. Framework**

The GDP paper, like the previous work, focused squarely on the technical changes to GDP estimation as part of shift in the base from 2004-05 to 2011-12. Consequently, it excluded from the analysis more recent changes, including the back-casting exercise and the upward revisions to the latest GDP growth estimates. The period covered by the paper's analysis were the growth rates for the initial five years of the new estimates, 2012-13 to 2016-17, which included the last two years of the UPA-2 government and the first three years of the NDA-2 government.

Estimating GDP is necessarily a detailed exercise relying on vast amounts of data and applying carefully devised estimation procedures, varying across sectors. Since the underlying data are not available publicly, nobody outside the CSO can “estimate GDP”. Outsiders can only check to see whether the GDP estimates are plausible, broadly satisfying some macro-consistency checks.

That is what my GDP paper attempted to do: not to estimate but to cross-check and validate the CSO figures. Other attempts at validation have done so by comparing GDP figures to various production indicators.<sup>3</sup> But this methodology suffers from a serious shortcoming. The Indian economy is exceptionally diverse, both in the wide range of activities and the variety of their growth rates. As a result, it is impossible to select a parsimonious list of representative sectors, as any list will raise questions of exclusion and inclusion.

Accordingly, the GDP paper attempted something different: a macro-validation exercise from the demand side. The paper did this by exploiting some fundamental macroeconomic principles. We know that the CSO numbers are compiled from the production side. And we know from the basic macro (supply equals demand) identity that:

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<sup>3</sup> Such attempts at constructing alternative indicators to track GDP have gained prominence since Chinese Premier Li Keqiang identified a set of key ones for China.

$$Y = C + I + X - M \tag{1}$$

Where Y stands for GDP, C for consumption (private and government), I for investment (private and government), X for exports, and M for imports.

Accordingly, we can check whether the CSO production-side estimates are consistent—or move consistently—with independently-produced indicators of C, I, X, and M. If the two move plausibly together we consider that the official figures have been validated. If not, we conclude there is a puzzle.

This is simply textbook economics. But we have a problem in operationalizing the framework, since we need to find independent, reliable proxies for the macro-indicators. Balance of payments figures for exports are obviously a good proxy for national income account estimates of the same. Meanwhile, investment is typically financed by credit and is also associated with imports of capital goods.<sup>4</sup> But consumption is difficult to proxy: even the CSO, with all its data, finds consumption difficult to measure.

Fortunately, theory and empirics can come to our rescue. Theory suggests that consumption is actually an endogenous variable, driven by income, whereas the exogenous variables driving GDP are exports and investment. And indeed if we look at the universe of other high income and emerging market countries (beginning in 1980 when consistent data start in the World Development Indicators database), we see that fast-growing countries had very rapid growth in investment and exports.<sup>5</sup> During this period, there were 69 such episodes (involving 26 countries) of 7 percent average real GDP growth for consecutive 5-year periods, which is India's estimated growth rate during 2012-12 to 2016-17. In these episodes, the median growth rate was about 12 percent for real investment and 10 percent for real exports of goods and services.<sup>6</sup> So, both theory and evidence point to a critical role for investment and exports as proximate drivers and robust correlates of growth.

Based on these considerations, and the fact that consumption cannot sustain medium term growth without increases in investment, we exclude consumption from our analysis.<sup>7</sup> Of course, we consider below whether this creates a problem, checking whether the proxies excluding consumption can

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<sup>4</sup> Exports and imports of goods and services, are produced by the RBI; electricity production by the electricity authority. In the WDI database, which is the source of data for the cross-country analysis, there are three measures of credit: credit extended by the financial system, credit extended to the private sector, and bank credit to the private sector. Our results hold with all three measures. There is no measure in the WDI for credit to industry which might be a better proxy for investment.

<sup>5</sup> For evidence from the East Asian experience, see World Bank (1993), Page (1994), Rodrik (1995), Sarel (1996), and Krueger (2007).

<sup>6</sup> All these numbers are based on the core sample of 74 high and middle income countries used in the original paper. The WDI database provides data on real exports and imports of goods and services (nominal values deflated by appropriate deflators), but not for China. Just so that China can be included in the sample of fast-growing economies, we use, for China, volume growth as a proxy for growth in real exports and imports. Also, data for China's gross capital formation begin in 1995, which means that the number of high growth episodes is under-estimated. But these should not alter the basic finding that high growth is associated with rapid investment and export growth.

<sup>7</sup> Periods of high growth driven by exports and investment will be accompanied by strong consumption growth but that is the consequence of the rapid income growth. In contrast, instances of consumption growth driving rapid and sustained GDP growth without export and investment growth are not easy to find in the data.

really “explain” growth econometrically (they can), and considering whether evidence suggests that growth was consumption-driven in this period (it doesn’t).

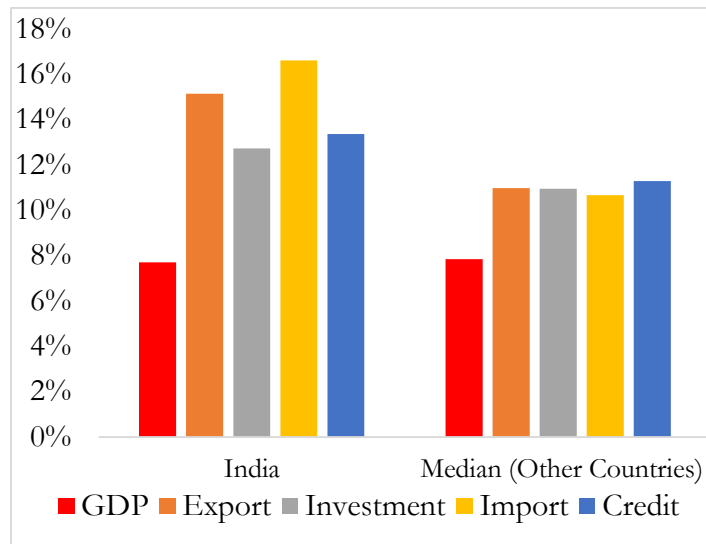
At the same time, we add electricity consumption to the list of indicators for the econometric analysis, even though it is a weak proxy for investment and exports. To a certain extent, we do so to follow precedent: using electricity to track GDP has become popular even since former Chinese Premier Li Keqiang identified it as a critical variable explaining growth in China. Beyond this consideration, our major reason for including electricity is that it prevents Type I errors—false rejections of the CSO GDP figures. India’s electricity production has been growing exceptionally rapidly in recent years, so using this proxy—perhaps capturing some trend increase in demand—makes it more difficult to reject the hypothesis that GDP growth has been rapid. That said, we perform tests with and without electricity, to make sure that the results do not hinge on the inclusion of this variable.<sup>8</sup>

#### IV. Central Puzzle

This framework allows us to explore the central puzzle of India’s GDP statistics.

During 2002-2011, India behaved like a typical fast-growing country, with measured GDP growth exhibiting a strong correlation with other demand indicators: GDP was growing at about 7.5 percent, while investment and exports were growing more rapidly, at 13 percent and 15 percent respectively, in line with the median value of 12 percent for both variables in comparable fast-growers.<sup>9</sup>

**Figure 1. Growth of Key Macro-Indicators for India and Other Countries Growing at 7.5%**



*Source: Author’s calculations based on WDI data.*

<sup>8</sup> Indeed, all the results point to a larger discrepancy of the GDP growth estimates when electricity is excluded from the analysis.

<sup>9</sup> Specifically, we identify all country-year combinations since 1980 where the average growth rate over ten consecutive years is between 7.5 percent and 8.5 percent to match India’s growth rate of 7.6 percent between 2002-2011. There are 27 such country-year episodes, involving eight countries, with the median GDP growth rate being 7.8 percent.

### *A. The major shocks*

During the period 2011-2016, the Indian economy was hit by a series of shocks. Three of these shocks affected growth for the entire five-year period under consideration. These were:

**1. Export collapse.** During the 2000s, emerging markets were buoyed by strong global demand for their products, which enabled their exports to grow rapidly on average. Since 2011, however, global demand has decelerated, causing emerging market export growth to collapse. In India, export growth fell to just 3 percent from an average of 15 percent per year in the pre-2011 period.<sup>10</sup> Since India's export-GDP ratio during the period 2012-16 was about 22 percent, this shock had the potential to reduce growth substantially, with a crude estimate being about  $2\frac{1}{2}$  percentage points.<sup>11</sup>

**2. Twin Balance Sheet (TBS) problem.** During the boom of the mid-2000s many companies invested heavily in projects that did not work out, leading to considerable stress in the corporate sector and double-digit levels of nonperforming assets in the banks. As a result, many firms have been not been financially strong enough to invest, while banks have been reluctant to lend to even to healthy firms. There is a rich literature documenting that TBS problems can extract output costs (Kaminsky and Reinhart, 1998; Eichengreen and Rose, 1998, and Dell'Ariccia et. al., 2008).

In India, real credit growth slowed to 6 percent from 14 percent pre-2011.<sup>12</sup> More importantly from an investment perspective, real credit growth to industry slowed to a paltry 1 percent from a torrid 15 percent. And insofar as some of the credit growth—post TBS kicking in—represented evergreening (bank lending to finance interest payments) of stressed firms, the numbers might even overstate how much credit was used to finance firms' investment. It is consequently unsurprising that investment growth declined by 10 percentage points, which could knock off another  $2\frac{1}{2}$  to 3 percentage points in growth.<sup>13</sup>

**3. Oil Price and Terms of Trade:** Offsetting these negative shocks was a positive one in the form of declining oil prices and a consequent improvement in the terms of trade for India as a net oil importer. The annual average change in real US\$ oil prices between 2002-2011 was about 16.5 percent and between 2012-2016 was minus 16 percent. Again, a rough calculation suggests that this should have boosted growth by about 1 to  $1\frac{1}{2}$  percentage points.<sup>14</sup>

In addition to these entire-period shocks, the net effect of which would be somewhere between 3 to 4 percentage points decline in GDP growth, other shocks affected some of the years between 2011 and 2016.

**4. Loss of macro-stability under UPA-2 (2012-2013):** Two out of the five years of our analysis—40 percent of the sample—were the last two years of UPA-2, characterized by rising macro-

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<sup>10</sup> Here and subsequently the “pre-2011 period” refers to the years from 2002 to 2011. The “post-2011 period” refers to 2012-16.

<sup>11</sup> Calculated as the export slowdown (15 percent -3 percent) times the export share in GDP (0.22 percent).

<sup>12</sup> As mentioned earlier, the numbers for credit growth are similar for broader and narrower definitions of credit and hence all our results hold for all measures of credit growth.

<sup>13</sup> Calculated as the investment growth slowdown (13 percent - 3 percent) times the investment share of GDP.

<sup>14</sup> Calculated as the terms of trade improvement (16.5+16 percent) times the share of net oil imports in GDP (about 4.2 percent).



economic distress, corruption scandals, and paralysis in decision-making, leading to the balance of payments near-crisis of July/August 2013.

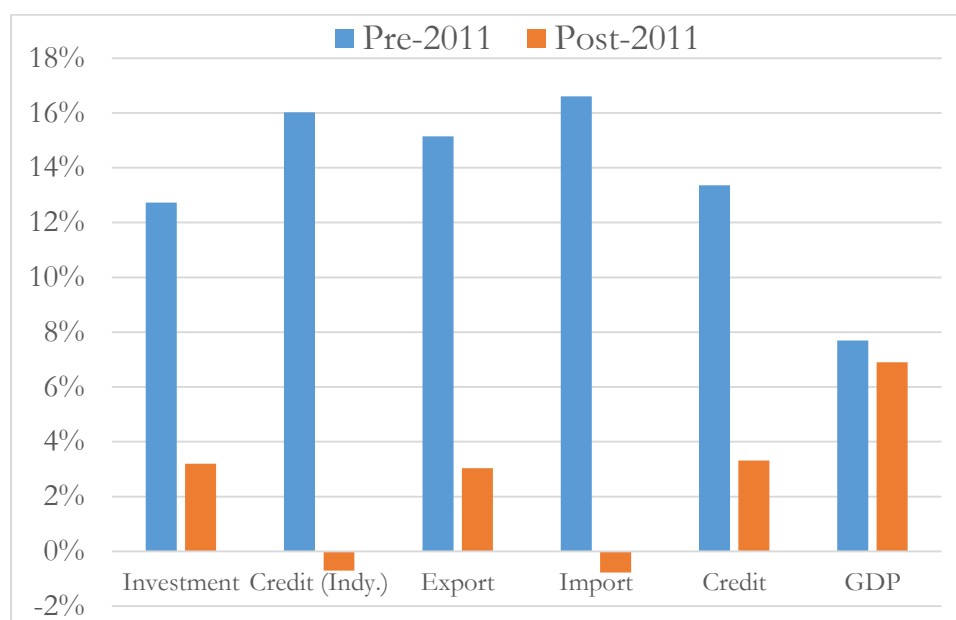
5. **Drought (2014-2015).** The agricultural sector was struck by drought for two consecutive years.<sup>15</sup> Growth in food grain production in these years were -4.9 percent and 0.5 percent, well below the long run average of roughly 3 percent. This exerted a downward drag on growth, amounting to roughly 0.4 percent.<sup>16</sup>

6. **Demonetisation (2016).** Finally, in the last year of our sample period there was a large macro-economic shock, when currency supply was reduced by 86 percent in November 2016, affecting output in the large informal sector, which relies heavily on cash. One estimate of the short-run negative impact is provided by Chodorow-Reich et. al. (2018).

Figure 2 shows the large toll that these shocks took on the key macro-demand indicators. Growth in:

- Real credit to industry collapsed, falling from 16 percent to -1 percent, mirrored in the official figures for real investment growth, which declined from 13 percent to 3 percent;
- Real exports fell from 15 percent to 3 percent;
- Overall real credit slowed from 13 percent to 3 percent; and
- Real imports slowed from 17 percent to minus 1 percent.

**Figure 2. Growth in Macro-Indicators and GDP, Pre- and Post-2011**



*Source: Author's calculations based on WDI data and RBI data for real credit to industry.*

<sup>15</sup> In these years, rainfall fell short of the long-run average by about 12 percent and 14 percent, respectively.

<sup>16</sup> Calculated as the average deviation of the 2 years from long-run average growth times agriculture's share of GDP.

But the new GDP series suggests that despite all these large shocks, economic growth declined by very little, slipping from 7.7 percent to 6.9 percent.<sup>17</sup> This situation invites a questions: is it really possible that these five large adverse shocks had such little impact on GDP growth?

### *B. Possible explanations*

Of course, it is possible that other things happened that offset these large shocks. In particular, three possibilities need to be considered: the beneficial efforts of the NDA government's reforms; productivity improvements; and a consumption boom.

#### **1.NDA-2 Reforms**

Consider first the NDA reforms. Three have been particularly important: the historic introduction of the Goods and Services Tax (GST), the potentially transformative Insolvency and Bankruptcy Code (IBC), and the public provision of essential private goods and services (PPEGS)—housing, cooking gas, power, toilets, bank accounts, emergency medical insurance. But the GST and IBC which will deliver growth benefits in the medium term, were implemented after the time period covered in this study. And PPEGS, which is profoundly welfare-boosting in its consequences, is not necessarily growth-enhancing.

#### **2. Productivity Surge**

Consider next the possibility of a productivity boom. If such a boom occurred over the post-2011 period, then productivity would need to have accelerated during the last two years of the UPA-2 regime, marked by acute macro stress and a collapse in policy credibility. This strains credulity; it's much more likely that during this difficult period productivity actually collapsed.

Moreover, if productivity had indeed boomed, we should have seen the benefits accruing to firms in the form of higher profits. But Figure 3, using the Prowess database (which collects data from the balance sheets of firms), shows that the opposite actually happened: annual growth in real profits (both before and after taxes) of India's corporate sector (domestic, foreign and government combined) declined from the 22-28 percent range to negative growth territory, a substantial decline, indeed a collapse, that would have been highly implausible had productivity surged. Collapsing profits strongly contradicts any explanation reliant on a productivity surge.

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<sup>17</sup> Another manifestation of this central puzzle is that the correlations between growth and these macro-indicators all changed dramatically, from positive in the pre-2011 period to negative post-2011. In Figure 1a of the GDP paper we showed that for 17 indicators, 16 were positive correlated with GDP growth pre-2011. But in the second period the correlations turned negative for 11 of these. So, something seems to have changed in India, and in an odd way. It is normal for correlations to weaken or change over time, depending on other changes occurring in the economy. But it is a mystery why key macro-indicators—investment, credit, exports and imports—which are either constituents or determinants of growth should move so sharply in the opposite direction of GDP growth.

**Figure 3. Growth in Real Profits of Indian Corporate Sector (Annual avg., %)**



*Corporate sector comprises domestic and foreign private companies and government enterprises.  
Source: Prowess.*

### **3. Consumption Surge**

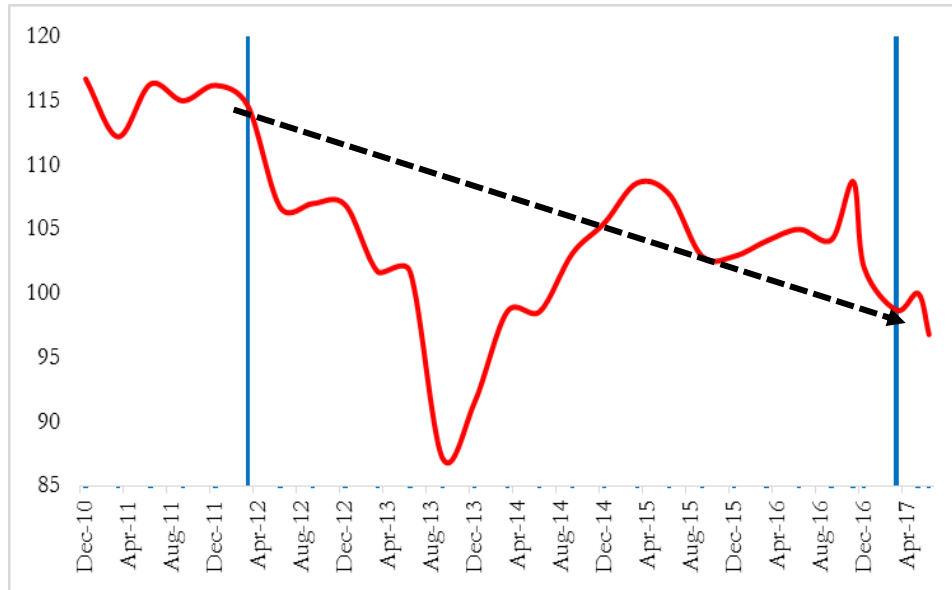
What about the third explanation, that India has suddenly developed a unique model of sustained consumption-led growth?<sup>18</sup> In that case, we would expect consumer confidence to have been high. Since December 2010, the RBI has been producing a monthly Consumer Confidence Survey which is shown in Figure 4a. It indicates that confidence has instead been variable: there was a large decline in the last 2 years of UPA-2, a pick-up in the first two years of NDA-2, and then a renewed decline. For the period as a whole, there is a marked deterioration in consumer confidence, which is not likely to be consistent with a consumption boom.

Moreover, one key indicator of consumption, namely the Index of Industrial Production (IIP) for consumer goods also shows a sharp deceleration in real growth from 9.2 percent to 4.5 percent (Figure 4b). This trend is also inconsistent with a consumption boom.

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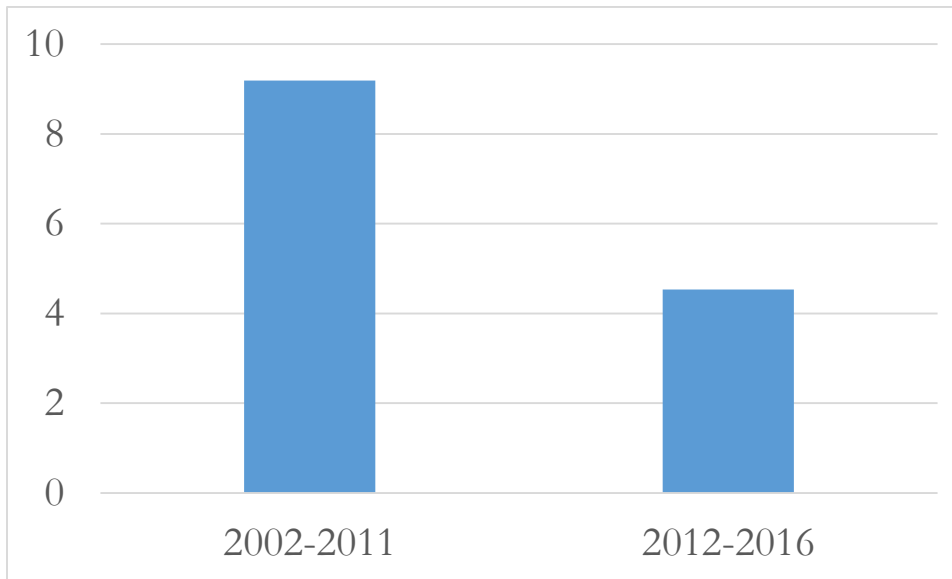
<sup>18</sup> Indeed, this is what the official data suggest. But there are reasons to try and validate this. For a start, unlike exports or investment the CSO doesn't have robust data on consumption; it bases its figures on a limited set of partial indicators. Indeed, it is primarily for lack of robust consumption data that India does not have expenditure-based estimates of GDP.

**Figure 4a. Consumer Confidence Survey**



*Definition: Index is a measure of consumers who say that the current situation is better than 12 months ago.  
Source: RBI, Consumer Confidence Survey*

**Figure 4b. Index of Industrial Production, Consumer Goods (Annual avg; %)**

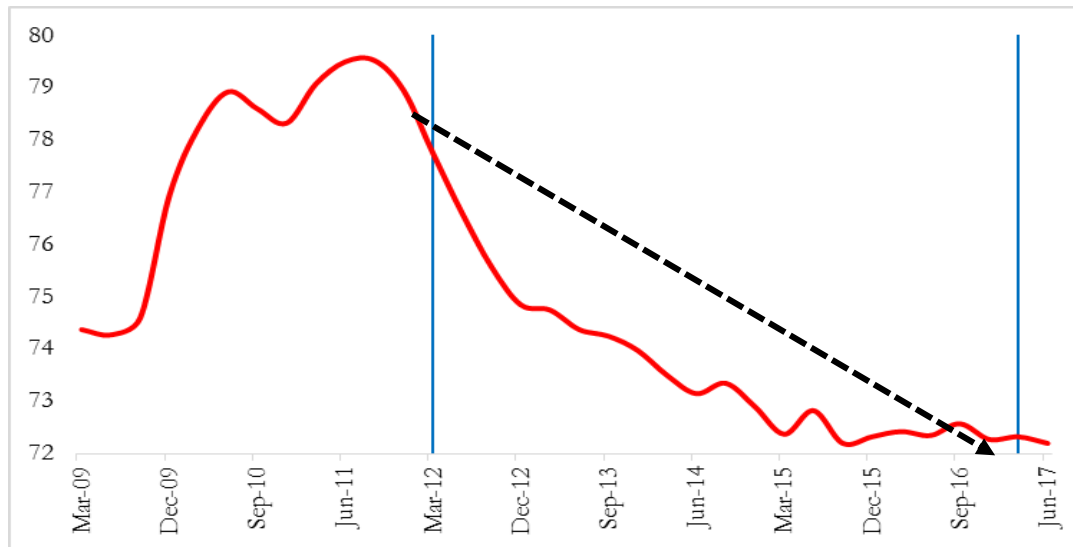


*Source: Author's calculations based on CSO data.*

Moreover, if there were rapidly growing consumption demand, it would have to be met through new investments in capacity, a surge in imports, and/or increasing utilization of existing capacity. We have already seen that new investments and imports actually collapsed. What about utilization of existing capacity? Figure 5 gives the RBI data: they show that utilisation, instead of increasing, has actually

been falling steadily. Since the peak utilization of about 83 percent in early 2011, the figure has declined by a hefty 10 percentage points to about 73 percent, contradicting the consumption boom hypothesis.

**Figure 5. Capacity Utilization (in %, 4-quarter moving avg.)**



*Source: RBI, OBICUS Survey*

In sum, India post-2011 was hit by a series of major shocks, which affected the demand indicators severely, but had little impact on measured growth. That is, India somehow sustained an economic boom in an environment with substantially lower investment, profits, exports, credit financing, and probably consumption. And the three standard explanations typically offered to explain this phenomenon are themselves inconsistent with the available evidence. That leaves us with a deep puzzle.

## V. Exploring the Puzzle

We consequently explore this puzzle more deeply, in two different ways. First, we look internationally, to see how India's post-2011 growth-indicator relationship compares with those in other countries. Second, we conduct a formal econometric analysis of the growth-indicator relationship in India and comparable countries over time. These exercises will help us answer the key question: was the relationship normal in India before 2011, and did it become abnormal subsequently?

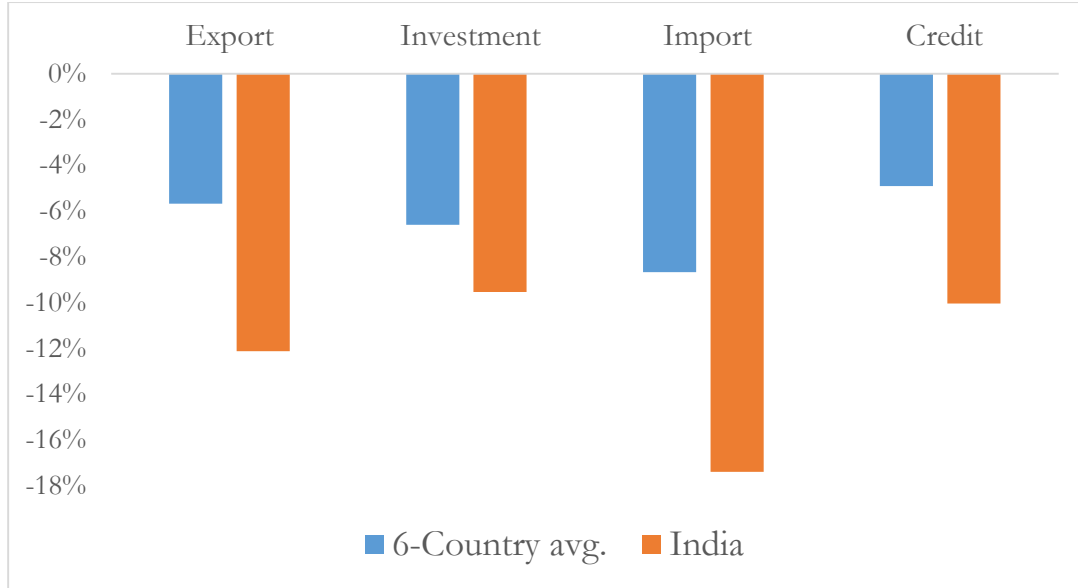
### *A. Comparison with other countries*

For the first cross-country comparison, we use a set of six large emerging market countries that are similar to India in size and considered the most obvious comparators: China, Brazil, Indonesia, South Korea, South Africa, and Turkey.<sup>19</sup> Figure 6a shows that post-2011 the macro-demand

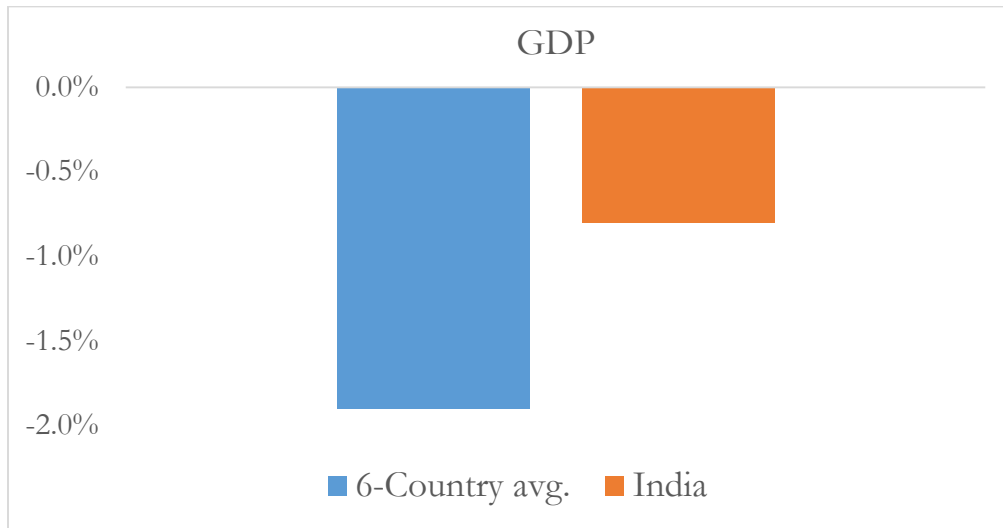
<sup>19</sup>Russia is also comparable in some ways, but is a large net oil exporter and hence less appropriate for examining a period with sharp movements in oil prices.

indicators fell more sharply in India than in comparable countries.<sup>20</sup> Yet Figure 6b reveals that India's growth fell by much less than that in the other countries, just 0.8 percentage point compared with 1.9 percentage points.

**Figure 6a. Change in Growth of Macro-Indicators, 6-EM Avg. and India (percentage points)**



**Figure 6b. Change in GDP Growth, 6-EM Avg. and India (percentage points)**



The 6 emerging market (EM) countries included are: Brazil, China, Indonesia, Korea, South Africa and Turkey. Change is the difference in the average values of the indicators for the 5-year period, post-2011 with the 10-year average, pre-2011.

Source: Author's calculations based on WDI data.

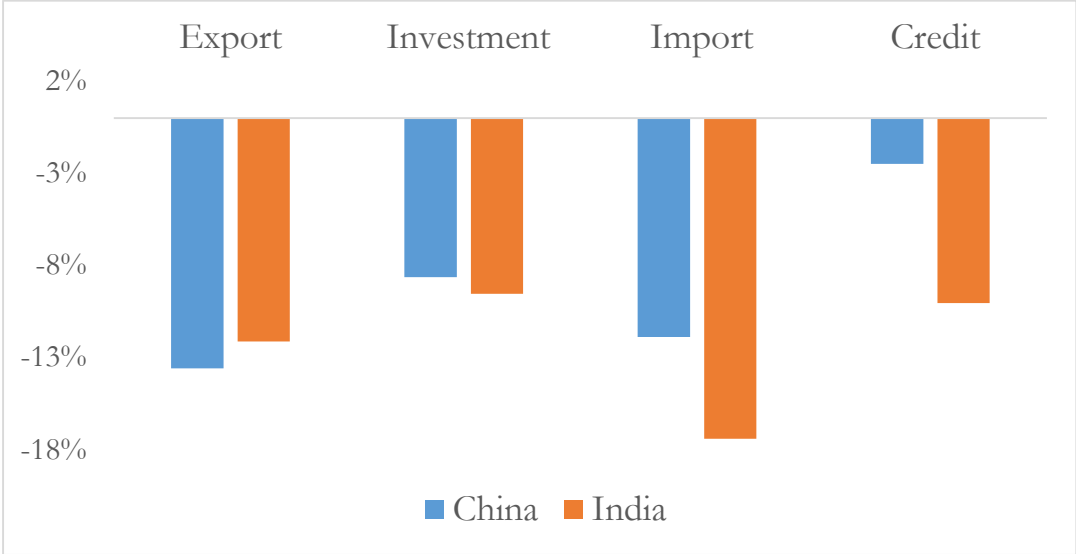
<sup>20</sup>Investment: 9.5 percentage points for India, 6.6 percentage points for the six; exports: 12.1 percentage points versus 5.7; credit: 10 percentage points versus 4.9.

A comparison with China is revealing. In one key aspect, China’s post-2011 experience was similar to India’s. Contrary to popular perception and as pointed out in the *Economic Survey* in February 2017, China and India had roughly similar export dependence after the Global Financial Crisis, with export-GDP ratios during 2012-2016 averaging 23 percent in China and 22 percent in India. Hence, the de-globalization shock had broadly similar impacts on exports and investment (Figure 7a).

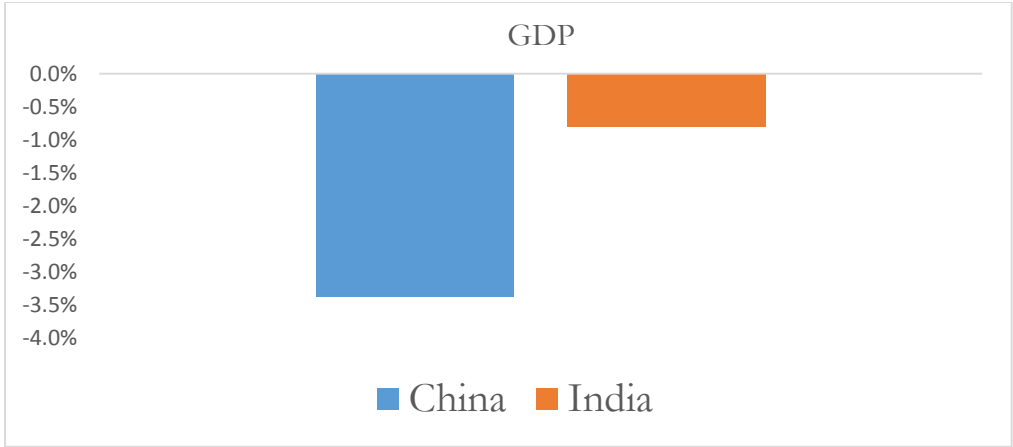
But China did not experience the Twin Balance Sheet shock and the associated credit squeeze; to the contrary, the government embarked on a sizeable credit injection that served to prop up consumption and imports.

One might therefore have expected the post-2011 growth slowdown to have been less pronounced in China. But the opposite is true. Figure 7b shows that China’s GDP growth rate fell by 3.4 percentage points while India’s fell by a mere 0.8 percentage point.

**Figure 7. Change in Growth of Macro-Indicators, China and India (percentage points)**



**Figure 7. Change in GDP Growth, Pre-and Post-2011, China and India (percentage points)**



*Change is the difference in the average values of the indicators for the 5-year period, post-2011 with the 10-year average, pre-2011. Source: Author’s calculations based on WDI data.*

So, the comparison with other countries does not resolve the puzzle. Rather, it intensifies the puzzle, since countries that suffered fewer or smaller shocks than India experienced larger declines in GDP growth.

*B. Econometric analysis*

Clearly, deeper, more formal econometric analysis, is needed. The analysis proceeds in several steps. We start by examining whether there is a robust relationship between the macro-indicators and GDP growth. Equation (1) suggests that there is, provided the indicators chosen are good proxies for the macro-demand variables. This hypothesis needs to be tested.

Accordingly, in the earlier paper, GDP growth was regressed on the macro-indicators (credit, exports, imports and electricity) for a sample of countries over time, to see whether the indicators move with GDP growth rates. It turns out that on average they do, with the indicators explaining between 60 and 75 percent of the variation in GDP growth (See Figure 8a; details in the original paper.)

The next question is whether this relationship holds for India. The regression shows that it does in the pre-2011 period, where India is “on the line”. This suggests that the structural relationship between GDP growth and key macro indicators in India is similar to that in other economies.

However, in the post-2011 period, India becomes a marked outlier. Compare Figure 8b with 8a to see this. Formally, this means the change across time in the relationship between the macro-demand indicators and growth is unusual in India, compared to other countries.

Put more directly, the deviation suggests that the new methodology overestimated growth substantially in the post-2011 period.

**Figure 8a. India in the Cross-Country Growth-Macro Indicators Relationship, 2002-2011**

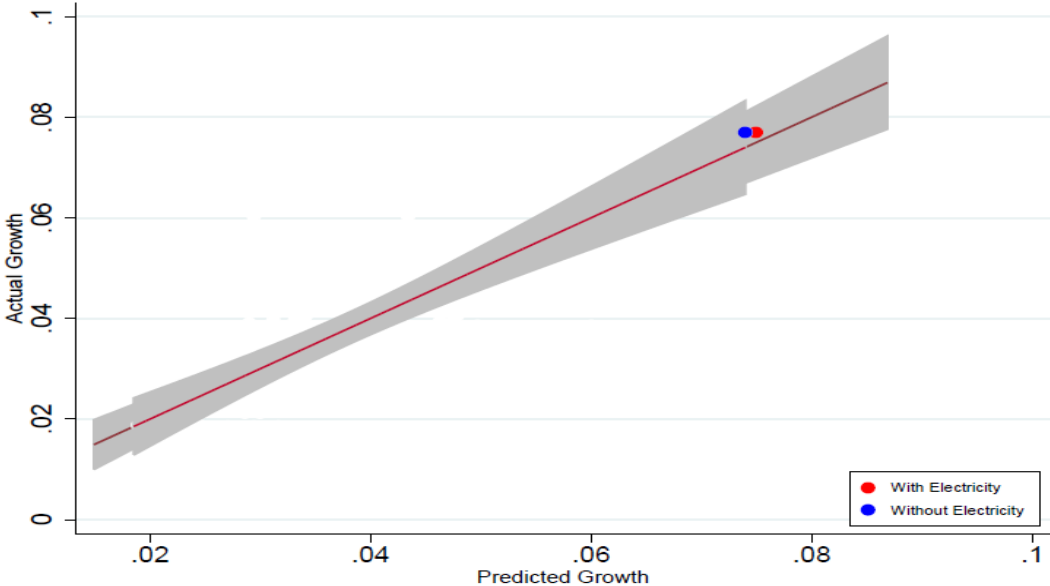
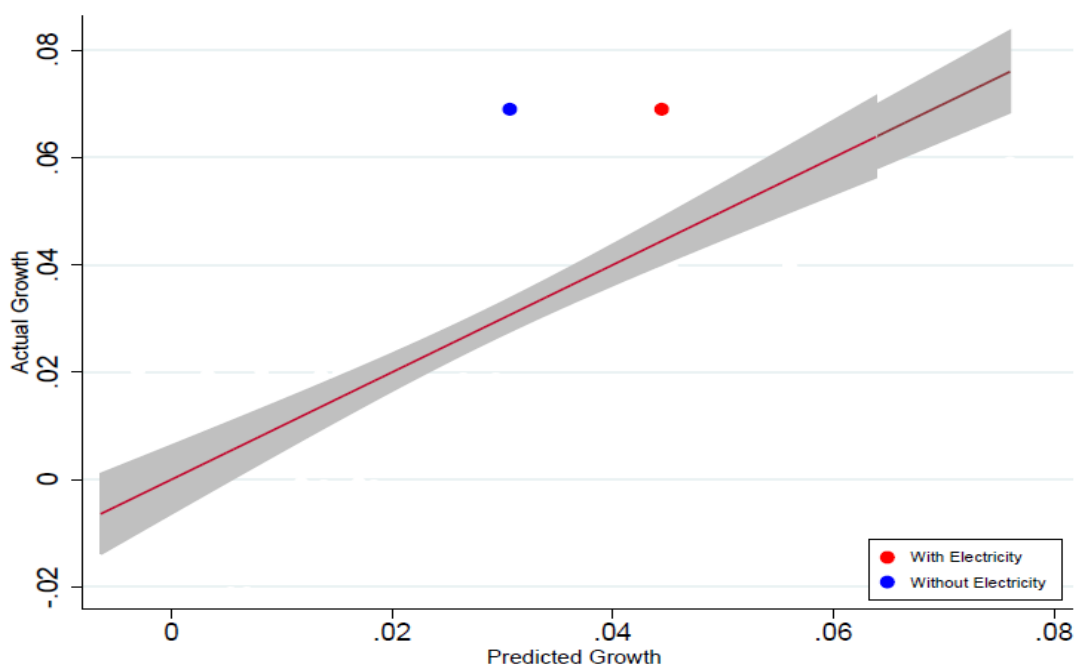




Figure 8b. India in the Cross-Country Growth-Macro Indicators Relationship, 2012-2016



Source: Author's calculations

## VI. Results/Interpretation

Now, it is important to stress that the GDP paper gave a range and a central estimate. The correct way of expressing the result is that there is a high likelihood of there being large over-estimation, which would result in growth falling in a range of 3.5 percent to 5.5 percent range, with 4.5 percent as the central estimate within that range. In other words, the confidence level applied to the range not the central estimate. With that note, we now turn to magnitudes.

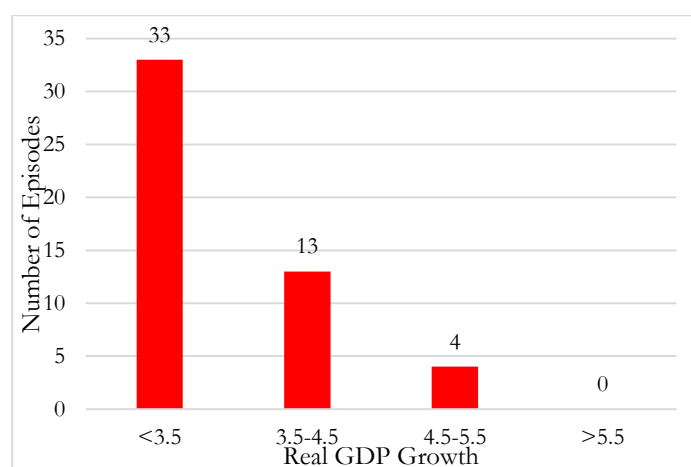
### A. Robustness checks: Comparable cross-country experiences

Is the key result valid? To answer this question, we separate out the two implicit claims. First, the exercise is effectively claiming that there is substantial discrepancy between official GDP growth estimates and what other macro-indicators are pointing to. Is this claim fair? We can check by examining whether any other countries have managed to achieve 7 percent GDP growth, over any 5 year period, with India's post-2011 combination of investment and export growth (3 percent for both). We went back to 1980 and identified 69 country-year experiences where the average growth rate over 5 consecutive years was between 6.5 percent and 7.5 percent. The answer is: none. Indeed, the median combination of investment and exports necessary to achieve 7 percent growth is 11.8 percent and 9.8 percent, respectively, more than three times India's performance on. So, historical evidence from other countries does cast doubt on the post-2011 GDP growth estimates.

The second claim is that the magnitude of the overestimation is significant, that actual growth may be less than 5 percent. We can cross-check this claim by examining the average 5-year GDP growth rate achieved by countries with India’s post-2011 combination of investment and export growth.

Since 1980, there have been 50 country-year experiences (involving 28 countries) where both investment and export growth rate are close to or above India’s combination of 3.2 percent and 3 percent, respectively.<sup>21</sup> No country case ever achieved any growth greater than 5.5 percent, consistent with our result that the 95 percent confidence interval is below 5.5 percent (Figure 9). Four countries in this sample achieved growth averaging 4.9 percent, but the median growth was only 3 percent.<sup>22</sup> So, if India were a typical country with typical relationships between investment, exports and GDP growth, its GDP growth would be closer to 3-3.5 percent.

**Figure 9: Distribution of Historical Growth Rates for Countries with India’s Post-2011 Combination of Investment and Export Growth**



*Source: Author’s calculations based on WDI data.*

*B. Possible explanation for substantially lower growth: GDP deflator growth under-estimated*

In the GDP paper, we had identified one possible explanation for GDP growth over-estimation. This related to problems in the measurement of formal manufacturing, which several others have also pointed out (Nagraj, 2015; *Economic Survey*, 2014-15, Goldar, 2016; Dholakia et. al. 2018, Morris and Kumari, 2019). We found that formal manufacturing value-added growth from the national income accounts tracked closely growth of the index of industrial production in manufacturing before 2011 but diverged substantially thereafter: this wedge widened from about 0.5 percentage points pre-2011 to nearly 6 percentage points thereafter. But this could only explain about 1 percentage point of the total over-estimation because manufacturing constitutes only 17 percent of overall GDP.

<sup>21</sup> Specifically, we identified country-years where average export and investment growth over consecutive 5-year periods was between 2.5 percent and 4.5 percent to match India’s performance.

<sup>22</sup> Median export and investment growth for this sample is above 3.5 percent compared to 3 percent for India. And just to ensure that these numbers are comparable to India’s, we checked that import and credit growth numbers for these countries are substantially above India’s.

Is there another, complementary explanation that can account for a large over-estimation, something close to our central estimate? That is, is there a reason why the new CSO methodology might lead to large overestimates of the growth rate? Indeed, there may well be.

A key change post-2011 was a shift from relying on volume indicators toward using nominal numbers from the MCA21 corporate database. In theory, this was a substantial improvement, moving India closer to internationally-standard ways of calculating GDP. But in practice there have been difficulties. In particular, nominal numbers need to be deflated by producer price indices to derive the figures for real GDP—but India does not have any producer price indices.

For many sectors, the CSO is forced to use price indices from the WPI as its deflator. And this is highly problematic, because the WPI tends to understate inflation, especially when commodity prices fall, as occurred after 2011 (See Morris and Kumari, 2019, the government's *Mid-Year Economic Analysis*, 2015-16, Sengupta, 2016, and Section V of the GDP paper for more discussion). The details are complex, but the sense of the problem can be seen from Figures 10a and 10b, which plots the difference between the CPI and the GDP deflators for a large sample of countries.

The figure shows that the CPI-GDP deflator wedge tends to be distributed around zero: on average across time and countries, consumer and producer inflation should track each other so that the differential is close to zero. And for India, the differential was indeed small during the 2002-11 period (averaging 0.6 percent), spiking briefly during the global financial crisis years when measurement in general was severely affected. If the crisis years (2009-10 and 2010-11) are excluded, the average wedge is virtually zero (-0.3 percent), and the jump in the wedge occurs after 2011-12. Indeed, comparing across countries, India's wedge was not unusual pre-2011 (Figure 10a).<sup>23</sup>

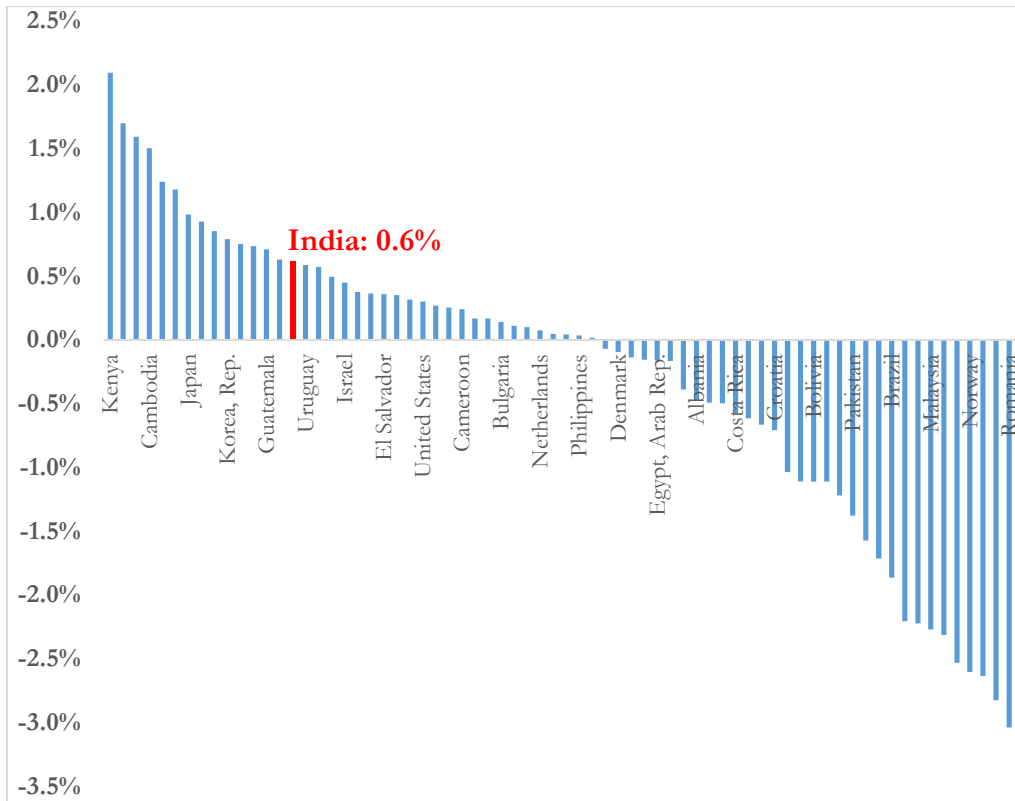
But during the 2012-16 period, the differential in India surged to nearly 3 percentage points and was the second highest in the world (Figure 10b). That is, measured GDP deflator growth was nearly 3 percentage points less every year than CPI inflation. If this occurred because the deflator was underestimated during this period, then, for a given nominal GDP growth, average real growth rates would be overstated by a corresponding amount. Any mis-measurement of nominal GDP growth itself—perhaps because of problems related to the MCA-21 database—would be additional to that.

Again, what is important and consistent between this finding on the GDP deflator and the other finding on real GDP growth mis-measurement (shown in Figure 3) is how India changes from being a “normal” country pre-2011 to a large outlier post-2011. And the magnitudes of price and real GDP mis-measurement are also broadly consistent.

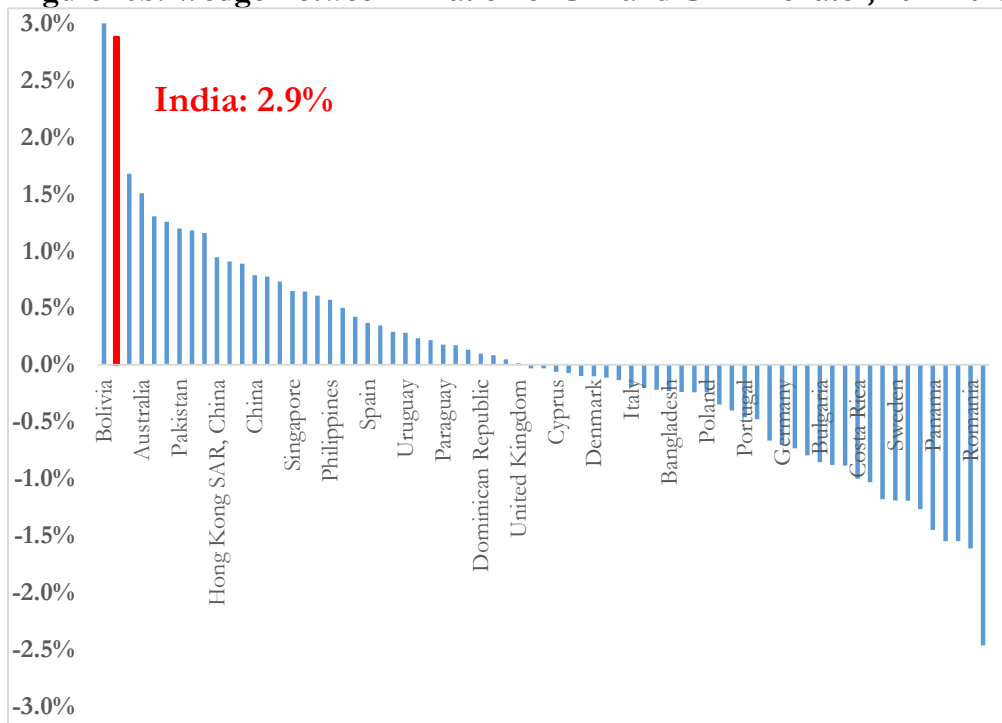
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<sup>23</sup> Ukraine is omitted from Figure 10a because it is a large outlier (-5.1 percent) in the pre-2011 period which would distort the pictorial representation but would not alter the analysis in any way.

**Figure 10a. Wedge Between Inflation of CPI and GDP Deflator, 2002-2011**



**Figure 10b. Wedge Between Inflation of CPI and GDP Deflator, 2012-2016**



Source: Author's calculations based on WDI data.

In sum, a number of inconsistencies have been noted in the data:

- India’s sustained high measured GDP growth after 2011, despite large negative macro-economic shocks (Section IV.A), contrary to the pattern in other large emerging markets (Section V.A);
- India’s outlier relationship between GDP growth and macro indicators after 2011, despite a normal relationship before 2011 (Section V.B);
- India clocking significantly higher measured GDP growth than all other countries with the same export and investment growth rates in the post-war period (Section VI.A); and
- Signs that the GDP deflator might be under-estimated, which for a given nominal GDP, implies that real GDP growth would be over-estimated (Section VI.B)

The most likely explanation for this pattern of inconsistencies is that measured GDP growth was overestimated after the methodological changes post-2011.

## VII. Objections to the results

### A. *Growth of “4.5” percent is implausibly low*

Despite this evidence, some prominent commentators have nonetheless argued that the growth over-estimation cannot be large. In broad terms, they have argued along the following lines: “4.5 percent growth is a disaster. India’s economy is not a disaster. Ergo, India cannot have grown at 4.5 percent.”

This widespread belief stems from three deeply held cognitive benchmarks:

- How can India be growing at pre-1980 levels, when the economy three decades ago was in much worse shape?
- How can India be growing so much slower than during the boom period?
- How can India be growing so much slower than its potential?

Consider each in turn.

#### *1. Hindu rate of growth, redux?*

The first cognitive benchmark that makes a 4.5 percent growth difficult to accept is that it harks back to the pre-1980s era of the “Hindu rate of growth”. How can the Indian economy today, with all the changes that have happened, be comparable to that old performance?

The answer is that it is *not* comparable, for several reasons. To begin with, today’s 4.5 percent translates into a per capita growth rate of about 3 percent. In the pre-1980s era, the GDP growth rate was about 3-3.5 percent and the population growth rate was 2 percent, yielding a per capita growth rate of 1-1.5 percent. So, today’s 4.5 percent represents more than a doubling of the old “Hindu” per capita growth rate.

That is surely good. But what takes it from being good to impressive is that today’s GDP level is five times what it was in the 1980s. The 1.5 percent growth was achieved at a per capita GDP of US\$1000 (PPP terms), meaning that the annual increments in income were very small in dollar terms. Today’s 3 percent per capita implies annual increases in income that are *ten times larger*.

Most impressively, a 4.5 percent growth rate is a notable achievement in the current, post-Global Financial Crisis world. In fact, if we take all the large major economies of the world, say those with GDP greater than \$1 trillion dollars (there are 13 of them), India, at 4.5 percent real GDP growth, would be the second-fastest growing economy in the 2012-2016 period, just as it was in the 10 years preceding. Indeed, India's 4.5 percent is well ahead of the third fastest growing economy, Korea which grew at 2.9 percent. And it may well be that even at 4.5 percent India is the fastest growing large economy if account is taken of China's growth mis-measurement (Chen et. al., 2019).

To be sure, a pace of 4.5 percent GDP growth for India would represent some under-performance because there are other countries that have been growing rapidly such as Bangladesh, Vietnam etc. but it is far from being a disaster. The lesson, of course, is that India needs policy action to boost exports and investment—as other countries have done—and fix its Twin Balance Sheet challenge in order to revive real activity.

### *2. Boom, not bust?*

The second cognitive benchmark sees the boom years, when India achieved growth in excess of 8 percent, as the norm. But this benchmark fails to take account of the changed economic circumstances as discussed in Section IV, in particular the de-globalisation and Twin Balance Sheet shocks, which could have reduced growth by more than 3 percentage points (see calculations in Section IV).

One reason that cognitive benchmarks have not changed is that these shocks have produced not dramatic crises but persistent bleeds, which have gradually sapped the economy's strength. An aspect of this has recently been documented by Harish Damodaran (2019), namely the loss of animal spirits and the spirit of entrepreneurship in the wake of the TBS.

Another reason why people underestimate the impact of the TBS and deglobalisation problems is that India has never experienced anything similar in its recent economic history. Apart from conventional macro-economic crises, the country has only experienced small financial crises, each of which it has managed to overcome quickly. But India has had no experience in modern times (since 1991) with a decade-long stress on the corporate, financial, and export sectors, all afflicting the economy simultaneously.

### *3. Unchanged potential?*

The third benchmark is a notion of India's potential, which some believe is 7-8 percent or more. But this benchmark may also need to be revised. All the other G-20 countries had to reduce their estimates of potential after the Global Financial Crisis, to reflect the completely changed economic environment internationally and domestically. India may have to do so, as well.

## **B. Rising tax collections show GDP growth was buoyant**

Another counter-argument is that growth could not have declined, since India's tax-GDP ratio rose in the post-2011 period, from about 10 percent in 2011-12 to 11 percent in 2016-17. After all, revenue performance tends to be pro-cyclical, so rising revenue-GDP ratios tend to suggest surging growth.

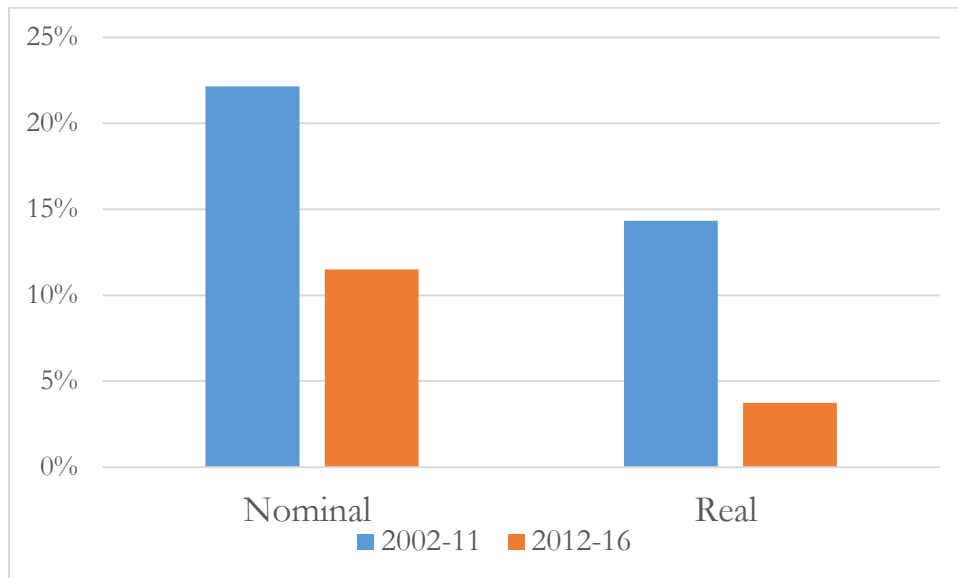
A number of points need to be made here.

First, revenues are affected by more than just economic growth; they are also affected by changes in tax policies and administration. Amongst the latter were the spate of measures to unearth black money, including demonetization which led to a spike in collections in 2016.

Amongst the former, there was one aspect of tax policy that underwent significant change post-2014. After international oil prices fell, the government raised excises on petroleum sharply, which increased revenues and hence the petroleum tax-GDP ratio by about 0.8 percentage points of GDP between 2011-12 and 2016-17.<sup>24</sup>

So, clearly we cannot infer much about real GDP growth using indirect taxes. Suppose, however, we looked at the center’s direct tax collections. What does this data show? Nominal taxes grew at about 22 percent pre-2011 and dropped sharply to 11.5 percent, post-2011; the corresponding real growth numbers are 14.3 percent and 3.7 percent (Figure 11).

**Figure 11. Growth in Center’s Direct Taxes, Pre- and Post-2011 (Annual avg.; %)**



*Source: Author’s calculations based on Budget documents and WDI data.*

So, the sharp decline in real direct tax growth is striking.<sup>25</sup> Again, we must be careful here because a lot could have changed by way of tax rates and enforcement to explain the change. But sharply declining real direct tax growth is more likely to be consistent with *declining* real GDP growth. Indeed, the slow pace of real direct tax growth during 2012-16 seems consistent with a real GDP growth rate of 4.5 percent.

<sup>24</sup> The average growth of petroleum excises was 30 percent in the five year period, 2012-2016, with growth of 19.6 %, 76% and 36.2% since 2014-15 when the excises were raised.

<sup>25</sup> This pattern of sharply declining revenue growth over the two periods is also true of states’ own tax revenues which include petroleum taxes levied by them.

## VIII. Methodological critiques

In this section, we discuss a few additional methodological critiques that have been made.

### *A. Starting point of 2002-03 is arbitrary*

Some commentators have argued that the starting point for the analysis should be 2004-05 because 2002-03 was a drought year (and 2003-04 a recovery from the drought), hence distorting measurement. Specifically, they argue that starting the clock in 2004-05 raises the pre-2011 growth and hence would suggest a reasonable drop in growth for the post-2011 period.

The choice of 2002 was dictated by having a sufficiently long time span—in this case ten years—that would not allow the two-three years of the global financial crisis to distort measurement. By starting in 2004-05, the pre-2011 sample period is reduced to eight years, three of which are affected by the Global Financial Crisis.<sup>26</sup>

In any case, we re-did the analysis for every starting point from 2002: that is we compared the post-2011 period, successively with 2003-04 to 2011-12, 2004-05 to 2011-12, 2005-06 to 2011-12, 2006-07 to 2011-12. In all cases, the results remained, with the key coefficient, varying from 2 percent to 2.8 percent.

The reason why changing the starting point does not matter is that shortening the horizon changes the average GDP growth rate but will also change the growth rate of the macro-demand indicators. And as a result, the relationship between the two—which is what the regression is trying to identify—did not change.

So the conclusion remains the same: the correlation between indicators and growth was high (and similar to other countries) pre-2011 but broke down, in fact even changing sign (causing India to be an outlier) once the methodology was changed.

### *B. Flipping correlations can happen because of changing economic structures*

In the paper, Figure 1 showed that the correlations between the indicators and GDP growth had flipped from positive to negative for 11 of the 16 indicators. Some have argued that correlations can change because the structure of the economy changes.

Without doubt, specific correlations can weaken over time as the economy changes. But it is difficult to understand how the key macro-indicators—exports and imports, overall credit, and credit to industry, and investment—should be *negatively* correlated with growth.

Also, while the structure changing argument is reasonable, it is more likely that structures change over much longer periods of time than suddenly within 5 years.

### *C. There are other outliers*

In the statistical analysis, it is true that India is not the only outlier. Indeed, there are always some outliers in any regression. When we ran the regression in column 1, bottom panel (our core specification) for every other country we found that Bangladesh (3.9 percent), Romania (3 percent),

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<sup>26</sup> 2004-05 was also a drought year.



Albania (2.8 percent) and Hungary (2.7 percent) were larger outliers than India (2.6 percent). But the fact that there are other outliers suggests the need for further investigation of these cases, as well. They don't invalidate the inference that India's post-2011 estimates warrant scrutiny.

Indeed, it is the combination of the regression analysis and all the other evidence (India's performance, pre-and post-2011, its contrast with comparable other countries, the discrepancy in performance of manufacturing, the behaviour of India's GDP deflator) put together that creates the compelling need for re-examination of India's GDP estimation.

#### *D. Other checks*

One criticism of the GDP paper related to the choice of 2011 as the dividing line. We must be clear that the choice of 2011 is compelled by the fact that that was the year of the methodology change. Nevertheless, it could be argued that all the changes that we document before and after 2011 could just be random. To provide reassurance, we need to check that other dividing lines do not generate the same results.

A clean check which we undertook was, in the baseline cross-section regression, to divide the pre-2011 sample (without any of the "treated," post-methodology change years) into two equal periods of five years, 2002-06 and 2007-2011. We then checked whether the pattern of India changing, from being normal to unusual occurred across these two periods. They did not.<sup>27</sup>

Shifting the dividing line from 2011 successively to 2010, 2009 and 2008 does weaken the baseline cross-section results—as we would expect—in that the magnitude of the coefficients are lower than in the baseline result, although India remains an outlier.

### **IX. Conclusions/Way Forward**

The GDP paper and this note have used the basic macro (supply equals demand) identity not to estimate but to validate India's GDP estimates from the demand side, using a set of independently produced proxies.

Further, it has provided a variety of evidence to suggest that it is likely that India's GDP growth is being overestimated by the new methodology:

- India's sustained high measured GDP growth after 2011, despite large negative macro-economic shocks, in contrast to the experience of other large emerging markets;
- India's outlier relationship in a broader cross-section of countries between GDP growth and macro indicators after 2011, despite a normal relationship before 2011;
- Unusual correlations between macro-indicators and growth post-2011 compared to pre-2011;
- India clocking significantly higher measured GDP growth than all other countries in the post-1980 period, with the same export and investment growth rates;

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<sup>27</sup> In doing such checks and deciding on dividing lines, the issue of the global financial crisis years—and their effect on measurement should also be kept in mind.

- A large differential opening up between formal manufacturing growth as recorded in the national accounts and in the index of industrial production; and
- A large wedge between the GDP deflator and CPI post-2011 (amongst the highest in the baseline sample) but not pre-2011, indicating that the GDP deflator might be underestimated; for a given nominal GDP, this implies that real GDP growth would be overestimated;

Each individual piece of evidence could possibly be explained by appealing to reasons other than measurement changes. But the cumulative and mutually consistent nature of this evidence makes it difficult for non-measurement related reasons to explain this collection of empirical facts. The evidence suggests that measurement changes likely caused India's GDP to be overestimated in the post-2011 period. Moreover, while it is not possible to say precisely what India's GDP would have been absent the measurement changes, the evidence suggests that the discrepancy in measured GDP growth post-2011 is likely to be significant, in the range provided in the GDP paper and confirmed by other new evidence provided here.

Where do we go from here? The most important task is to re-visit the GDP methodology, to see how the problems that seem to have resulted in an overestimation of GDP growth can be addressed. As part of this exercise, a number of issues could be explored in greater detail, such as the impact of the new methodology (and the new MCA data) on nominal GDP estimates, so we can see whether the problems are in the nominal numbers, the deflator, or both.

More importantly, there is a real opportunity here for significantly upgrading India's GDP estimates. Disaggregated GST data that are now available at the transactions level could be harnessed to estimate—for the first time—expenditure side estimates of India's GDP. That would take India to the global frontier in its GDP estimation.

**Box 1.1 : Revised Estimates of GDP and GDP growth**

*Notwithstanding the new estimates, the balance of evidence and caution counsel in favour of viewing India as a recovering rather than surging economy.*

On January 30, the Central Statistics Office released a new GDP series that entailed shifting the base year from 2004-05 to 2011-12 but also using more data and deploying improved methodologies (Chapter 1 in the second volume of the Survey provides greater details). New estimates for GDP have been provided for the years 2011-12 to 2014-15.

How should one view these estimates? First, the improvement in data and methods puts India on par with international standards of GDP estimation. India is perhaps unique in that GDP revisions result in lower numbers rather than the typically high upward revision seen in many countries. The key estimate for the level of GDP for 2011-12, which is the new base year, is actually 2 percent lower than previously estimated.

However, the growth estimates warrant further reflection. On the one hand, directionally the growth estimate for 2014-15 relative to that for 2013-14 seems plausible and consistent with the fact of improving investor sentiment and reform actions.

On the other, both directionally and in level terms, the growth estimate for 2013-14 is puzzling. According to the new estimates, growth at market prices in 2013-14 apparently accelerated by 1.8 percentage points to 6.9 percent (1.5 percentage points for growth at basic prices).

These numbers seem difficult to reconcile with other developments in the economy. 2013-14 was a crisis year—capital flowed out, interest rates were tightened, there was consolidation—and it is difficult to see how an economy's growth rate could accelerate so much in such circumstances. Also, imports of goods in 2013-14 apparently declined by 10 percent, which, even accounting for the squeeze on gold imports, is high. Growth booms are typically accompanied by import surges not import declines. This boom was one over-reliant on domestic demand because the contribution of net external demand was substantially negative.

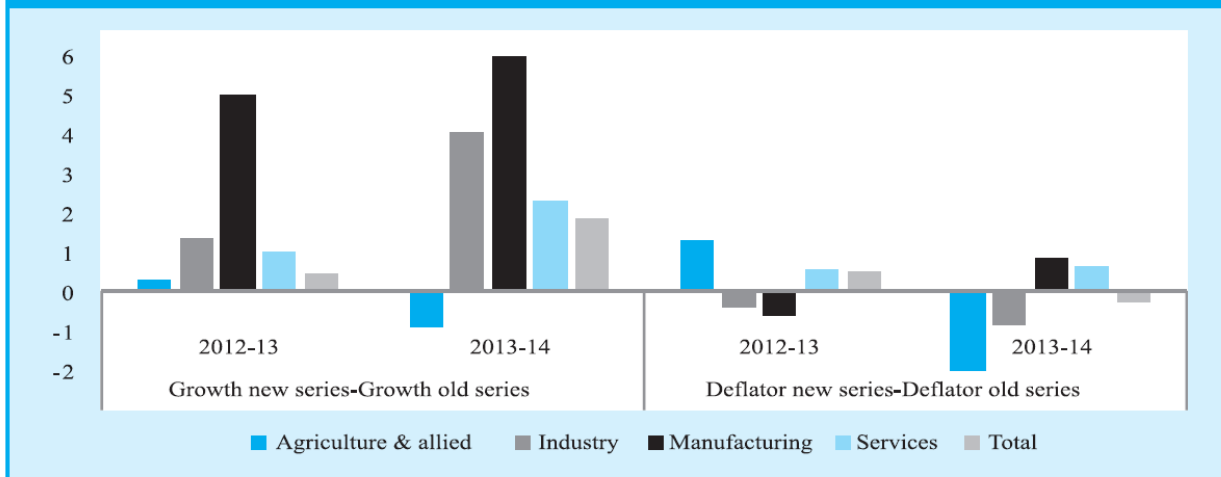
This growth surge also appears to have been accompanied by dramatic declines in savings and investment ratios. For example, gross fixed capital formation declined from 33.6 percent in 2011-12 to 29.7 percent in 2013-14 while gross domestic savings declined from 33.9 percent to 30.6 percent. The implication is that the growth surge in the crisis year of 2013-14 was also a massive productivity surge, reflected in an incremental capital ratio that declined by about 30 percent, and total factor productivity growth that improved by over 2 percentage points. The data show that private corporate investment increased robustly in 2013-14 which seems at odds with stressed balance sheets and the phenomenon of stalled projects.

Some clues to understanding the new series are provided in the chart below which decomposes the differences between the new series into those relating to real GDP growth and those to the deflator. This decomposition is shown sectorally.

The largest discrepancies between the two series arise in 2013-14 and relate to real GDP growth for the manufacturing sector, where the magnitude is 6 percentage points! Even in 2012-13 the divergence between the two series in manufacturing is 5 percentage points. Jumps in the level of the manufacturing share of GDP can be attributed to the new methodology but it is still unclear why the rate of growth should diverge so much from previous estimates and from other indicators of manufacturing growth (viz. the index of industrial production). Even allowing for the fact that the latter is a volume index and the former a valued-added index, the discrepancy remains large. Clearly, these issues need to be examined in greater detail.

Until a longer data series is available for analysis and comparisons, and until the changes can be plausibly ascribed to the respective roles of the new base, new data, and improved methodology, the growth narrative of the last few years may elude a fuller understanding. Regardless, the latest numbers will have to be the prism for viewing the Indian economy going forward because they will be the only ones on offer. But, the balance of evidence and caution counsel in favour of an interpretation of a recovering rather than surging Indian economy.

**Figure: Difference between New and Old Estimates of Economic Growth, 2012-13 and 2013-14 (Per cent)**



Source: Central Statistics Office.

### 5. Can the current growth configuration be maintained?

1.103 In the last 2 years, real GDP growth has averaged about 7.5 percent. But this has been achieved against the context of weak investment, export volume and credit growth. This wedge between steady growth and its underlying (relatively weak) drivers raises a question and also poses a puzzle. To shed light on this a cross-country comparison was undertaken to investigate whether in the last 25 years there have been similar experiences in other emerging market countries (that is, of successive two-year periods where Indian levels of growth were achieved with such a combination of factors, i.e. Indian levels of real investment, export volume, and credit growth witnessed in 2015-16 and 2016-17). The focus is on the last 25 years because of data availability.

1.104 First, Indian performance on real investment (gross fixed capital formation), export volume and credit during the last two years (2015-16 and 2016-17) is identified.<sup>18</sup> These were 4.5 percent (real) growth in investment, 2 percent growth in export volumes, and decline in credit-to-GDP ratio of 2 percentage points (all averages over the two years). A sample of 23 other comparable countries (listed in Appendix 5) is then considered to infer how many times this combination of investment, export volume, and credit has led to growth of at least 7 percent. The results are shown in Table 7.

1.105 Since there are three criteria, there are seven possibilities: three cases where any one of the criteria are met, three cases where any two combinations are met, and one case where all the three criteria are met. The Table shows that never in the last 25 years has there been another case of 7 percent growth with investment, exports and credit corresponding

to the current Indian combination. In fact, there have also been no cases when two of the three criteria have been met. Only in a very few cases, has 7 percent been consistent with only one of the three criteria having been met.

1.106 The next question is whether the Indian combination of investment, export volume, and credit is consistent with a weaker growth performance of 5 percent (Table 7). Again the answer is never. In fact, 5 percent real GDP growth has been consistent with two of the three criteria having been met only four percent of the time.

1.107 Therefore, the Indian experience of the last two years has been exceptional. Another way of seeing this is to note that the average investment and export volume growth in the 7 per cent sample is 13.8 and 12 percent respectively, well above India's. From a strictly accounting perspective, there is no difficulty in explaining Indian exceptionalism. By definition, consumption and, to a lesser extent, Government investment have powered the economy. But the purpose of the cross-country comparison is to move from accounting to plausible economic explanations.

1.108 One lesson is the following. While the current configuration is certainly unprecedented in cross-country experience, sustaining current growth trajectory will require action on more normal drivers of growth such as investment and exports and cleaning up of balance sheets to facilitate credit growth.

### 6. Banking: Declining Profitability in Power and Telecom and the Twin Balance Sheet Challenge

1.109 Significant developments have taken place in two sectors that cloud the outlook for resolving the TBS problem and hence for credit, investment and economic growth.

<sup>18</sup> The focus is on the last two years because of the sharp divergence between WPI and CPI series that has complicated GDP estimation.

Table 7. Cross-Country Record of Current Indian Growth Configuration (1991-2015)

Criteria	Number of instances of real GDP growth $\geq 7\%$	Number of instances of real GDP growth $\geq 5\%$
	108	285
A. Percent of growth instances attained with any one criterion satisfied	16	29
B. Percent of growth instances attained with any two criteria satisfied	0	4
C. Percent of growth instances attained with all three criteria satisfied	0	0

*\*Note:* The criteria are (for every 2-year period over 1991 to 2016): (i) Real investment growth  $\leq 4.5\%$ , (ii) Export volume growth  $\leq 2\%$ , and (iii) Fall in the credit to GDP ratio by at least 2 percentage points. The threshold for export volume growth has been assumed to be 2% even though the average growth in the same for India over FY 16 and FY 17 has been below 1%. Credit to GDP ratio data is from the World Bank and includes non-bank sources of credit.

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