

METHODOLOGY APPENDIX FOR FIRSTPOST (PRINT) ARTICLE, MARCH 23-29, 2019

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This appendix is meant to help the reader replicate the analysis presented in the article.

1. Macroeconomic data

1.1 GDP

By GDP (Gross Domestic Product) I mean GDP at market prices.

By nominal GDP I mean GDP as measured in terms of current rupees. By real GDP, I mean GDP in terms of constant rupees of a fixed base year. This is also known as constant GDP. I will use ‘nominal’ and ‘current’, and ‘real’ and ‘constant’ synonymously.

For India, GDP data is available through two series: the 2004-05 series and the 2011-12. I obtained both from the EPW Research Foundation’s “India Time Series” bank [<http://www.epwrfits.in/index.aspx>, query date: March 5, 2019]. From 1998-99 to 2010-11, I used the 2004-05 series, and from 2011-12 to 2018-19 I used the 2011-12 series (in both cases, constant and nominal). This was used to construct one nominal GDP series from 1998-99 to 2018-19 and two constant series: one from 1998-99 to 2010-11 (in terms of 2004-05 rupees) and the other from 2011-12 to 2018-19 (in terms of 2011-12 rupees).

All caveats about GDP numbers and change in methodology must be kept in mind.

1.2 GDP deflator

The GDP deflator index is a measure of inflation. It is calculated as the ratio of GDP at constant prices to GDP at current prices with reference to a fixed base year. The GDP deflator index of the base year is set as 100 since, by definition, in the base year nominal GDP = constant GDP.

The GDP deflator rate r_t is the rate of change of the GDP inflator index between time $t - 1$ and t . More precisely,

$$r_t = \frac{\text{GDP deflator index at } t - \text{GDP deflator index at } t - 1}{\text{GDP deflator index at } t - 1}$$

The GDP deflator rate series is a series of GDP deflator rates for $1999-00 \leq t \leq 2018-19$.

Since I have two base years in my data set, to construct a single GDP deflator rate series from 1999-00 to 2018-19, I had to re-index the constant 1998-99 – 2010-11 GDP series in terms of 2011-12 rupees. This was done by multiplying each entry in that series with the ratio:

$$\frac{\text{Nominal GDP in 2011-12 in the 2011-12 base year series}}{\text{Real GDP in 2011-12 in the 2004-05 base year series}}$$

This way, I obtained a constant/real GDP series from 1998-99 to 2018-19 in terms of 2011-12 rupees/2011-12 base year. Once I had that, I constructed the GDP deflator rate series using the formula described above.

All real/constant figures in the article have been obtained the following way:

- i. For the base year (2011-12), constant value of $x = \text{nominal } x$
- ii. For entries between 1999-00 to 2010-11,

$$\text{constant value of } x \text{ at time } t = x \times (1 + r_t)^n$$

Here, n is the difference between time period t and the base year (2011-12). So, for $t = 2010-11$, $n = 1$, for 2009-10, $n = 2$ and so on.

- iii. For entries between 2012-13 to 2018-19,

$$\text{constant value of } x \text{ at time } t = x \times \frac{1}{(1 + r_t)^n}$$

n has a similar meaning as above. So, for $t = 2012-13$, $n = 1$, for 2013-14, $n = 2$ and so on.

1.3 Foreign exchange rate

I have taken the first recorded value of the USD/INR reference rate for each year, from 1999 to 2018 (that is, the first available value from April 1 of each year in that time period) from the RBI Reference Rate Archive [<https://www.rbi.org.in/scripts/ReferenceRateArchive.aspx>].

Note: Another way of creating an annual USD/INR reference rate would have been to take the average of all observations within a year. The problem with this approach is that means are misleading in presence of potentially-severe fluctuations.

1.4 Interim versus actual budgets

In election years, there are two budgets presented: the interim (before elections) and the actual. All through this report, **I have taken the post-election actual budget.**

2. MoD allocations and defence budget

I obtained data on MoD allocations from “Demand for Grants” in the Expenditure Budget across twenty years. These are available from <https://www.indiabudget.gov.in/>.

2.1 General observations

In India's annual expenditure budget, MoD allocations can be clubbed under four headers:

- 1) Defence services revenue expenditure (including ordinance factories and research & development revenue expenditure)
- 2) Defence services capital expenditure (including ordinance factories and research & development capital expenditure)
- 3) MoD miscellaneous allocations
- 4) Defence pensions

However, over the 1999-00 – 2018-19 period, the number of “Demand for Grants” (DfG) in the Expenditure Budget of MoD has varied, and line items have often been moved around them. Therefore, particular care needs to be taken to ensure consistency across the four headers described above.

Note: Budget Estimates of a given year can be found in the same year itself. Revised Estimates of any year can be found in the succeeding year.

As mentioned in the text: **I denote the fiscal year 1999-2000 as 1999, and so on.**

2.2 Specific observations on idiosyncrasies

I observed the following and made suitable adjustments:

1. Between 1999-00 and 2002-03, Research & Development Revenue Budget was included in the Army Revenue Budget. From 2003-04 to 2015-16 it had a separate DfG: “Defence Services Research and Development.” From 2017-18 to present, Defence Services Research and Development Revenue Budget is inside the “Defence Services Revenue,” except for 2016-17 where it is inside MoD Miscellaneous DfG.
2. Between 1999-00 and 2015-16, Ordnance Factories Revenue had a separate DfG. From 2017-18 to present, it is inside Defence Services Revenue DfG, except for 2016-17 where it is accounted in MoD Miscellaneous DfG.
3. For 2016-17, Rashtriya Rifles Revenue is in MoD Miscellaneous DfG.
4. From 1999-00 to 2002-03 the Grand Total Revenue = Total Army Revenue + Total Navy Revenue + Total Airforce Revenue + Total Ordnance Factories Revenue.
5. From 2003-04 to 2014-15 the Grand Total Revenue = Total Army Revenue + Total Navy Revenue + Total Airforce Revenue + Ordnance Factories Revenue + DRDO Revenue.

6. For 2015-16 and 2016-17, Revenue Outlay Grand Total = Total Armed Forces Revenue + Ordnance Factories Revenue + DRDO Revenue.
7. For 2016-17 the Capital Outlay Ordnance Factories, Capital Outlay Research and Development, Capital Outlay Rashtriya Rifles headers are in MoD Miscellaneous.
8. For 2015-16 Capital Outlay Grand Total (Revised Estimate) is the sum of Defence Services Capital + Ordnance Factories Capital (taken from MoD Misc DfG of 2016-17) + Research and Development Capital (taken from MoD Misc DfG of 2016-17) + Rashtriya Rifles Capital (taken from MoD Misc DfG of 2016-17) + GCQA Capital (taken from MoD Misc DfG of 2016-17) + Military Farms Capital (taken from MoD Misc DfG of 2016-17) + Ex Serviceman Contributory Health Scheme Capital (taken from MoD Misc DfG of 2016-17) + National Cadet Corps Capital (taken from MoD Misc of 2016-17).
9. For 2016-17 Capital Outlay Grand Total (Budget Estimate) is the sum of Defence Services Capital + Ordnance Factories Capital (taken from MoD Misc DfG of 2016-17) + Research and Development Capital (taken from MoD Misc DfG of 2016-17) + Rashtriya Rifles Capital (taken from MoD Misc DfG of 2016-17) + GCQA Capital (taken from MoD Misc DfG of 2016-17) + Military Farms Capital (taken from MoD Misc DfG of 2016-17) + Ex Serviceman Contributory Health Scheme Capital (taken from MoD Misc DfG of 2016-17) + National Cadet Corps Capital (taken from MoD Misc DfG of 2016-17).
10. For 2016-17 Capital Outlay Grand Total (Revised Estimate) is the sum of Defence Services Capital + Ordnance Factories Capital (taken from MoD Misc DfG of 2017-18) + Research and Development Capital (taken from MoD Misc DfG of 2017-18) + Rashtriya Rifles Capital (taken from MoD Misc DfG of 2017-18) + National Cadet Corps Capital (taken from MoD Misc DfG of 2017-18).
11. **Important:** For 2015-16, Revised Estimates for Armed Forces Revenue heads in a lot of instances are missing. I estimated all Revised Estimates (including the three that *were* reported – Rashtriya Rifles, DRDO, and Ordnance Factories) through the formula:

$$\text{Revised Estimate of } X \text{ in 2015-16} = \text{Budget Estimate of } X \text{ in 2015-16} \times (1 + \Delta)$$

$$\text{where } \Delta = \frac{\text{Revised Estimate of } X \text{ in 2014-15} - \text{Budget Estimate of } X \text{ in 2014-15}}{\text{Budget Estimate of } X \text{ in 2014-15}}$$

The rationale behind adjusting *all* values is to ensure consistency of data for that year across all revenue heads.

2.3 Defence budget

Following standard convention in the Indian defence economics/accounting literature (especially by the IDSA Defence Economics and Industry Centre),

Defence Budget Estimate of Year K = Capital Expenditure Estimate (= Capital Outlay Grand Total) of Year K + Revenue Expenditure Estimate (= Revenue Outlay Grand Total) of Year K,
Revenue Expenditure Estimate of Year K = Total Armed Forces Revenue Expenditure Estimate of Year K + DRDO/R&D Revenue Expenditure Estimate of Year K + Ordnance Factories Revenue Expenditure Estimate of Year K

Note that this does not include defence pensions and MoD Miscellaneous estimates. Adding these two to the defence budget estimate gives us the total MoD allocations estimates.

All numbers in the text are Revised Estimates (RE) and not Budget Estimates (BE)

Finally, RE of a given year K often varies with actual expenditure of that year (which is reported in the budget of year K+1). For reasons explained in the text, **I have considered RE and not actual expenditure.**

2.4 Estimating import content

I estimated the import content of the modernisation/capital acquisition budget in the following way:

1. For 2000-01, 2006-07, 2007-08, 2008-09, and 2009-10, I took the numbers from IDSA monograph *Indian Defence Industry: Issues of Self Reliance* (p. 49) [<https://idsa.in/system/files/monograph21.pdf>].
2. From 2010-11 to 2014-15, I computed the import content from data presented in the *Thirty-First Report on "Demands for Grants of the Ministry of Defence for the year 2017-18 on Capital Outlay on Defence Services, Procurement Policy and Defence Planning (Demand No. 21) of the Parliamentary Standing on Defence* [http://164.100.47.194/Loksabha/Committee/CommitteeInformation.aspx?comm_code=7&tab=1].
3. I averaged over these 10 observations (from (1) and (2)) to obtain an import content ratio for the 1999-2000 to 2018-19. Numerically, it is around 38.5% of the modernisation budget. Therefore the indigenous content of the modernisation budget is $(100 - 38.5)\% = 61.5\%$.

3. Comments on specific graphs

1. Defence Budget as % of GDP

This is simply the ratio of defence budget of year K and the nominal GDP of year K expressed as a percentage.

2. Revenue/Capital ratio

This was simply the ratio of revenue to capital expenditure estimates, in nominal terms. (Reminder: the *sum* of the two forms the defence budget.)

3. Indian Army's Pay & Allowances and Pensions in 2011-12 rupees (in INR crores)

1. Indian Army (IA) Pay & Allowances (P&A) and Pensions (all in nominal terms) = IA Pension + IA P&A + IA Auxiliary P&A + IA Civilian P&A (all in nominal terms).

Note that Rashtriya Rifles was *not* accounted for in this graph (which is subject of an individual graph of its own in the text).

2. The sum in (1) was adjusted to real terms using the GDP deflator according to the method described in section 1.2 of this Appendix.

4. Rashtriya Rifles Expenditure in 2011-12 rupees (in INR crores)

1. Rashtriya Rifles Expenditure estimate (nominal) = Rashtriya Rifles Capital Expenditure + Rashtriya Rifles Revenue Expenditure (all nominal).

2. (1) was adjusted to real terms using the method described in section 1.2 of this Appendix to give me the graph.

5. Indian Army's Revenue for Purchase of Ammunition in 2011-12 rupees (in INR crores)

1. This graph relies on a **major assumption**: that **55% of Indian Army Stores revenue allocation is for buying ammunition**. This estimate was provided to me by a defence economist with significant work experience in the Ministry of Defence (details withheld to protect identity).

2. I obtained Indian Army's revenue for purchase of ammunition in nominal terms by multiplying the revenue allocation for Indian Army stores by 0.55.

3. The series in (2) was converted to real terms using the GDP deflator according to the method described in section 1.2 of this Appendix.

6. Air Force Modernisation Budget vs. Army Pensions (in INR crores)

1. Air force modernisation budget = IAF Aircraft and Aeroengine + IAF Heavy and Medium Vehicles + IAF Other Equipment. I reported nominal numbers.

2. Indian Army pensions were also taken at their nominal values.

7. Defence Modernisation's Share of Defence Budget (in %)

1. Defence modernisation budget (nominal) = (IA Aircraft and Aeroengine + IA Heavy and Medium Vehicles + IA Other Equipment + IA Rolling Stock) + (IN Aircraft and Aeroengine + IN Heavy and Medium Vehicles + IN Other Equipment + IN Joint Staff Capital + Naval Fleet + Naval Dockyard) + (IAF Aircraft and Aeroengine + IAF Heavy and Medium Vehicles + IAF Other Equipment) (all nominal). I have not included Rashtriya Rifles capital budget (which, in any case, is miniscule compared to the total modernisation budget ~ 0.16%, in 2017-18).
 2. Defence budget estimate (nominal) = revenue expenditure estimate + capital expenditure estimate (nominal) (not including defence pensions and MoD miscellaneous).
 3. The ratios of (1) and (2) expressed in % gave me the graph.
8. YoY Change in Indigenous and Foreign Component of Modernisation Budget (in %)
1. The nominal modernisation budget was the sum described above.
 2. This was split into two components – foreign and indigenous – in a 38.5/61.5 ratio. (See section 2.4 of this Appendix for the rationale.)
 3. The nominal indigenous component thus obtained was adjusted to real terms using the method described in section 1.2 of this Appendix.
 4. The nominal foreign component was adjusted to USD billion by dividing the nominal foreign component by the annual USD/INR reference rate (see section 1.3 of this Appendix for more on this).
 5. I computed the YoY (year-on-year) change for (3) and (4) in the usual way.
9. DRDO Budget in 2011-12 rupees (in INR crores)
- This was the DRDO nominal budget adjusted by the GDP deflator according to the method described in section 1.2 of this Appendix.
10. Navy's Share of the Defence Budget (in %)
1. Navy's budget (nominal) = (IN Aircraft and Aeroengine + IN Heavy and Medium Vehicles + IN Other Equipment + IN Joint Staff + Naval Fleet + Naval Dockyard) + (IN P&A + IN Civilian P&A) + (IN Repair and Refits + IN Stores + IN Works + IN Joint Staff Revenue) (all in nominal terms).
 2. The ratios of this to the defence budget (nominal) expressed in % gave me the graph.
